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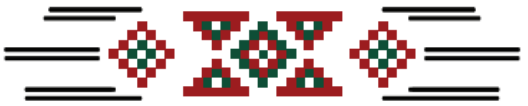

COMPLEMENTARY CURRENCY SYSTEMS BRIDGING COMMUNITIES

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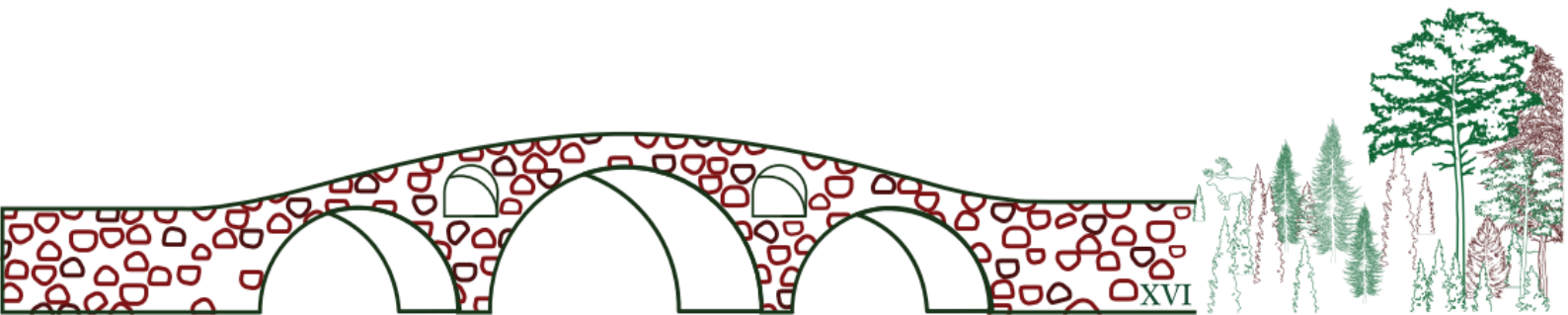

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Dialectic of money

The nature of modern money as 'ideational money' that diversifies as private money such as community currencies and cryptocurrencies
- in view of evolutionary perspective* -

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ABSTRACT:
The tree diagram of evolution of money shows that meterial money (commodity money) and credit money (debt money) independently emerged and evolved in parallel as external money, and that there was diversity of money and exchange according to the counterpart and the sphere of circulation. Modern fiat money without redemption obligations has still been recorded as debt on the balance sheet of the central bank after the introduction of the floating exchange rate system in 1973, however, it can no longer be conceived as credit money as a debt instrument. Given this reality, it is appropriate to regard them as securities or utility tokens and record them as equity/ capital on the balance sheet. Doing so is expected to have the effect of reducing the risk of insolvency of the central bank and promoting a change in the cognitive and behavioural rules (internal institutions) of economic agents so that it can provide more stability with a global financial system. The fundamental problem is that modern legal tender is neither material money nor credit money, but a third type of money, i.e. 'ideational money' or 'symbolic money', which is established and maintained as the self-realisation of two ideas, 'past customs' and 'future expectations', and this is the common nature of modern money, including community currencies and cryptocurrencies. Currently, communities (including nations and regions) that share different ideas and symbols are diversifying due to digitalisation and online access. The emergence of a situation of multiple belonging of individuals to communities has led to the diversification of private currencies such as cryptocurrencies and community currencies, which have different names, different standards of exchange and different spheres of circulation with non-fixed exchange rates, promoting what Hayek calls the 'denationalisation of money'. There, instead of quantitative competition based on Gresham's Law ('bad money drives out good'), qualitative competition based on the principle of choice in currency ('good money drives out bad') operates, and the characteristics of 'good money' other than stable monetary value are created and discovered through monopolistic competition for money.

The relevant theme of RAMICS2022: I. Dialectics of CCS and/or money

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0. Introduction

The central question for understanding and envisioning modern money in the 21st century is the enigma of what fiat central bank notes that exist at the core of the modern myth of finance 'one nation, one money' are and what they are worth. To dispel the myth and solve the enigma, we should reconsider the real nature of modern legal tender as inconvertible central banknotes under the floating rate system operating since 1973. Although the Bank of Japan's balance sheet still shows outstanding banknotes as liabilities, fiat central banknotes are not material money, nor are they credit money with repayment obligations like convertibles. They are purely informational money, completely independent of physical use values and debt-credit relationships. In other words, they should be regarded as a third type of money, what we call "ideational money" or "symbolic money. This characteristic is shared not only by modern national currencies, but also by increasingly diverse private currencies, including cryptocurrencies and community currencies. If we rethink Bank of Japan notes as equity securities or utility tokens and conduct a thought experiment on what might happen if they are listed as net capital on the balance sheet, we can begin to see the possibilities of a future in which currencies are diversified.

How such new ‘currencies’ survive through users’ choice in money and what the criteria of such decision are crucial points to be considered. In such diversity of money where it is possible to seek the kinds of money to be desired, we must realize the true meaning of Hayek’s principle of choice in currency in terms of ‘quality', which is ‘good money drives out bad’, instead of the Gresham’s law only regarding ‘quantity', which is ‘bad money drives out good’. For the principle of ‘choice in currency’ to function well, 1) different denominations for distinction of money in quality, and 2) the non-fixed exchange rates are necessary. Since cryptocurrencies met these conditions, the principle of choice in money began to work. They satisfied the forementioned two conditions for users’ choice in money to begin to work and simultaneously took the test for good money through users’ search for it. However, cryptocurrencies failed to pass the criteria of 'a stable value of money' that Hayek attached importance to for good money.

For cryptocurrencies and other digital money to become 'good money,' it is at least indispensable to have 'a stable value of money' that enables for currency to be more accepted and smoothly circulating. Whether a community-based or local consumer market can be formed, and workers' salaries can be paid by it are also other important factors for good money. In this respect, DCC with the connotation of local area and community could be a strong candidate for good money. Two DCCs in Japan, Sarubobo coin and Aqua coin are now challenging towards realization of good money. Finally, we will introduce Good Money Lab, an industry-academia-government-private consortium to foster DCCs as good money.

1. Dematerialization of Money: “Dematerialization of Monetary Substance" and "Demonetization of Monetary Media"

The digitalization of money and the shift to cashless transactions, which are currently underway, became possible only on the premise of the dematerialization of money, which was made possible by the emergence and spread of fiat money. This is because the value embodied in fiat money has been completely separated from the physical use value of the specie (gold coin or bullion) used to secure it. By switching from traditional physical value representation media composed of materials such as ink, paper, and printing presses, which are used for printing fiat money, to other physical value representation media composed of hardware such as computers, smart phones, smart cards, as well as software such as operating systems and applications, in addition to infrastructure such as power plants, power lines, optical fibers, radio towers, and artificial satellites, we can replace all the analog information of money with digital information. This has enabled smoother, more efficient, remote, global, and automatic monetary transactions even without human intervention.

The current "dematerialization of money" means the dilution of things as substance that embody and represent value, rather than things as media that express and transmit value. In other words, the "dematerialization of money" means the "dematerialization of monetary substance" and not necessarily the "dematerialization of monetary media". In the ongoing digitalization of money and cashless society, out of the genuine money consisting of "cash" and "deposits," we are trying to reduce the tangible things

~~expressing analog information called "cash" as much as possible by substituting the digital information~~ of "value" of electronic money and digital coins (cashless society), and integrate as much genuine money as possible into intangible figures of digital information called "deposits".

In this case, we notice that there are important intangible industrial products such as electricity, electromagnetic waves, light, and sound as well as many tangible industrial products such as electric wires, optical fibers, computers, and smartphones, the latter of which we can only see and touch, and that those intangible and tangible industrial products for enabling digital monetary media have rather increased in volumes. In other words, we can see that the "dematerialization of monetary substance" has currently progressed, but the "dematerialization of monetary media" has not progressed much.

In the white paper by Satoshi Nakamoto, Bitcoin was intended to be a "P2P digital cash system" that would use blockchain (Distributed Ledger Technology) to completely digitize "cash" through distributed ledger and distributed issuance (Nakamoto 2017). Thereafter, the core idea had been forgotten, and Dr. Craig Wright, who I assume to be considered as one of the members stood for Satoshi Nakamoto, has been struggling to reinstate it as Satoshi's original vision and has established the true Bitcoin as Bitcoin SV incorporating Satoshi's Vison (Wright 2019). On the other hand, the idea of Central Bank Digital Currencies (CBDCs), which would allow the state and central bank to turn cash into digital cash while maintaining the traditional central bank centralized issuance, is being promoted mainly in China and is one step closer to reality. CBDCs can be either wholesale, which is used only for settlement among financial institutions and businesses without changing the existing coexistence of analog "central bank notes (cash)" and digital "current accounts (deposits)" in the existing central bank currency, or general-purpose, which changes the existing structure of cash and deposits by completely digitizing cash and is used by all entities, including citizens. In any case, if we can completely eliminate analog central bank notes, we will be able to settle funds more efficiently, but even in that case, we will need to answer the fundamental question of whether Bank of Japan notes as 'cash' are certificates of obligation or something else.

2. A Tree Diagram of money with four stages: primitive money, material and credit money, cash and deposit money, and various non-national moneys

Central banknotes have a long history as the legal tender of the nation-state and have a solid institutional foundation, so their value may appear to be unassailable. However, if you recollect it, it has only been about 280 years since Peel's Bank Act of 1844, which practically established the monopoly of the Bank of England, the first central bank in history to issue notes. In terms of human history, that's just a blink of an eye, and it's an event that could change at any time. We are not trying to say that the value of Bitcoin is much more stable or solid than legal tender. If we look at the evolution of money from a very long-term perspective of thousands of years, both legal tender with its 280 years of history, and Bitcoin with its only 10 years of history, are not that different in terms of the length of time they have been around. In addition, they both share the common characteristics of modern money.

The value of modern money, such as fiat legal tender, cryptocurrencies, and community currencies, is not supported by intrinsic value such as the use value of the physical goods that make up the currencies, nor by the credit-debt guaranteed by the currencies, nor by expected future earnings such as interest and dividends. In other words, modern money is neither material money (commodity money) nor credit money, and it is not securities such as bonds and stocks that pay interests and dividends, either. Then, what exactly are these modern money?

According to the theory of the origin of material money (commodity money), it emerges spontaneously as a means of exchange to mediate indirect exchange because direct exchange (barter) becomes more difficult as the number of goods increases. This leads to another assertion that thus emerging material money such as gold coin or bullion is the principal money, and credit money is derived as an IOU that proves the credit-debt relationship of material money. In contrast, the theory of the origin of credit money argues that the credit settlement system is the money because the ledger, which is a record of transactions written by numbers and letters, plays the role of money even if there is no physical object as in material money in the first place. In other words, credit money can be established on its own without the existence of real entity such as use value of material money if there was some acknowledged ledger

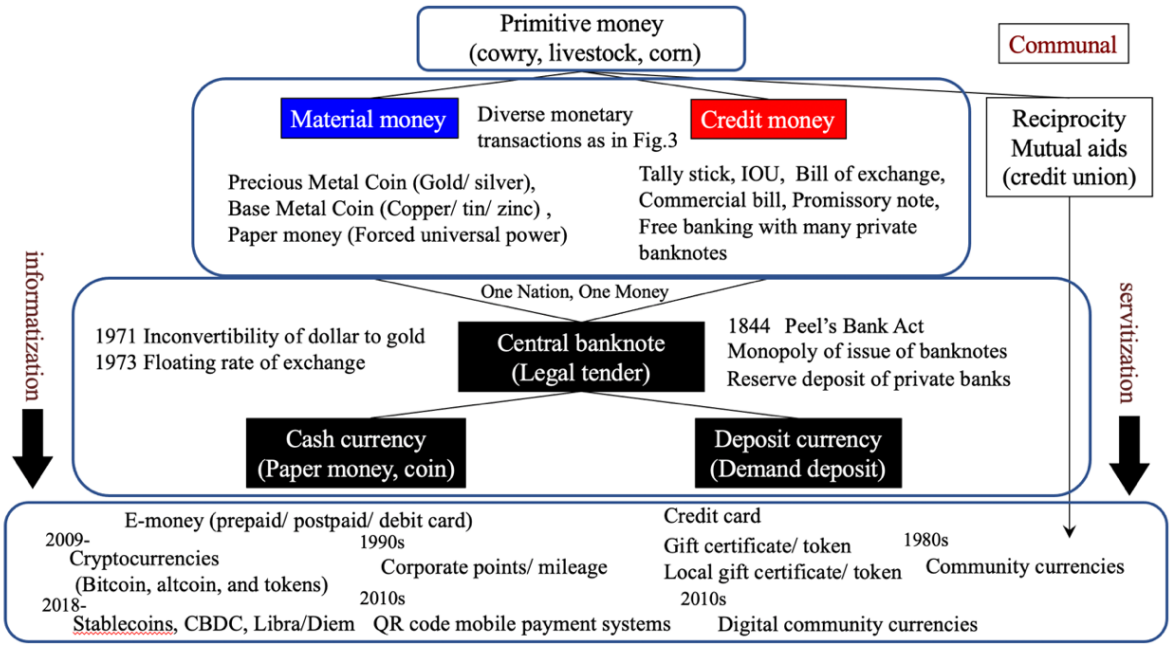
form using written language. According to this view, money is not a thing as a means of exchange, but a transferable credit or debt. It is a transaction clearing system consisting of three basic elements: 1) a unit of value, 2) an accounting system, and 3) transferability.

Perhaps because cryptocurrencies like Bitcoin and Ethereum use a distributed ledger technology called Blockchain, the latter idea is growing in power. Thus, credit money is now becoming to be believed to be not necessarily a derived representation of material money nor emerged in capitalist economy but to have already existed in the ancient world. In medieval Europe, wooden-made split tally sticks were widely used, in which the creditor and debtor recorded their debt information, which was then split in two and kept by both parties as a certificate. Single tallies, in which debt information was recorded on animal bones, can be traced back to the Paleolithic period. This type of credit money was used not only by private merchants and artisans, but also between them and the official state. Thus, it has become increasingly clear that credit money has a history as long as that of material money.

As a result, the view that the essence of money is not material money but credit money, and that modern money is an IOU that circulates on the basis of credit relationships, has gradually gained strength. Randall Wray, one of the founders of Modern Monetary Theory (MMT), developed a theory of money whose origin is credit money. It combines nominalism, which holds that money is merely a unit of nominal value, and chartalism, which holds that money is created as a means of direct economic activity of the state, such as fiscal spending, with its compulsory right to collect taxes. In Wray's view, modern central banknotes do not represent real value as in the case of material money but are negotiable instruments of indebtedness (IOUs) that represent a unit of account and are issued on the basis of the state's ability to collect taxes. Whether this view of MMT is correct or not will be discussed later.

Here the problem is if it is appropriate to ask which expresses the essence of money, material money or credit money, and which is the historically prior origin? For the question itself may be wrong. The reason why we think that the money that forms the market economy is *either* material money *or* credit money is because we unconsciously assume that money has developed on a straight path in history. This is probably because the modern money that we daily get used to under the current "one nation, one money" system is only one type of national currency. However, if the evolution of money branches into multi-track rather than just single-track, and if the ways of monetary exchange have been always diverse in history, it should not be possible to explain the actual history using only a single theory or position.

Fig.2 A Tree Diagram of Money (prepared by the author)



The tree diagram depicts the evolution of money in four stages: 1) the emergence of primitive money as a medium for gift-giving and reciprocity in primitive communities; 2) the parallel development and growth of "material money" represented by gold, and "credit money" represented by IOUs (I Owe You), as media for equivalent exchange in the market economy since ancient times; and 3) the coexistence of two currencies, cash currency and deposit currency, with the core of central banknotes integrating material money and credit money in the period of establishment of capitalism; and (4) the ongoing diversification of private currencies, such as cryptocurrencies, corporate currencies, gift certificate/ tokens, and community currencies.

The salient feature of such primitive money is that it was used to realize ritual and customary bilateral gift-giving and return within a certain community, or multilateral reciprocal relation as a chain of gift-giving among three or more parties. In addition, primitive money contained both economic and commercial purposes as well as social and cultural purposes, the latter often being more important. When money emerged from primitive money in the community used for reciprocity as well as redistribution eventually to provide the principle of equivalent exchange in the market, it branched into two types of money, material money and credit money, and evolved in parallel while influencing each other. In the history of mankind, primitive money, which is internal money and special-purpose money for community reciprocity and redistribution, has been the forerunner, and material money and credit money, which are external money and all-purpose money for the development of market economies outside and among communities, have continued to expand in parallel (Polanyi, K. 1957).

3. Plurality of Monetary Exchanges in History and the Evolution of Money through Self-organization, Replication, Variation, and Selection

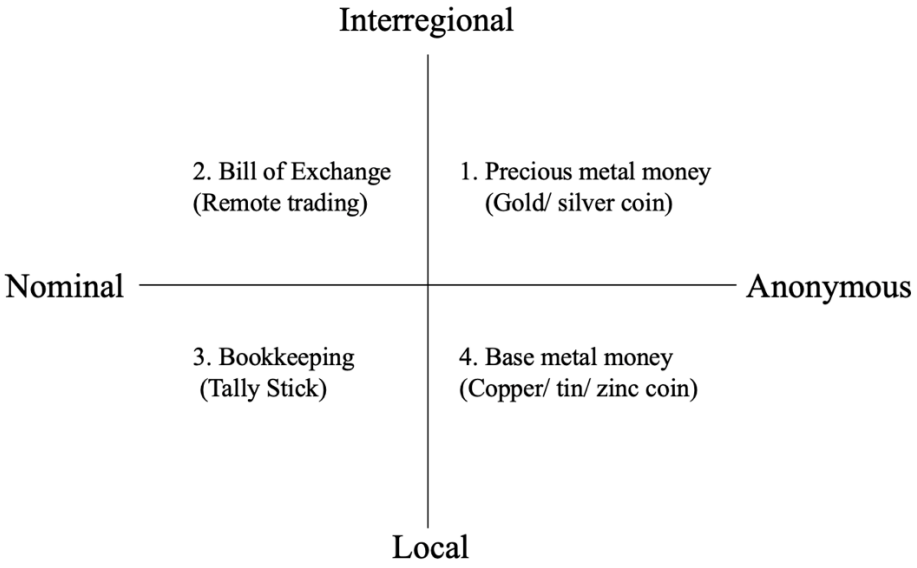
From a global historical perspective, it is known that there were a variety of ways of monetary exchange, not a single way (Kuroda 2020). In Fig.3, the horizontal axis indicates whether transactions are anonymous or nominal (named), and the vertical axis indicates whether they are interregional or local. According to these two axes, monetary exchange can be classified into four different areas. First, let's look at the first quadrant, which is anonymous and interregional. In the international marketplace, where traders who are strangers to each other engage in high-value transactions, they are paid in precious metals (gold and silver coins), which are material money. Next, in the second quadrant, which is both nominal and local, remote trade could be conducted using bills of exchange, which are credit money mediated by a trustworthy third party, because it is possible to trust a partner with whom one has had a long-term face-to-face business relationship. Furthermore, the third quadrant, which is manifestly nominal and localized, corresponds to the case where consumers shop at neighborhood stores or artisan workshops. Since small transactions were carried out by acquaintances who knew each other, bookkeeping transactions were carried out using credit money such as tallies to describe credit-debt relations. Finally, the fourth quadrant, which is anonymous and localized, refers to transactions in non-permanent markets such as regular markets and bazaars around cities. In small transactions between strangers at fish and vegetable markets, where the buyers and sellers were strangers, payment was made with base metal currency, which is material money.

In this way, material money is used in anonymous business relationships and credit money is used in nominal (named) business relationships, and the specific form of money is determined according to whether the transaction is interregional or local. However, from the 19th century onward, with the development of capitalist market economies and the establishment of central banks, the "one nation, one money" system was established, and the diversity of monetary exchange was lost, and material money with physical use value became cash money and credit money in commercial banks became deposit money. As a result, the plurality of monetary exchanges was lost. The diversity of currencies, which had once disappeared, is now emerging again as the diversity of non-national, private currencies, taking the form of e-money.

Money, like language, was not originally invented or deliberately created by anyone, but was naturally created through the repeated interaction of people. In addition, the rules differ slightly from region to region, and as the rules change little by little over the long period, the system that is accepted by the people of each region and era is inherited, and the system that is not is discontinued and no longer used.

Money is thus self-organized, propagated, and spread, and new types and characteristics are created through innovations in which people intentionally change the rules regarding new materials, technologies, and the scope of distribution. Those that adapt well to the sometimes rapidly changing environment survive, and those that do not perish. In other words, the evolution of money is a dynamic and complex phenomenon that consists of four different processes: 1) self-organization (emergence), 2) replication (propagation and diffusion), 3) variation (innovation as artificial mutation), and 4) selection (survival and extinction)[1]

Fig.3 Plurality of monetary exchange
(Source: Kuroda 2020, amended by the author)



4. Reconsidering the nature of legal tender as national currency

Let us now reconsider the controversial issue of central banknotes, which make up the bulk of legal tender and underpin the national monetary system at large. What exactly is a central banknote? Is it a liability or an asset? Why do they circulate from person to person? Let's take Japan's central bank, the Bank of Japan as an example.

If Bank of Japan notes are held by all economic entities other than the Bank of Japan, including the Japanese government, private financial institutions, corporations, and citizens, they are recorded as "cash" in the assets section of their balance sheets. However, in the Bank of Japan's own balance sheet, the balance of outstanding Bank of Japan notes (the total amount of Bank of Japan notes held by all entities other than the Bank of Japan at a given point in time) is recorded as "banknotes issued" in the liabilities section of the balance sheet. Bank of Japan's "current accounts" in the same liabilities section are deposits made with the Bank of Japan by all private financial institutions.

When the Bank of Japan engages in "buying operations" to purchase previously issued bonds from financial institutions, it transfers the proceeds to the BOJ current accounts of the counterpart financial institutions, thereby increasing the BOJ current accounts. The Bank of Japan issues Bank of Japan notes and supplies them to the market when private financial institutions withdraw Bank of Japan notes as cash from the Bank of Japan current account. When this happens, the number of Bank of Japan notes issued increases and the Bank of Japan current account decreases by the same amount.

[1] For more information on the basic concepts and framework of evolutionary economics, please refer to the following literature and papers: Aruka (2015), Dopfer, Potts (2008, 2009), Nishibe (2006, 2012).

Conversely, if financial institutions do not need cash, they will deposit it in the Bank of Japan's current account, which will reduce the amount of banknotes issued and increase the Bank of Japan's current account by the same amount. This return is called the 'reflux' of Bank of Japan notes. On the other hand, 'cash' is recorded in the assets section of the balance sheet. This portion is recorded as "cash" because it is issued when the Mint, an independent administrative agency, manufactures coins on behalf of the government and delivers them to the Bank of Japan. In other words, 'cash' does not refer to Bank of Japan notes but to the supplementary currency issued by the government and held by the Bank of Japan, different from daily usage of the term 'cash'.

Thus, central banknotes issued by the central bank are certificates of indebtedness and represent liabilities of the Bank of Japan to other entities, and only government money (supplementary currency as coin) held by the Bank of Japan itself is considered to be an asset as "cash". According to the Bank of Japan's financial statements as of March 31 shown in Fig. 4, total assets were 604,484.6 billion yen, total liabilities were 599,937.2 billion yen, and net assets were 4,547.3 billion yen. The balance of banknotes issued by the Bank of Japan is 109,616.5 billion yen. At present, cash as asset accounts for only 0.19% of banknotes issued as a liability.

Fig. 4 Balance Sheet of Bank of Japan (March 31, 2020) Source: Financial Statements for the 135th Fiscal Year/Fiscal 2019 (https://www.boj.or.jp/en/about/account/zai2005a.pdf)

Item	yen
ASSETS	
Gold	441,253,409,037
Cash	205,061,074,044
Japanese government securities	485,918,129,988,422
Commercial paper	2,551,889,033,716
Corporate bonds	3,220,825,190,968
Pecuniary trusts (stocks held as trust property)	727,714,519,973
Pecuniary trusts (index-linked exchange-traded funds held as trust property)	29,718,938,645,617
Pecuniary trusts (Japan real estate investment trusts held as trust property)	575,305,889,680
Loans and bills discounted	54,328,648,000,000
Electronic loans	54,328,648,000,000
Foreign currency assets	25,966,256,288,216
Foreign currency deposits	1,732,262,396,986
Foreign currency securities	2,355,224,668,143
Foreign currency mutual funds	60,613,713,087
Foreign currency loans	21,818,155,510,000
Deposits with agents	23,994,220,003
Other assets	590,051,545,382
Bills and checks in process of collection Capital subscription to the Deposit Insurance Corporation, and the	6,356,685
Agricultural and Fishery Cooperative Savings Insurance Corporation	225,000,000
Capital subscription to an international financial institution	15,278,374,364
Withdrawn cash to be returned to the government	38,707,429,941
Refund on accrued tax	52,621,989,719
Accrued interest receivable	470,183,576,216
Others	13,028,818,457
Tangible fixed assets	216,444,108,401
Buildings	105,726,690,246
Land	84,124,182,999
Lease assets	7,598,665,055
Construction in progress	7,458,248,538
Other tangible fixed assets	11,536,321,563
Intangible fixed assets	129,890,768
Utility rights	129,890,768
Total assets	604,484,641,804,227

LIABILITIES	
Banknotes	109,616,575,483,650
Deposits (excluding those of the government)	447,076,239,363,367
Current deposits	395,256,035,035,254
Other deposits	51,820,204,328,113
Deposits of the government	12,633,850,593,434
Treasury deposit	150,001,026,112
Domestic designated deposit	12,239,860,364,524
Other government deposits	243,989,202,798
Payables under repurchase agreements	24,116,347,566,200
Other liabilities	84,086,119,657
Remittances payable	14,760,764,172
Taxes payable	28,031,000,000
Lease liabilities	7,988,759,130
Others	33,305,596,355
Provision for retirement benefits	203,316,793,791
Provision for possible losses on bonds transactions	4,799,292,993,013
Provision for possible losses on foreign exchange transactions	1,407,536,000,000
Total liabilities	599,937,244,913,112
NET ASSETS	
Capital	100,000,000
Legal reserve	3,252,007,626,093
Special reserve	13,196,452
Net income	1,295,276,068,570
Total net assets	4,547,396,891,115
Total liabilities and net assets	604,484,641,804,227

Here, the following points should be noted. If the government manufactures 200 billion yen in coins at a cost of 40 billion yen and delivers them to the Bank of Japan, 200 billion yen in "cash" will be recorded in the assets section of the Bank of Japan, but no liabilities will be incurred by the government. Therefore, the difference between the two, 160 billion yen, becomes revenue. This gain on money issuance is called seigniorage. In the Middle Ages, seigniorage referred to the privileges of feudal lords, and especially to the profits from the issuance of gold and silver coins. If seigniorage occurs in coins, does it also occur in Bank of Japan notes? It is tempting to think that if 100 trillion yen of Bank of Japan notes are printed and issued at a cost of 20 trillion yen, the difference of 80 trillion yen would be seigniorage, but the general view is that seigniorage does not occur because Bank of Japan notes are recorded as liabilities, not assets. We will discuss whether this is true or not later.

The Bank of Japan used to issue convertible banknotes that had to be exchanged on demand for the nation's standard currency, specie (gold or silver coin). A convertible banknote is a check of deposit of specie, a certificate of debt obligation guaranteeing that the bank will hand the specie over to the person who brings it to the bank. Under the gold standard and/or silver standard, specie is a coin that contains a certain amount of precious metal based on par value and whose real value does not differ from its marked face value, i.e., gold/ silver coin or bullion. In Japan, the New Currency Ordinance of 1871 set the gold parity at '1 yen = 1.5 grams of pure gold', but the Coinage Law of 1897 halved the gold parity to '1 yen = 0.75 grams of pure gold'.

When the Bank of Japan issued convertible banknotes, it entered the gold or silver bullion or coins for specie reserve as assets on its balance sheet and the banknotes issued as liabilities. The Bank of Japan convertible notes were negotiable certificates of obligation (IOUs) and were credit money. However, since Nixon's cancellation of direct convertibility of US dollar into gold in 1971 and the transition to a floating exchange rate system in 1973, all national currencies, including the US dollar, are no longer guaranteed to be convertible to gold. The central banks of each country now issue inconvertible banknotes that are not guaranteed to be convertible into specie. That is fiat money, legal tender, or cash, and there is no longer specie. The exchange rates that fluctuate daily in the foreign exchange market merely indicate relative exchange ratios between national currencies, and do not represent any absolute real value. From a postmodern philosophical point of view, modern money is just information that displays only 'differences'.

However, the Bank of Japan kept on making an entry of the balance of central banknotes issued as "banknotes issued" in the liabilities section of its balance sheet, just as it did when it issued convertible banknotes. Included in the assets section are not gold or silver coins or bullion for specie reserve, but government bonds, loans, Exchange Traded Funds (ETFs), Real Estate Investment Trusts (REITs), and stocks paid with BOJ banknotes and current deposits.

According to the financial statements for FY2019, Japanese government bonds (JGBs, Japanese government securities in Fig.4) account for the largest portion of total assets at 485,918.1 billion yen, followed by loans and bills discounted at 54,328.6 billion yen, ETFs at 29,718.9 billion yen, foreign currency assets at 25,966.2 billion yen, equities at 727.7 billion yen, REITs at 575.3 billion yen, gold bullion: 441.3 billion yen cash: 205.1 billion yen etc. It should be noted that JGBs, ETFs and REITs have grown significantly. On the other hand, in the liabilities section, banknotes issued, and deposit increased up to 109,616.5 billion yen and 447,076.2 billion yen, respectively, while government deposits decreased to 12,633.8 billion yen, which is probably due to an increase in extraordinary spending for corona virus countermeasures.

ETFs and REITs, which are assets other than JGB, have been rapidly growing among assets since 2010, when the Bank of Japan began buying them to help the Japanese economy escape the Subprime financial crisis and promote stable growth after it. They are not stocks of specific industries or companies, or specific buildings or land, but rather indices that represent the weighted average of the market value of Japanese stocks and Japanese real estate listed and traded on the stock market, so the Bank of Japan is, so to speak, an anonymous holder of stocks and real estate for all of Japan. If you closely look into the ETFs owned by the Bank of Japan and add up the shares that make up the ETFs, you will find that there are more than 200 companies in which the Bank of Japan owns 5% or more of the shares, and about 50 companies in which it owns 10% or more. The Bank of Japan not only influences the stock market, but also has a great deal of influence over these private companies as an indirect major shareholder, although it is the asset management companies that exercise the voting rights.

Why is the balance of central banknotes issued listed as a liability on the balance sheet? In the Bank of Japan's view, this is because the stability of the value of Bank of Japan notes is due to the Bank's appropriate monetary policy, which makes them "like" certificates of obligation. It is also claimed that such a dealing of central banknotes issued is the same as major central banks of foreign countries. However, we do not understand the logic behind the Bank of Japan notes' "debt-like" status[2]. For, whether inconvertible central banknotes are debt instruments or not is irrelevant to the appropriateness of the BOJ's monetary policy and public confidence in the BOJ. Since fiat money has no obligation to be redeemed in the first place, the question of debt repayment does not arise whatever happens. If this is the case, then there should be no need to correlate the amount of banknotes issued that are recorded in the liabilities section of the BOJ's balance sheet, with the amount of government bonds, stocks, and real estate purchased with banknotes that are recorded in the assets section.

If the plunge in JGBs, stocks, and real estate were somehow attributable to the Bank of Japan's monetary policy failures rather than to exogenous natural disasters or the global financial crisis, the Bank of Japan would be held accountable and would lose the confidence of the public, corporations, and investors. In such an event, if the outstanding Bank of Japan notes would remain as liabilities, the Bank would be at risk of becoming insolvent as its liabilities exceeded its assets as the value of its assets declined. However, in the case of the central bank, even though it becomes insolvent, the government would certainly provide capital injections and other bailouts, so it is unlikely that the bank will go bankrupt anytime soon.

Such risks, even if they are the result of monetary policy failures and a loss of confidence, are independent of the fact that Bank of Japan notes are certificates of obligation. Rather, by maintaining such an interpretation, the risk of insolvency has seemingly increased. What the BOJ is doing now to support the private sector in the fight against the new coronary infection is unlimited purchases of JGBs and increased purchases of CP, corporate bonds, etc. Accordingly, the BOJ's issuance of

[2] https://www.boj.or.jp/announcements/education/oshiete/outline/a23.htm/

banknotes and its balance sheet are expanding further. Therefore, the insistence that identification of Bank of Japan notes as debt certificates can work as a break against excessive issuance causing hyperinflation may be incorrect.

There is no small possibility that the Bank of Japan's ultra-easy monetary policy stance will create significant risks in the future. What would be more consistent with such monetary policy would be to gracefully recognize "banknotes in issue" as capital and record them in net assets. If the government changes this conventional practice retained from the age of convertible banknotes and declares that it will change the items listed in its financial statements from now on, the banknotes it issues, which account for nearly 20% of liabilities, will disappear in an instant, and its net assets will increase by that amount, which should prevent it from falling into insolvency even if the value of its assets, including JGBs, is severely damaged.

5. Bank of Japan Notes are not "Certificates of Obligation" but "Equity Securities"

First, we must deeply consider what exactly is a "debt" without obligation to repay. Modern fiat central banknotes are not issued as negotiable certificates of debt obligation to be redeemed in specie when it is refunded to the central bank after circulating among economic agents other than themselves as asset "cash", as was the case with earlier convertible banknotes. Therefore, we must admit that it is no longer credit money. Of course, it is also not material money that retains its intrinsic use value. Then, what exactly is a "debt" that does not have to be repaid? In fact, the expression "debt" without obligation to repay is a literal contradiction. There is no such thing as a debt without an obligation to repay it. What it simply means is a situation where there is no more debt and no more repayment.

The Bank of Japan was established with a capital of 100 million yen, but it has now issued more than 100 trillion yen in Bank of Japan notes, a million times that amount, which continue to circulate as fiat money with no obligation to repay. To understand this curious reality, we only need to reconceptualize Bank of Japan notes not as certificates of debt obligation or IOUs but as equity securities, a means of raising funds on a massive scale. The modern central banknote is conceivable as an equity security issued by the central bank in the name of "cash." We thus reinterpret it as a quasi-security or utility coupon without voting rights nor dividends, not as IOUs.

ICO (Initial Coin Offering) is a popular way to raise funds by ‘presale' of new tokens to investors in exchange for contributions in-kind of such cryptocurrency as Bitcoin or Ether before they are listed on an exchange. There are two types of tokens issued through ICO: security tokens that come with revenue sharing rights, and utility tokens that are a means of payment like service vouchers or gift certificates. Since Bank of Japan notes do not hold any rights for interest or revenue, they provide such services of ‘money’ as payment and purchasing power to buy anything. So, it can be considered as a utility token. In recent years, financial regulators around the world have been trying to regulate crypto-asset tokens by regarding them as the latter. But what if the central bank notes can be also regarded as utility tokens? It surprisingly resembles the way in which fiat central banknotes are issued as equity for financial institutions’ contribution in kind of government bonds as we have just seen even if it has no risk of rip-off as in ICO.

Then, what changes if we understand fiat central banknotes as securities of contribution? First, it changes the meaning of central banknotes as money: fiat central banknotes are neither material money nor credit money, but a third kind of money: ideational or symbolic money, in other words, utility token. By recognizing this, it can be clarified that modern money, including national currency as well as non-national private currency such as cryptocurrency and community currency, shares such unique characteristics that were not present in earlier material money and credit money.

Second, in the balance sheet, capital/ equity is distinguished from liabilities and is entered as net assets in the same credits of a balance sheet. If the Bank of Japan reinterprets "banknotes issued" as capital/ equity, then "banknotes issued" will disappear from liabilities and be recorded as net assets/ shareholders equity, eliminating almost all fears of insolvency even if the value of current holdings such as government bonds, real estate, and stocks were to collapse significantly.

It is self-evident from the outset that the principle of self-responsibility does not apply to central banks which are certain to be bailed out by the government even if they become insolvent. Rather, it may be more appropriate to clarify beforehand in principle that central banks are capitalized by the banknotes they issue because they play a public role in finance, and therefore the risk of their failure becomes extremely small compared to that of private entities. When Japan's bubble economy collapsed in 1990s and the U.S. fell into a financial crisis after the Lehman Shock, the government broke the universal principle of self-responsibility by bailing out major financial institutions with capital injections using taxpayers' money as a stopgap measure. However, if such an event took place to central banks, it would be much better to fundamentally solve the problem by changing the monetary and financial principles rather than executing ad hoc bail-out with public funds.

If we assume that a financial institution receives Bank of Japan notes as equity securities, how can we understand trading in JGBs for "cash"? The financial institution would be seen as making contributions in-kind of the JGBs, rather than monetary contributions, and receiving the Bank of Japan notes as capital contribution securities. In other words, it is not a sale of a commodity for money, but an investment in kind in the form of JGBs for the delivery of investment securities. In such a case, the entities contributed in-kind are not goods and services, but rather securities such as government bonds, corporate bonds, CPs, bills, corporate bonds, ETFs, and REITs, which are exchanged mainly by the Bank of Japan and financial institutions as assets. Since modern capitalism has reached the ultimate stage of free investment, then considering central bank notes as equity securities is not particularly strange, as it places the principle of investment at its core. If the Bank of Japan were to actually record "banknotes issued" as capital/ equity rather than liabilities on its balance sheet and make such information widely available, the perceptions and actions of the government, financial institutions, corporations, and the public would not remain the same, but would change dramatically.

First, how would the government view it? The government's budget deficit has been increasing, with the outstanding amount of government bonds issued at the end of FY2019 (end of March 2020) reaching a record high of 997.9 trillion yen, and the outstanding amount of long-term debt for the national and local governments combined standing at 1,125 trillion yen, or 197% of GDP. The Bank of Japan's JGB holdings at the end of the same period were also 486 trillion yen, so almost half of all JGBs held by the Bank. If Bank of Japan notes are recorded in net assets as capital instead of liabilities, the risk of the Bank of Japan becoming insolvent would be significantly reduced and it would be able to hold even more government bonds even if long-term interest rates were to rise sharply and government bond prices were to plummet accordingly. The central bank's underwriting of new government bonds is currently prohibited by Article 5 of the Fiscal Law. But the situation is that the nation eventually contributes new government bonds in kind and provides capital/ equity to the central bank, in exchange for receiving 'legal tender' as security of investment from the Bank of Japan. Eventually, it would be the exchange of debt certificates as JGBs and equity securities as Bank of Japan notes. Then the central bank should not be specifically prohibited from doing so, since the risk is ultimately borne by the government as the investor.

This may sound similar to MMT's argument that unlimited issuance of government bonds is possible. MMT sees the government and the central bank as a single integrated entity and argues that no matter how much government bonds are issued, there will be no problem because the central bank can finance all of them, because fiat central bank notes are guaranteed to be valid by the state's authority to levy taxes. This arises from the incorrect notion of money that modern fiat central bank notes are a form of credit money based on 'chartalism'. It is completely different from our claim that modern money is no longer material money nor credit money, but ideational or symbolic money. We consider that MMT' concept of modern money is outdated and its policy implication is mistaken.

The relationship between the central bank and financial institutions has long been thought of as a one-way hierarchical relationship, with the central bank assisting and bailing out financial institutions and supervising and regulating them, as seen in the "bank of banks," the "lender of last resort," and the reserve deposit system. If, however, Bank of Japan notes are explicitly stated to be equity securities for capital contributions by private financial institutions to the Bank of Japan, then the opposite effect of financial institutions jointly supporting and assisting the central bank is clarified, and this would create a more interactive and equal relationship between the two. If financial institutions are investors in the Bank of Japan, there will be risks associated with investments in kind rather than trading in money. However,

even if the value of assets such as government bonds, stocks, and real estate were to be severely damaged, the risk of the Bank of Japan becoming insolvent would be significantly reduced, which would simultaneously reduce the risk to financial institutions of investing in the Bank of Japan.

Financial institutions that hold current accounts with the Bank of Japan would not only view the cash, Bank of Japan notes as certificates of contribution in the Bank, but would also view their current accounts as the same securities they receive on withdrawal of their deposits. For the Bank of Japan, the current account is a liability, but the Bank of Japan only have to repay the financial institutions for the securities for their investment under the name of 'legal tender.' So, theoretically, issuing an unlimited number of such securities will not cause the Bank of Japan to become unable to repay its debts. Although the author does not agree with it, the unlimited supply of monetary base, which the Bank of Japan has already implemented as QQE (Quantitative-Qualitative Easing), should be more consistent with this logic. This is also true of MTT.

However, this is subject to the condition that there is no possibility of the other party refusing to accept the note due to the side effect of hyperinflation. Even though Article 46, Paragraph 2 of the Bank of Japan Act stipulates that "banknotes issued by the Bank of Japan shall be accepted without restriction as legal tender," it does not necessarily mean that the other party can be 'forced' to accept the banknotes because physical commodities of necessary use value such as rice and eggs become material money with a much higher purchasing power in such a hyperinflationary situation, as was seen in Germany after the defeat of WWI. It is not always possible to force the other party to accept paper money.

The value of modern money is spontaneously formed and automatically maintained by the inertia and conventions from the past and the expectations and anticipations for the future that people unconsciously or consciously rely on in their daily receipts. In other words, the value of modern money is formed and grown by self-fulfilling notions. In this sense, the modern money since the 1970s is neither material money nor credit money, but rather purely informational money that should be called 'ideational money' or 'symbolic money.'

If individuals and companies recognize that cash and deposits are also risk involving investment securities, the traditional monetary mindset that holding money is secure and that money has no risk will change[3]. We will be forced to realize that we are investors who choose portfolios of various assets on our own initiative and responsibility, while constantly being aware of such risks, and the nature of free investment capitalism will be strengthened[4]. However, 'investment' is not just quantitative 'speculation' aimed at increasing the volume of one type of national currency. As private currencies other than legal tender become more diverse, individuals and companies will become to consider their main objective more comprehensively and, by selecting multiple currencies to match their own values and lifestyles while taking various risks into consideration, eventually aim at not only quantitative expansion but also qualitative improvement of their possibilities and world in the future by utilizing these currencies.

6. What is good money? Hayek's principle of choice in currency in terms of 'quality' realizes that 'good money drives out bad'

6.1 Gresham' law: Bad money drives out good

In this era of diversification and evolution of money, we can no longer see money as given, ready-made, and top-down. We should regard it as being bottom-up created and selected by users. Therefore, in the creation and selection of money, the question of what kind of money becomes "good money" is crucial. It's not just convenient, efficient, and stable. What exactly is "good money"? It is the most fundamental question. The answer is not something anyone can give, but something we have to find by ourselves.

[3] The "liquidity preference" that Keynes introduced in his The General Theory (Keynes 1936) assumes that the interest rate of money is zero compared to positive interest rate of bonds, but the reason why he assumes so is because the risk of holding money is zero unless there is no accelerating inflation. This may have reflected the normal monetary attitudes of the British rather than the Germans, who experienced hyperinflation after World War I.

[4] In my view, it is "free investment" rather than "free trade" that characterizes modern global capitalism. For more on this, see Nishibe (2020).

Let us first check ‘Gresham’s law’ that is one of the famous monetary principles in economics claiming that "bad money drives out good".[5] The 19th-century Scottish money and credit theorist Henry Dunning McLeod had given the name after the 16th century Tudor Treasury Secretary Sir Thomas Gresham. However, there are many precedents for the law since the Ancient Greek era (Mundell 1998; Selgin 1996, 2003). Nicolaus Copernicus, who is famous for advancing the theory of heliocentric system, is one of such precedents who accurately acknowledge the law (Ziffer 1957)[6]. Accordingly, this law is currently sometimes called ‘Gresham- Copernicus’ law.’

The meaning of this law is as follows. Let's assume that there are two gold coins (silver coins make no difference). The face value of a gold coin is the denomination of the unit of measure, e.g., Pound, and the real value of a gold coin is its content of gold. When the real value of one gold coin is lower than the face value of the other due to debasement, including the issuing body's mixture of base metals and users' clipping or scraping, which one will you use to pay first? Assuming users behave selfishly, they are supposed to use "bad money" with low content of gold first and try to keep "good money" with a high content of gold. Then bad money will be circulated, and good money will be hoarded. Thus, Gresham’s law originally meant "Gresham’s law of coinage" in the case of the debasement of minting coins. In general, in the case of any material money (commodity money) in which the material has an intrinsic value, good money with the small difference between the face value and real value will be preserved as an appropriate asset, and, as a result, bad money will gradually prevail in the market.

However, if we expand its substantial meaning of the law to bimetallism where both gold and silver are adopted as a standard of value with the fixed exchange rate, the relatively lower evaluated one will circulate among users. Gresham’s law is also valid for the case where gold coins with the same unit of denomination (e.g. yen) and convertible paper money that can be converted into gold coins coexist. For people would tend to keep on hand the gold coins with higher real value and try to use the convertible paper money with lower real value first. Furthermore, even in the case of inconvertible paper currency, Gresham’s law still holds. If there are two inconvertible paper currencies with different inflation rates due to the difference in the amount of currency issued, bad money with a low real value caused by high inflation rate drives out good money with a low inflation rate.

Gresham’s law tells us that it is a very convenient law for minters and issuers of money. If the issuer reduces the gold content of gold coins and reduces the casting cost, the difference between the face value and the commodity value can be obtained as Seigniorage (profit from minting) while bad money continues to circulate. Besides, as a result, if the real value of money decreases and the inflationary trend progresses, inflation has the actual effect of substantially reducing the nation's fiscal deficit. Because of these dual benefits, the government tends to mint and issue bad money that incessantly causes inflation. And if there is no legitimate choice for users but to use a coin bearing the king's seal, such bad money will be forced to circulate within the nation, which will be a big nuisance for users.

Next, let's apply this to the present day. Today, neither standard money such as gold or silver coins nor convertible paper money is in circulation. Inconvertible banknotes issued by the central bank and subsidiary coins minted by the Mint Bureau of the Ministry of Finance are legally designated as legal tender. The production cost of a 500 yen coin is only about 20 yen at most. Then, the seigniorage for the central bank on minting a 500 yen subsidiary coin would be 480 yen. Its real value is only 4%, negligibly small compared to a gold coin. Similarly, the production cost of a 10,000 yen note is only about 10 yen at most. Its real value is now only 0.1%. Then, we would like to say that the seigniorage for the central bank on issuing a 10,000 yen central banknote would be 9,990 yen. But be careful. It is a controversial point. As we have just seen above, in the current institutional setting of accounting, the central banknotes are not regarded as asset but liability on its own balance sheet. So, they say it cannot be seigniorage. But, as we discussed earlier, if the central banknotes are to be shifted from liabilities to

[5] The full survey article on history of precedents and transition of theoretical meanings of Gresham’s law is found in Verde (2008). The author expalined three refinements of Gresham’s law in history, but he mentioned Akerlof’s discussion on the lemon’s market of the asymmetric information, but he doesn’t mention the theoretical implication of Gresham’s law for diversifying modern money including community currencies and cryptocurrencies as well as modern monetary policies.
[6] Copernicus’s *Monete cudende ratio (On the Coinage of Money)* is his third version of his treatise on money and coinage written in Latin in 1526 (). Nicholas Oresme’s *On the origin, Mature, La, and Alteration of Money* is found more than century earlier works (Mundel 1998)

capital in net assets, we may say once again that 9,990 yen is the seigniorage. Inconvertible legal tender potentially become a real 'bad money'.

From some time after WWII in Japan, the yen could be exchanged for dollars at a fixed rate of '1 dollar = 360 yen', and dollars could be exchanged for gold at a rate of '1 ounce of gold = 35 dollars'. Therefore, we could say that the yen was indirectly convertible into gold. However, President Nixon stopped the conversion of dollars to gold in 1971 due to the shortage of gold reserves, and all developed countries shifted to floating exchange rates in 1973. Since then, the legal currencies of each country have lost their anchor based on the value of physical commodities such as precious metals and commodity baskets. The floating exchange rate system merely indicates the relative exchange rate between legal currencies and doesn't show the absolute value as in the gold standard system. Therefore, it often fluctuates greatly depending on the speculation of investors in the foreign exchange market.

In the Asian currency crisis in 1997, investors who expected the asset bubble to end flowed out of the country from Asian countries such as Malaysia, Thailand, and Korea. As a result, in these countries, the real economy fell into a recession by the collapse of currency and assets, and people's living conditions deteriorated rapidly. Modern money is not only a means of circulation and a measure of value for buying and selling goods but also a store of value and liquidity as a shelter from volatility for investment. In the case of FX (foreign exchange margin trading), money itself is the subject of speculation to make profits from trading. Thus, modern money suffers not only quantitative deterioration due to a tendential decline of real value but also qualitative deterioration due to large value fluctuation accompanied by the nullification of real value.

The Bank of Japan, under its Abenomics policy, has continued QQE, or an unlimited supply of cash currency with negative interest rates, in an attempt to achieve an inflation target of 2%. The weaker yen improved the performance of exporting companies and boosted stock prices. However, inflation has not occurred as expected because banks do not increase their lending to supply deposit money to the market. This situation occurs because banks consider that they do not have borrowers considering the risks involved. The government's inflation targeting policy aims to improve the economy by raising nominal prices through an increase in money stock despite the lack of favourable investment opportunities. It assumes the extreme assumption that people's expectations of inflation based on the illusion of money will continue. In reality, the rise in wages has been slow, and households whose real purchasing power has declined have tightened their purse strings. The Bank of Japan governor, Kuroda, has now stopped short of mentioning a deadline for achieving a 2% inflation rate and seemingly has given up on that goal. Centralized issuance of cash by the central bank under the national managed currency system has made such unsound economic policies possible.

Modern legal tender as an inconvertible currency is bad money not only in the quantitative sense that its real value is tremendously smaller than its face value in contrast to gold coins, but also in the qualitative sense that it has become an object of the speculation as a financial asset like a stock and a derivative commodity so that it shows an extraordinarily high degree of capital function and that it also serves an instrument of current arbitrary and risky monetary policy by central banks. We could say here was the culmination of evil. In such a pathological situation of the modern money system, it was significantly expected that Bitcoin, which differed from the centralized issuing legal tender, would potentially become a new original currency based on the decentralized issuing by utilizing blockchain or DLT. However, once cryptocurrencies began to be exchanged with legal tender on the exchanges, Bitcoin and other cryptocurrencies rapidly became speculative. They rose in prices sharply, especially in 2017, as their public recognition of names increased, but made a sudden plunge in 2018. The price fluctuation was tremendously huge, compared with legal tenders such as the dollar and euro. It seemed that cryptocurrencies had become financial instruments with high risks and high returns, just like FX with quite high leverage by a factor of 10, rather than ‘money’ that transacts goods and services. Disappointingly, cryptocurrencies have become indeed ‘bad money’.

6.2 Hayek ‘s Denationalization of Money and the the Principle of “Choice in Currency”

The Austrian School economist Hayek, in his book "The Denationalization of Money" (1976b), stated that a desirable currency can be found as a "good money" only when multiple currencies of different quality mutually compete. For that purpose, the principle of ‘choice in currency’ for “Good money drives

out bad" should work instead of Gresham's law stating, "Bad money drives out good". If only monopoly currencies and their simulacrums exist, that is, currencies can be differentiated only by the quantity of real value, amount of issue, and interest rate when they have the same face value or the fixed exchange rate, the Gresham's law will come into effect.

For example, in Scotland and Hong Kong, several private banknotes with the same standard of measure circulate alongside the legal tender, which is the central banknote. Private banknotes are different from legal tender, but they use the same name and unit of measure, i.e., "pound sterling" or "Hong Kong dollar. This creates the possibility that such private banknotes will be refused by some stores, but in most cases, they will be circulated as having the same value as central banknotes. Thus, they will be substitutive currencies of legal tender. In this case, legal tender and substitutive currency are apparently different currencies, but they can be used as money with the same name and unit of measure.

Even if the central bank properly adjusts the amount of legal tender issued so as not to impair its real value, i.e., so as not to cause inflation, if private banks, which issue private substitutive currency with the same name and unit of measure, issue too much of it, the supply of such substitutive currency will increase, its real value will decline, and inflation will occur. In this way, the legal tender with the same real value as before will be hoarded as "good money" because people will try to use the "bad money" that has the same nominal value but has a lower real value first. In other words, even if legal tender and substitutive currencies are outwardly distinguished, if the exchange ratio between them remains fixed at one to one, the substitutive bad currencies will drive out the legal tender good currency. This is the result of what Gresham's law works.

In order for a competitive relationship between multiple currencies of different quality to be established, a situation must be created in which this Gresham's law does not hold, and Hayek's principle of 'choice in currency,' "good money drives out the bad" must come into play (Hayek 1976a). This is the case when multiple currencies of different quality enter a competitive relationship of "monopolistic competition". The following two conditions are necessary for it, 1) multiple currencies should have different denominations (names) of the unit of measure, the types of reserve assets and reserve instruments so that they can be distinguished not only in such quantities but also in qualities such as users' trust on the stability of value of money, and 2) the exchange rates between currencies must not be fixed entirely, but they must be somewhat changeable reflecting users' evaluation of the differences in quality.
In a capitalist economy, as a result of such monopolistic competition, the principle of commodity selection, "good commodity drive out bad commodity," is at work. This is the merit and strength of the capitalist market economy. Monopolistic competition, which is applied to heterogeneous goods and services with slightly different quality and design, rather than perfect competition, which is applied to completely homogeneous and perfectly substitutive goods and services, is the reality of competition in a market economy. Monopolistic competition is by no means an exceptional situation, but represents a universal situation. The principle of commodity selection brought about by such monopolistic competition is the outstanding characteristic of a market economy, which does not exist in a planned economy. In other words, markets are better appreciated because they make goods not only cheaper, but also better, not because they realize efficient allocation of scarce resources.

Monopolistic competition thus generally refers to an oligopolistic situation in which there are incompletely substitutive commodities supplied by heterogenous firms and they differ in quality and design, even though they form a market for roughly the same kind of commodities, and in which both price and non-price competition among firms occur simultaneously. Hayek tried to apply the concept of monopolistic competition that is usually used in terms of commodity differentiation to the differentiation of money. He thought that money differentiation through monopolistic competition bring about 'better money' that have better quality of money. The principle of "good money drives out bad money" is a principle that begins to operate only when the issuer of money innovates its currency service to enable competition in quality. The "denationalization of money," as Hayek called it, was a dynamic process in which multiple private currencies of differentiating quality would create this complex and intricate process of "monopolistic competition" or, in other words, "rivalry". It does not mean perfect competition that is a condition for Pareto efficiency of resource allocation as in neoclassical microeconomics. It is important to note that other economists' criticisms of these ideas of Hayek often do not fully understand this point.

The principle of choice in currency does not work under the current situation where currencies are monopolized by the state and legal tender is dominant. This is because the "one nation, one money" institution of modern money must be changed for it to be applicable. However, if multiple currencies of the same quality are issued freely, as is the case in Scotland and Hong Kong as free banking theorists insist, the Gresham Law, which states that "bad money drives out good money," will come into play.

Since cryptocurrencies obviously met these two conditions, the principle of choice in money began to function. The next problem was whether cryptocurrencies could pass the test of users' choice in money in search for good money. Hayek defined the currency with 'a stable value of money' to mitigate uncertainty as "good money" (Hayek 1976b, Ch.13). The prices of the current cryptocurrencies to legal tenders are so volatile that they are by no means good money from the viewpoint of Hayek. However, it is not clear whether the condition of good money should be based only on the stability of currency value. If the result of the selection made through inter-currency competition is seen as "good money", the criteria should be continuously discovered and innovated through evolution. For cryptocurrencies to escape from the present state in which they seem just objects of speculation and to become "good money" usable in actual transactions, the stability of currency value with the formation of consumer goods market for them is at least indispensable.

Currency stability usually means that hyperinflation, causing a sharp decline in value of money, never take place. But Bitcoin is programmed to continually increase its scarcity and value over time by mimicking the 'mining' of gold with limited reserves. In that sense, speculation in bitcoin is inevitable. Still, the critical issue of unstable currency value arises because cryptocurrencies have been in sale for legal tender at real-time floating rates on hundreds of exchanges all over the world. The floating exchange rate system similar to FX quickly enabled speculation aiming at a trading margin by using value fluctuation. In fact, without this factor, bitcoin would not have been as globally popular as currently. However, it is the very factor which prevents bitcoin from becoming good money.

Currently, bitcoin is only available for a small portion of all merchandizes, and altcoin and tokens have to be converted into bitcoin to use them for purchase of goods and services. Even at shops where bitcoin is available, users have to pay by converting the list price in legal tender into bitcoin. If you expect the price of bitcoin to go up, you better to hold it than to pay it for taking appreciation profit. On the contrary, if the price is expected to drop, it will be better to use it than to keep it, but the seller may refuse to accept it. Because of violent price fluctuation of bitcoin, such speculation depending on expectation is always easy to occur, and the factor of speculative investment always mixes in the consumption. It is mainly international hedge funds, investment banks, and corporate and individual speculators who buy and sell these cryptocurrencies globally. Since cryptocurrencies are convenient tools for foreign remittance, illegal transactions such as money laundering, tax evasion, and drug dealings are inevitably involved. It is a world far from the vast majority of ordinary people.

6.3 The precondition of good money: ordinary people in an actual socioeconomy

To reconsider what criteria of good money are, we should return to the right image of the human nature of ordinary people who daily use good money in an actual socioeconomy. It must be the real precondition for the criteria of good money.

We live by consuming the basic goods and services necessary for food, clothing and housing with the income obtained by working, and decide the lifestyle based on our sense of values, carry out hobbies and activities depending on our interests, and acquire knowledge and information. Because of emotional and psychological biases, we cannot make the best choice. Nor can all options be known in advance. Not only is there a limit to rationality, but there is also a limit to ability in all aspects such as information gathering, decision-making, and action-taking.

Therefore, the place that ordinary people buy consumer goods by money is not a vast global market but a common local market which spreads in the vicinity of one's own life. In addition to blood relation, regional ties, and neighbourhoods, the communities as the active fields of life, labour, and hobby as well as the community as the sharing field of language, value, and interest are considerably related to the local market. A human being is not a rational fool who can make globally optimum decisions all the time, which is actually the image of rational agents assumed in orthodox economics. Instead, it is a decent

but emotional animal that judges based on the bounded knowledge and information that are framed by its own value and interests in the local region, and lives belonging to various communities. Thus, we should consider that good money is the money that ordinary people need to live their daily lives.

There is an inevitable impression that cryptocurrencies have become far from ordinary people because only speculative capital functions have become independent. To convert such cryptocurrency into good money that enriches people's lives, a strategy to positively introduce such multi-layered sets of territorial locality and virtual community will be effective. Here we need to learn from the present situations of DCCs that are in practice in local communities, seeking a good hint for criteria of good money.

In order for such DCCs to become a good currency, it is essential to create a market for consumer goods. In addition, it is important for merchants to use it to pay for purchases and wages. As a result, if the circulation of the currency can cover not only the market for consumer goods but also the market for production goods and investment goods, the local economy will be revitalized through local production for local consumption. To achieve this, DCCs need to form a new local currency market that fuses two seemingly incompatible areas: the "volunteer" area, such as mutual help and sharing within the community, and the "business" area, such as shopping in shopping malls and business-to-business transactions. To do this, we need the support of the local government, but we also need to bring together the various groups, organizations, and citizens who are currently scattered and disparate, such as local governments, economic organizations, shopping malls, schools, welfare councils, and hospitals, to reestablish the community itself.

In Japan, DCCs are spreading in local communities, such as Sarubo Coin in Hida Takayama City and Aqua Coin in Kisarazu City. The question is whether they will be able to create a local virtual currency market rooted in the local community and achieve regional development. We should also pay attention to whether any good money would emerge out of such new waves as CBDCs and citycoins as well as web3 and metaverse acompanied by Defi, DAO and NFT with smart contracts on various types of blockchain (DLT). That is the issue for the future.

7. Conclusion

This paper depicted the outlook of diversity and evolution of money from the past to the present and then gave an answer to the central question for understanding modern money under the myth of “one nation, one money,” which is the enigma of what fiat central banknotes are.

Differently from the view of MMT, they are neither material money nor credit money, but purely informational “ideational money” or “symbolic money” regardless its present status as “liability” on the balance sheets of central banks. To correctly understand such real nature of modern money is crucial. It is because both national money as legal tender and non-national money as crypto currencies and community currencies share the property as the root, on which other derivative forms of money as stablecoins and tokens depend.

We must release ourselves from the stereotype of a single national currency to seek a new way of adequately understanding the diversity and evolution of modern monetary systems and find a new bottom-up approach for evolutionary theory and policy with a diversity of money, different from conventional top-down approaches found in micro theory without money as well as a macro policy with single money[7].

Besides, we cannot merely be satisfied with describing such ongoing events of the plurality of money. We should be concerned with theoretically explaining how money diversifies and maintains itself; in other words, monetary systems dynamically change with its diversity kept. To the end, we need to consider how participants or users select from many alternatives of currencies so that some of them can only survive in the evolution of money. It is also necessary to focus on diverse monetary and social exchange systems, such as schemes that contribute to economic diversity, social cohesion, democratic participation, and environmental sustainability, as in community currencies and

[7] On plurality and diversity of money, see Gomez (2018), and on the diversity of community currencies, see Nishibe (2018).

cryptocurrencies[8].

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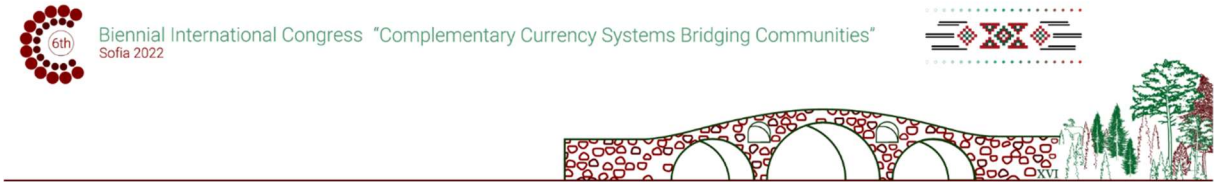
[8] We have constructed the theoretical model of institutional ecosystems to explain and describe the evolutionary dynamics of currently observed diversified money (Hashimoto and Nishibe 2017). In the model, an institution such as money is a game constrained by given game rules, and a variety of institutions such as diversified money constitute a complex institutional ecosystem subject to a meta-rules composed by players' value consciousness as criteria to evaluate multi-games. Refer to the article if interested in such theoretical aspects of this topic.



6th Complementary and Community Currency Systems (CCCS) Conference
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Complementary Currency Systems – Bridging Communities
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University of Finance, Business and Entrepreneurship (VUZF):
Laboratory for Applied Scientific Research (VUZF Lab).

Leading question
How do monetary innovations and complementary currency systems
help to build necessary bridges within and between our communities?

Theme & Topics
I. Dialectics of Complementary Currency Systems (CCS) and/or money:
Philosophy of money, Theory of money, Monetary diversity, Typology of CCS, Topology of CCS, Social money, Commercial money, Fiscal money, Local money, Private non-bank money, Convertibility of CCS, Reciprocity, Barter, Trust, *etc.*.

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Integrative Review of Integral, Mixed and Creative Methods Research Approaches to Currency Innovation and its Impact—through 102 articles published in the International Journal of Community Currency Research from 1997 to 2013 as a preliminary study.

Abstract

After an introduction of the previous literature reviews on currency impact assessment which revealed a research gap which led me to develop an 'impact assessment matrix' prototype (already used to assess 10 complementary currencies), I describe how I came to follow the advice of the mastermind Bernard LIETAER—who introduced me to the complementary currency movement in 2009—to use an integral approach to the study of money—according to Ken WILBER's Integral Theory *alias* the 'EINSTEIN of Consciousness' that he met in 2004 and to Christian ARNSPERGER's *Full-Spectrum Economics* that he reviewed in 2010.

Going deeper into the subject, I discovered the meta-theoretical paradigms of Edgar MORIN's Complex Thought, Ken WILBER's Integral Theory, Roy BHASKAR's Critical Realism, and Sean ESBJÖRN-HARGENS's Complex Integral Realism. The latter advocates the use of multi-methodological frameworks to investigate complex phenomenon—especially Integral Methodological Pluralism which invites the use of up to 8 methodological families.

While exploring some synergies with 'mixed methods' research and 'creative research' methods, I decided to apply no less than 6 methodological families for the impact assessment of the Lake District Pound issued in a National Park and World Heritage Site in England during 20 months in 2018–2020. By doing so, I revealed its educational impact for monetary reform beyond a purely economic one for localism (*e.g.* local spending or supply chain for carbon mitigation) as expected by the usual methodologies (*e.g. systems theory*, econometrics).

Time for me to check whether currency innovation research had already used such integral approach in the past. For this reason, I proceeded to the integrative review of integral, mixed and creative methods research approaches to currency innovation and its impact—through 102 articles published in the International Journal of Community Currency Research from 1997 to 2013 as a preliminary study.

I was surprised to discover that not one-eighth (12.7%) as previously found in 2013 but five-seventh (69.6%) of its articles were actually dealing with currency impact assessment—of which one-third (33.8%) were a positive impact and seven-eighth (88.7%) were aiming at sustainable development objectives. Moreover, all 102 articles investigated currencies involving 2.55 of the 5 pillars of sustainable development and targeting 4.66 of the 17 Sustainable Development Goals—confirming what was already suspected about them.

Finally, one-nineth (11.8%) used at least one of these meta-theoretical paradigms; one-third (34.3%) used a 'mixed methods' research; one-half (47.1%) used some 'creative research' methods excluding 'mixed methods' research; and three-fifth (60.8%) used more than one methodological family—for an average of 1.78 of these 8 methodological families for all 102 articles. Knowing that authors came from some 16 different disciplines.

To promote this integral research and education on money networking, organizational management, entrepreneurial leadership, and impact research, I aspire to not only conceive an historical atlas and implementation guide for these currency initiatives, but also develop another impact assessment matrix as well as a university.

Keywords

Integral theory, critical realism, complex thought, integral methodological pluralism, mixed methods research, creative methods research, multiple methodology, impact assessment, literature review, integrative review, historical atlas, implementation guide, impact assessment matrix, university.

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I dedicate this article to Bernard LIETAER, Stefan BRUNNHUBER, and Christian ARNSPERGER who were the first to integrate Ken WILBER's Integral Theory into complementary currency.

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Thanks to the letters of support of Laura RIVAL and David ZEITLYN from the Institute of Social and Cultural Anthropology, I had the opportunity to visit the School of Anthropology and Museum Ethnography of the University of Oxford while accessing the Bodleian Library during the six terms of Hilary–Trinity 2020–2021–2022.

During the two terms of Hilary–Easter 2021, I attended the Postgraduate Research Training of Simon WATTS and Kimberley BARTHOLOMEW at the Faculty of Social Sciences of the University of East Anglia—under the care of the Guild Higher Education and South-East Network for Social Sciences.

On Michaelmas 2021, I enrolled the postgraduate course on Digital Monies for a Sustainable Future taught by Ester BARINAGA, Anders ÖGREN, and Paul STANKOVSKI WAGNER from the School of Economics and Management, and Faculty of Engineering of the Lund University.

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Introduction

Use the same tool to achieve a different vision? For those with a hammer, all problems are nails!

> "No problem can be solved from the same level of consciousness that created it. […] Insanity is repeating the same mistakes and expecting different results." — Albert EINSTEIN.
>
> "You never change things by fighting the existing reality. To change something, build a new model that makes the existing model obsolete." — Richard BUCKMINSTER FULLER.

"'We see what we are ready to see" (*alias* 'I do not see what I do not want to see') and by using the same "labelling" (*e.g.* backward primitive economy of *premodern* decentralized community *vs* progressive capitalist economy of *modern* centralized state), one is preventing oneself from discovering other types of economic tools or means of exchange—as do most of the scientists, academics or researchers among social science disciplines such as economics, anthropology, or sociology—hence the absence of wording for "The * Hypothesis" of Irene SOTIROPOULOU (SOTIROPOULOU, 2012, p. 77–78).

Indeed, by entering into a dualist vision of conflictual opposition through the *postmodern* anti-capitalist discourse of heterodox economics against the *modern* capitalist discourse of neoclassical economics, one is inevitably reducing all monetary alternative proposals to the unconventional and marginal (for such is the power of words to reflect and feed limiting beliefs on an ongoing basis so as not to discover the 'true truth' and the 'real reality').

This could probably be the reason why complementary currency is not the focus of attention or interest of the conventional or mainstream economics—which would allow us to name "The * Hypothesis" of Irene SOTIROPOULOU previously stated as 'The *lack of transdisciplinary, evolutionary or integral perspective* Hypothesis' to investigate a complex phenomenon.

Besides, this rejection of a specific 'quadrant' or 'level' for the benefit of another one has been deeply and rigorously theorized by Ken WILBER's Integral Theory as 'level reductionism'[1] or 'quadrant reductionism'[2] (*alias* 'flatland') (HELFRICH, 2007). Moreover, the reduction or conflation of the domain of the 'real' to the domain of the 'actual' and/or 'empirical' has been described as the 'actualism's fallacy' by Roy BHASKAR's Critical Realism (HEDLUND, 2013). And lastly, problem-solving abilities by guessing, preferring, believing a solution has been defined as 'simple thought' by Edgar MORIN's Complex Thought (which consists in proposing hypotheses for solutions by creating relationships, searching for criteria, relying on valid justifications, and self-correcting) (MONTUORI, 2013).

This article aims to give a bird's-eye-view on how people perceive, understand, design, use, and assess Money as well as the influence of Money on people's beliefs, behaviours, values, collaborations (*alias* 'four quadrants' of Ken WILBER's Integral Theory)—and on how currency innovations or networks help to build relevant bridges within and between communities from different evolutionary development (*alias* 'development levels'; *resp. premodern*, *modern*, *postmodern*, 'post-postmodern').

To do so, I will present my past, present, and future journey for the integral impact assessment and integral definition of Money. Because by broadening the definition of impact and Money, I will discover some unexpected impacts of Money.

After an overview of some literature reviews on currency impact assessment, I will present four integral approaches already achieved: an 'impact assessment matrix' prototype which assessed already 10 complementary currencies; a multi-methodological framework which assessed 1 local currency; a new definition of money partially validated; a preliminary integrative review of the methodology used to investigate currency and its impact.

This being the intermediate data that will be used for four other integral approaches to be carried out soon: a historical atlas; an implementation guide; an integral matrix; an integral university.

Literature reviews about currency impact assessment, a quick overview of the room for improvement

It is important to note that literature reviews are usually differentiated between narrative literature review[3] and analytical literature review[4].

About one-fifth (18.3%)[5] of all the contributions listed in 2010 in the Bibliography of Community Currency Research database (CC-Literature) were systematic empirical studies about specific exchange systems (*e.g.* country investigations, activist reports, *etc.*) which could be considered as impact reports—as first published in 2011 through an analytical umbrella review[6] (SCHROEDER *et al.*, 2010, p. 216–222 *apud* SCHROEDER *et al.*, 2011, p. 34, 38).

About one-fifth (18.7%)[7] of the English sources listed in 2012 in the Bibliography of Community Currency Research database (CC-Literature) appeared with terms related to impact assessment—as first published in 2012 through an analytical scoping review[8] (PLACE, 2012c, p. 12).

About one-eighth (12.7%)[9] of the papers published between 1997 and 2013 in the peer-reviewed International Journal of Community Currency Research (IJCCR) dealt with an impact evaluation approach of Complementary Currency Systems (CCS)—according a literature review carried out in 2013 and only published in 2015 (PLACE and BINDEWALD, 2013a, p. 7–8 *apud* PLACE and BINDEWALD, 2015b, p. 154). It is important to note that this literature review was indeed only an analytical rapid review[10] of which studies of complementary currencies—within its leading academic journal—were using an impact assessment approach in the strict sense of the term.

In average, about one-sixth (16.6%) of research on CCS is dealing with impact report, assessment or evaluation. There is therefore a research gap in the literature about currency impact assessment.

Not to be confused with the overall impact comparison—as a narrative generic overview[11] for lack of an analytical qualitative[12] or quantitative[13] meta-analysis—of 3 leading literature reviews until 2015 that assessed the actual impact of CCS (PLACE and BINDEWALD, 2013a, p. 9 *apud* PLACE and BINDEWALD, 2015b, p. 155):

- Overall positive impact through an analytical mixed methods systematic review[14]: positive impact with high social sustainability, limited economic benefits, and few environmental outcomes has been demonstrated with systematic literature review of 1'175 studies of complementary currencies from 1993 to 2013 (MICHEL and HUDON, 2015).
- Overall neutral impact through an analytical mapping review[15]: neutral objectives, mainly economic and social with few environmental goals, have been analyzed with reference to a study of 3'418 currency-related projects from 1996 to 2011 (SEYFANG and LONGHURST, 2013).
- Overall negative impact through a narrative state-of-the-art review[16]: negative impacts due to limited tax integration, as well as business model and policy agenda change, have been shown through 126 studies of complementary currencies between 1996 and 2013 (DITTMER, 2013).

There is therefore a research gap in the literature about currency impact improvement. But it is clear that it is the definition of the impact sought by the currency project leader or even the currency impact assessor that will define whether the currency has an impact or not—in the strict or broad sense of the term.

Currency impact assessment framework and matrix prototype, a first integral approach

In *Full-Spectrum Economics* (*alias* 'integral economics')—published in 2010 with a foreword by Ken WILBER (ARNSPERGER, 2010b; ARNSPERGER, 2010a) and reviewed by Bernard LIETAER the same year (LIETAER, 2010)—Christian ARNSPERGER invites economists to apply Ken WILBER's Integral Theory (IT) *alias* the 'EINSTEIN of Consciousness' (WILBER, 1995; WILBER, 1996; WILBER, 2000). And yet, Bernard LIETAER—the original thought leader of the complementary currency movement—already used in 2005 its 'four quadrants'[17] on the concept of Money through *An Integral View on Money and Financial Crashes* (LIETAER, 2005b, p. 2 *apud* PLACE, 2010, p. 152) and its 'development levels'[18] on the history of Money in *Economics as an Evolutionary System* with Stefan BRUNNHUBER (LIETAER and BRUNNHUBER, 2005a)—after he met him at the same time as Ken WILBER in 2004[19] (KRAUSE, 2021).

After having discovered *Sex, Ecology, Spirituality* of Ken WILBER (WILBER, 1995) by chance by wandering in a bookshop on 27 February 2010 when looking for a book for my partner at the time, I finally did the same by distributing or categorizing some 71 indicators of currency progress measurement in an 'impact assessment matrix' (IAM) prototype among the 'four quadrants' of IT as well as the 5 pillars of sustainable development[20]—in an article presented in 2015 and published in 2018[21] (PLACE, 2015a *apud* PLACE, 2018c).

The impact assessment framework developed with Leander BINDEWALD (PLACE *et al.*, 2013b *apud* PLACE and BINDEWALD, 2013a *apud* PLACE and BINDEWALD, 2015b) as well as my IAM prototype (PLACE, 2015a *apud* PLACE, 2018c) has been cited and used in 2 master's dissertations (MOSSAY, 2018; LANGEDER, 2018) and cited in 1 evaluation guide, 2 other master's dissertations and 1 doctoral thesis (BINDEWALD and STEED, 2013; BALLERINI and BARTOLOMUCCI, 2018; SILLEN *et al.*, 2019; BINDEWALD, 2018)—to the best of my knowledge.

Since 2015, this IAM prototype has been already used by 3 researchers to assess the impact of a total of 10 complementary currencies in Switzerland, France, Belgium, South Africa, and England[22] (PLACE, 2015a *apud* PLACE, 2018c; MOSSAY, 2018; LANGEDER, 2018; PLACE, Forthcoming). A comparative case study of the results remains to be done.

By expanding the number and type of qualitative and quantitative indicators as much as possible (up to 71 indicators of currency progress measurement), this was my first attempt to not only incorporate an integral approach into currency impact assessment; but also give a broader definition of impact.

Meta-theoretical paradigm and multi-methodological framework for a currency impact assessment, a second integral approach

Following a new meta-theoretical paradigm[23] going further and completing Ken WILBER's Integral Theory (BHASKAR *et al.*, 2015; ESBJÖRN-HARGENS and HEDLUND, 2022; ESBJÖRN-HARGENS and HEDLUND, In Press) to investigate complex phenomena—such as Money—by implementing its multi-methodological framework called Integral Methodological Pluralism (IMP) with its 'eight zones'[24] (ESBJÖRN-HARGENS, 2006, p. 102–104; ESBJÖRN-HARGENS, 2010, p. 50–53), I assessed with 6 methodological families[25] the impact of this 1st touristic local currency issued in a National Park and World Heritage Site in 2018–2020[26] (PLACE *et al.*, 2021g)—as a synthesis of three other articles (PLACE and BENDELL, 2019a; PLACE and LAFFERTY, 2019c; PLACE, 2021b) [*cf.* Artwork 1 in Appendix on page 13]:

> "[T]he Lake District is the most visited and richest National Park in one of the poorest counties in the country—creating a tension between agricultural or tourism development and culture or nature conversation—which the Lake District Pound (LD£) aimed to resolve in part by targeting visitors with local leading figures, supporting local independent businesses, and giving its profits to local charities. […] As a result, the interaction with this complementary currency moderately impacted

> the local spending but reasonably raised awareness of localism and monetary economics among participants." (PLACE, 2021b, p. 39, 40).

By broadening the disciplinary spectrum of this research—from monetary economics to economic anthropology for instance—the findings were even more extensive—by revealing its educational potential for monetary reform—than the simple political and environmental economics perspective originally intended[27]—by adding up to 8 or even 14 integral, mixed and creative methods (PLACE, 2021f; PLACE, 2021e; PLACE, 2021d; PLACE, 2021c; PLACE, 2021a; PLACE, Forthcoming).

In this particular case, I gave a broader definition of impact by using multiple methodologies to multiply my paradigmatic prism—in order to investigate the impact of a complex phenomenon rather than limiting impact to a single disciplinary lens—with an emphasis on transdisciplinary breadth/span rather than disciplinary depth/mastery to obtain a fuzzy big picture instead of a clearly defined focus.

Integral Money definition hypothesis validation to extend currency impact definition, a third integral approach

In the words of Bernard LIETAER about money research according to the 'four quadrants': "95% of all research [or] literature about money […] [resides in] the upper right 'quadrant' (individual–exterior) [which] deals with how individuals can earn more money, spend, invest or give their money" as a description of the inner behaviour of economic agents (LIETAER, 2005b, p. 2).

Although there is much literature in the lower right 'quadrant' (collective–exterior) on the effects and interactions of the monetary and economic systems on social and environmental aspects, little of it focuses on the systemic causes responsible for the stability and viability of the monetary system itself (*e.g.* higher monetary diversity and interconnection for a polyculture resiliency instead of a monoculture efficiency) (LIETAER *et al.*, 2009 *apud* LIETAER *et al.*, 2012).

Some self-help books can be found in the upper left 'quadrant' (individual–interior) about one's personal and emotional relationships with money—including an excellent personal development and psychological work to free oneself from limiting beliefs (KOENIG, 2003).

Much scarcer is research and understanding about the lower left 'quadrant' (collective–interior) which aims at the interpretation of the collective meaning and definition of money through its cultural context through political history, or its normative discourse sometimes (BINDEWALD, 2018), or even by elucidating the archetypal dimensions underlying the "irrational exuberance" of financial market bubbles and busts (LIETAER, 2005b, p. 2–3).

It is with this in mind that I decided to test this definition hypothesis of Money as an integral object of inquiry (*alias* Integral Money) that involves, influences or affects all 'four quadrants' as follows (*resp.* individual–exterior, collective–exterior, individual–interior, collective–interior):

> *Money is a changing rule and an evolutive concept which encourage behaviours and collaborations, as well as activate beliefs and values*[28].

So far, I partially validated this definition hypothesis through a thematic analysis of 6 selective codes (*viz.* rule, concept, behaviour, collaboration, belief, value) identified in 77 out of 2'193 quotations—extracted from 7 qualitative data collections conducted among 240 stakeholders of the LD£ from August to December 2018 and 2019 (PLACE *et al.*, 2021g, p. 42).

Indeed, to extend the definition of the impact of an object of investigation, it is also necessary to extend the definition of the object itself—which is Money in the case in question.

Integrative Review of integral, mixed and creative methods research approaches to currency, a fourth integral approach

I am currently conducting an analytical integrative review[29]—as a combination of an analytical qualitative and quantitative meta-analysis—of integral, mixed and creative methods research approaches to CCS of 192 articles published in the IJCCR from 1997 to 2021 (PLACE, Forthcoming). From 15 August 2022 to 21 September 2022, I reviewed all 102 articles published between 1997 and 2013—which revealed many other unexpected findings that will not be covered in this paper.

As Money is usually considered as a social and economic system[30] (*i.e.* object of study in economic and social sciences), it is generally accepted that *systems theory* (*i.e.* interdisciplinary study of complex systems[31]) is the theoretical paradigm (*e.g.* monetary economics[32]) or methodological framework (*e.g.* econometrics[33]) the most appropriate and commonly used for the investigation of monetary systems (INGLEBY, 1998, p. 2).

And yet, this integrative review proves the contrary in the context of complementary currency since only 29 out of 102 articles (28.4%) have used methodological families from *systems theory* and only 15 out of 102 articles (14.7%) have used quantitative methods of econometrics (*e.g.* monetary multiplier effect, velocity, circulation, turnover, leger, accounting, transaction, *etc.*). Meaning that only about one-fifth (21.6%) have used close methodological criteria restricted to *systems theory* or econometrics in the strict sense of impact. This is certainly due to the fact that the researchers or practitioners came from some 16 different scientific disciplines [34] —thus revealing the multidisciplinary, interdisciplinary or transdisciplinary aspect of complementary currency studies.

As revealed in this analytical integrative review, according to open methodological criteria extended to all existing methodological families in the broad sense of impact, 71 out of 102 articles or five-seventh (69.6%) were proceeding an impact assessment of CCS—from which 5 out of 71 or one-fourteenth (7.0%) were negative, 42 out of 71 or three-fifth (59.2%) were neutral, and 24 out of 71 or one-third (33.8%) were positive. Furthermore, 29 out of 102 articles or two-seventh (28.4%) were proposing an impact framework and 29 out of 102 articles or two-seventh (28.4%) were encouraging an impact evaluation.

In terms of the objectives of the currencies studied[35], 39 out of 97 articles or two-fifth (40.2%) were investigating currencies aiming at economic objectives—of which 2 were about distributed ledger technologies—whereas 86 out of 97 articles or seven-eighth (88.7%) were investigating currencies aiming at social, environmental or territorial objectives (*alias* sustainable development objectives).

Concerning the 5 pillars of sustainable development[36], all 102 articles investigated currencies involving 2.55 of these 5 pillars in average or one-half (51.0%). As for Sustainable Development Goals (SDGs)[37] or Good Life Goals (GLGs)[38], all 102 articles studied currencies targeting 4.66 of these 17 goals in average or two-seventh (27.4%).

With regard to meta-theoretical paradigms using Edgar MORIN's Complex Thought, Ken WILBER's Integral Theory, and/or Roy BHASKAR's Critical Realism—without explicit reference: 12[39] out of 102 articles or one-nineth (11.8%) used at least one of these meta-theoretical paradigms (BHASKAR *et al.*, 2015).

About multi-methodological frameworks using integral, mixed and/or creative methods research approaches—without explicit reference: 35 out of 102 articles or one-third (34.3%) used a 'mixed methods' research[40] (CRESWELL and PLANO CLARK, 2017, p. 105); 48 out of 102 articles or one-half (47.1%) used some 'creative research' methods excluding 'mixed methods' research[41] (KARA, 2020, p. 5, 23–43); 62 out of 102 articles or three-fifth (60.8%) used more than one methodological family from the 'eight zones' of IMP—for an average of 1.78 of these 8 methodological families or one-fifth (22.3%) for all 102 articles (ESBJÖRN-HARGENS, 2006, p. 102–104).

This analytical integrative review revealed that by extending the definition of impact—from a strict to a broad sense of the term—we passed from one-eighth (12.7%) to five-seventh (69.6%) of the articles published in the leading academic journal of CCS dealing with currency impact assessment (*i.e.* of 102 articles published in IJCCR between 1997 and 2013)—of which one-third (33.8%) were a positive impact assessment. Also, that the majority of the CSS studied were dealing with sustainable development objectives, pillars, or goals. And that contrary to what one might have expected, little research was using classical economics methodologies (*i.e.* systems theory, econometrics) and that a significant number of studies was involving meta-theoretical paradigms (*i.e.* Complex Thought, Integral Theory, Critical Realism) or multi-methodological frameworks (*i.e.* Integral Methodological Pluralism, 'mixed methods' research, 'creative research' methods).

Historical Atlas and Compendium of expressible, measurable, exchangeable wealth valuation tools, a fifth integral approach

According to the thinking of Bernard LIETAER and Stefan BRUNNHUBER on the Money evolution through 'development levels' as "evolutionary economic systems" (LIETAER and BRUNNHUBER, 2005a, p. 123–135), *premodern* Money (concomitant with the agricultural revolution of an agrarian society) encompasses commodity-based money with utilitarian value (*alias* 'primitive currency'; *e.g.* cattle, rice, eggs, salt, *etc.*)—to overcome the prerequisite of a double coincidence of desire in unilateral barter—as well as precious metal coinage with the sovereign power to mint coins (LIETAER and BRUNNHUBER, 2005a, p. 125–126).

Modern Money (concomitant with the industrial revolution of an industrial society) includes paper-based money—with gold standard[42] as a transition mechanism from precious metal coinage to bills of exchange as private paper receipts—which became not only fiat money (*i.e.* created out of nothing or *ex nihilo* since paper had no intrinsic value unlike the scarcity value of precious metal) but also legal tender (*i.e.* only legal means of debt repayment or tax payment until declared null and void if refused)—by enforcing through coercion the monopoly of simple or composed interest-bearing debt money as scarce money for competitive markets—with the banking power to print banknotes (LIETAER and BRUNNHUBER, 2005a, p. 126–127).

Postmodern Money (concomitant with the information revolution of a knowledge society) embraces electronic-based money (with both high-tech smart card application and low-tech paper currency system) as complementary currency—to national currency (made of metallic coins, paper banknotes, central bank digital currency issued by central bank; and payment cheque, electronic money issued by commercial bank)—such as: loyalty point on a loyalty card among store chain alliances (*alias* private commercial currency, loyalty currency; *e.g.* air miles, luncheon voucher, gift voucher, *etc.*); barter credit or barter currency as a clearing house system to facilitate countertrade between accounting books of different corporate groups (*alias* complex multilateral barter, commercial barter system, international corporate barter; *e.g.* International Reciprocal Trade Association, National Association of Trade Exchanges, *etc.*); social or community currency with social or environmental purpose aiming at resolving sustainable development issues as for liquidity crisis, local unemployment, elderly care, environmentally friendly behaviour incitation (*alias* emergency currency, temporary barter market currency, mutual trade credit, time-based currency, mutual time credit, local currency backed by national currency, business-to-business exchange currency; *e.g.* stamp scrip, Barter Network or Barter Club, Local Exchange Trading System, Hours, Time Bank, Regional Money, WIR Bank, *etc.*)—by using goods and services inventory as working capital or common tender to perform exchange with abundant money for cooperative markets—with the people power to create and use currencies (LIETAER and BRUNNHUBER, 2005a, p. 127–132).

'Post-postmodern' Money (concomitant with the integral evolution of an integral society) would transcend and include both abundant money for cooperative markets and scarce money for competitive markets (*alias* yin and yang polarities) in a constellation for currency pluralism or polyculture and monetary resiliency or stability (*i.e.* monetary diversity and interconnection) (LIETAER *et al.*, 2009 *apud* LIETAER *et al.*, 2012)—thanks to some interoperability and intercurrency systems (*resp.* integrated currency networks, multiservice currency types).

It is on this basis of this preliminary work of an integral approach to Money evolution—and thanks to my transdisciplinary investigation on the subject as well as the complete findings of my integrative review—that I would like to develop and propose my own explorative work on the categorization (*alias* taxonomy, typology) of the emerging trends and 'development levels' of Money history (*resp.* *premodern*, *modern*, *postmodern*, 'post-postmodern' Money) (*cf.* BROCK, 2009; BLANC, 2011; MARTIGNONI, 2012; LATHROP, 2020)—in order to compose an Historical Atlas and Compendium (HAC) of expressible, measurable, exchangeable wealth valuation tools (PLACE, Forthcoming).

Implementation Guide and Toolkit for money networking, management, leadership, research, a sixth integral approach

As there will never be any perfect human-made product/system—by accepting humankind imperfection through incarnation as a mark of humility—it is preferable to have multiple imperfect but complementary currency systems choice (polyculture) rather than a single and unique imperfect one imposed by lack of alternative (monoculture).

In addition, each currency design and implementation is different and dependent on the historical, geographical and cultural context of a particular territory or community—with a short and narrow window of opportunity to build a deep and long confidence with the stakeholders. Reason why a guide and toolkit of a monetary architecture or engineering must be contemplated as a highly strategical and complex human-made project and must incorporate all 'four quadrants': money networking as a moneyer (collective–exterior); organizational management as a manager (collective–interior); entrepreneurial leadership as a leader (individual–interior); impact research as a researcher (individual–exterior).

By taking inspiration from previous complementary currency implementation guides (*cf.* LIETAER *et al.*, 2006a; LIETAER and HALLSMITH, 2006b; ROGERS, 2011; BINDEWALD and STEED, 2013; NEF *et al.*, 2015)—as well as the complete findings of my integrative review—I would intend to compose an Implementation Guide and Toolkit (IGT) for money networking, management, leadership, research (PLACE, Forthcoming).

Integral Impact Assessment Matrix for money, management, leadership, research, a seventh integral approach

Drawing inspiration from existing integral impact assessment framework—*Reinventing Organizations Map* (EMICH and MOLNÁR, 2018) based on *Reinventing Organizations* (LALOUX, 2014) and *MetaImpact/MetaCapital Framework* from the International Integrated Reporting Council (IIRC) (ESBJÖRN-HARGENS, 2020) for instance [*cf.* Figure 2 and 3 in Annex on page 14 and 15]—I would like to improve my 'impact assessment matrix' (IAM) prototype by not only incorporating the 'four quadrants' as already done previously (PLACE, 2015a *apud* PLACE, 2018c); but also the 'development levels' of money networking, organizational management, entrepreneurial leadership, and impact research—thanks to the complete findings of my integrative review [*cf.* Figure 1 in Appendix on page 13].

By doing so, I will be required to conceptualize four 'impact assessment matrix' (IAM) for money, management, leadership, research—integrated into an integral Impact Assessment Matrix (PLACE, Forthcoming).

Virtuous University of VirtoŜanĝo for integral research and education, an eight integral approach

Nowadays, sustainable development issues seem to be solely focusing on anthropogenic climate change[43] and carbon emission mitigation—sometimes flirting with the dictatorship of uniform thinking and political correctness—to the point of either condemning any energy mix including nuclear or hydrocarbon; or proselytizing degrowth and depopulation with guilt and alienation. Proof of this is the proliferation of all these carbon reporting frameworks[44] which quickly became the benchmark for sustainability impact reporting[45].

It is certainly undeniable that humankind have reached the peak oil[46]—or even the peak of economically viable extraction of any mineral or energy resource (*e.g.* water, wood, biomass, rare-earth element, precious metal, radioactive element, *etc.*)—and that a reduction in the exploitation of these resources per capita and globally is necessary.

But rather than banning per capita consumption/production or reducing the world population with quota schemes—even though the entire economic system is based on the growth paradigm inducing planned obsolescence due to interest-bearing debt money seeking to value everything via speculative markets and tax everything down to the informal economy (PLACE, 2010, p. 69 adapted from JACKSON, 2009, p. 61)—why not trying to encourage simple living or incentivize environmentally friendly behaviour (*alias* eco-friendly consumption) according to the complete social and environmental life cycle assessment of each goods and services—by reconsidering the entire monetary system through interest free complementary currencies to value voluntary work or household tasks?

The undertaking is tough—and to make sustainable development and money creation more virtuous—it is necessary not only to promote all that has just been said in this article; but also to teach all this in an integral way. For this purpose, I have imagined the creation of the Virtuous University of VirtoŜanĝo[47] (VUV) for research and education on integral money, management, leadership, research—through its Virtuous Institute of Research and Technology in Œconomy (VIRTO) (PLACE, Forthcoming).

Conclusion

Currency projects could be considered as one of the most complex human-made projects to be designed and implemented (and highly strategical as it involves and depends on entrepreneurial leadership, organizational management, and monetary network considerations) which therefore required a relevant theoretical paradigm and methodological framework to investigate such complex phenomenon—by using various 'labeling' (*e.g.* analytical method or methodological technique) rather than the same one again and again as described above.

A meta-theoretical paradigm with multi-methodological framework seems to me—and other big names on the international complementary currency scene such as Bernard LIETAER, Stefan BRUNNHUBER, and Christian ARNSPERGER—to be the most appropriate to do so (as it was already done in some previous complementary currency research without even knowing it according to my integrative review).

At the very beginning of my quest of impact improvement for the financing and professionalization of complementary currency projects—and after an overview of some literature reviews on currency impact assessment which revealed a research gap—I was led develop a framework and matrix prototype made of 71 indicators which was cited in 6 other works and used to assess 10 complementary currencies.

Having realized that a strict or broad definition of impact would change the way it is assessed, I followed the advice of my thought leaders to re-assess this 10th complementary currency with multiple methodologies (ranging from 6 to 8 and extended to 14) rather than

those usually expected (*e.g. systems theory*, econometrics)—which revealed its educational impact for monetary reform beyond a purely economic one for localism (*e.g.* local spending or supply chain for carbon mitigation). I have even proposed a more integral definition of Money that influences people's beliefs, behaviours, values, collaborations (*alias* 'four quadrants' of Ken WILBER's Integral Theory).

I also decided to re-review the literature of the leading academic journal of this field which revealed that not one-eighth (12.7%) as previously found in 2013 (PLACE and BINDEWALD, 2013a, p. 7–8 *apud* PLACE and BINDEWALD, 2015b, p. 154) but five-seventh (69.6%) of its articles were actually dealing with currency impact assessment—of which one-third (33.8%) were a positive impact—according to the partial results of this preliminary study of its 102 articles published from 1997 to 2013 (missing yet the 92 remaining until 2021). Although this integrative review confirmed the established fact that most complementary currencies were aiming at sustainable development, it also made the unexpected discovery of an intrinsic multidisciplinary approach as well as a relative integral approach to investigate currency innovation—through a significant use of meta-theoretical paradigms or multi-methodological frameworks without even knowing it through an explicit reference to it.

To promote this integral research and education (*i.e.* integral approach of 'four quadrants' and 'development levels'), I aspire to conceive the following in the foreseeable future: Historical Atlas and Compendium (HAC), Implementation Guide and Toolkit (IGT), Impact Assessment Matrix (IAM), Virtuous University of VirtoŜanĝo (VUV).

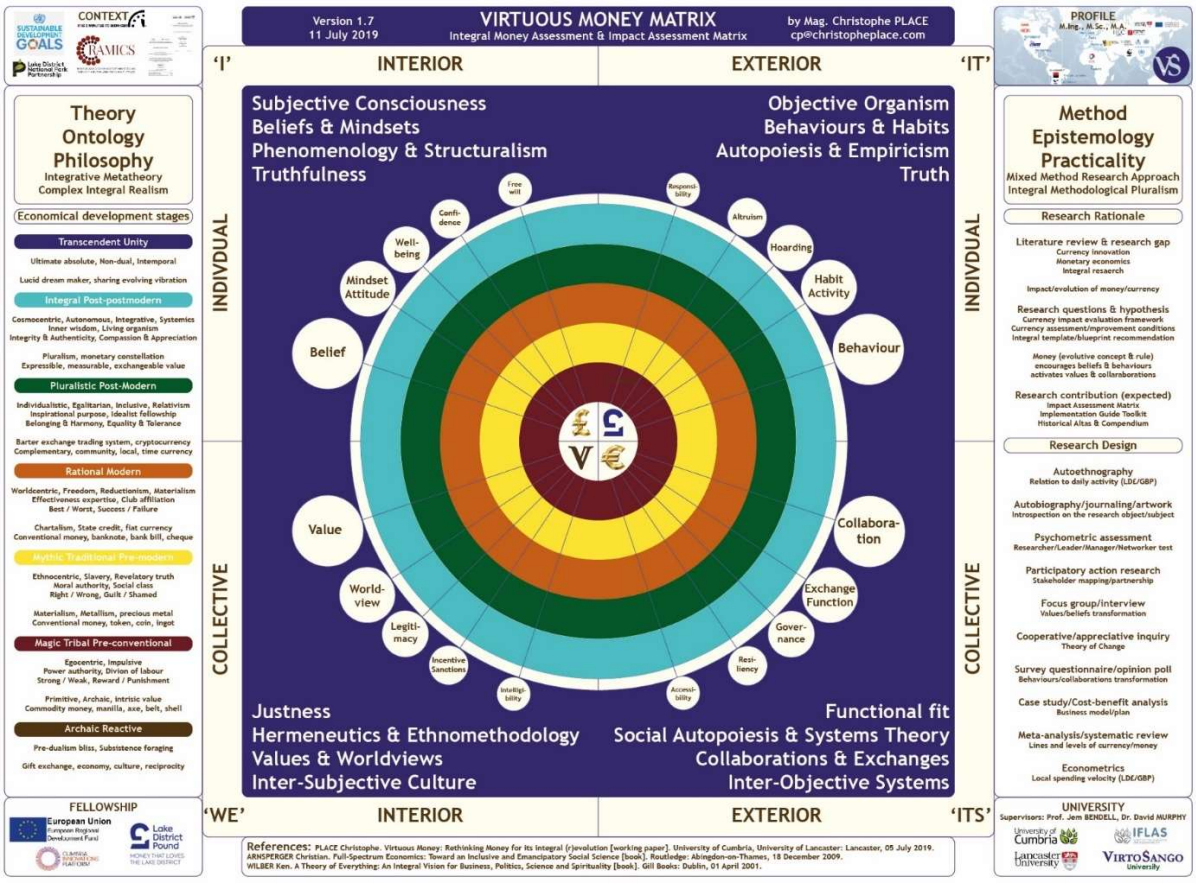
It has been a long journey since my discovery of complementary currency in 2009 by encountering Bernard LIETAER[48] and resulting on my master's dissertation (PLACE, 2010, p. 152)—before finalizing my doctoral thesis under the scrutiny of Sean ESBJÖRN-HARGENS's Complex Integral Realism, hopefully (PLACE, Forthcoming).

Appendix

Artwork 1: The Lakes Currency Project's photo story

Source: *Postgraduate Research Seminar* at Lund University (PLACE, 2021a, p. 18).

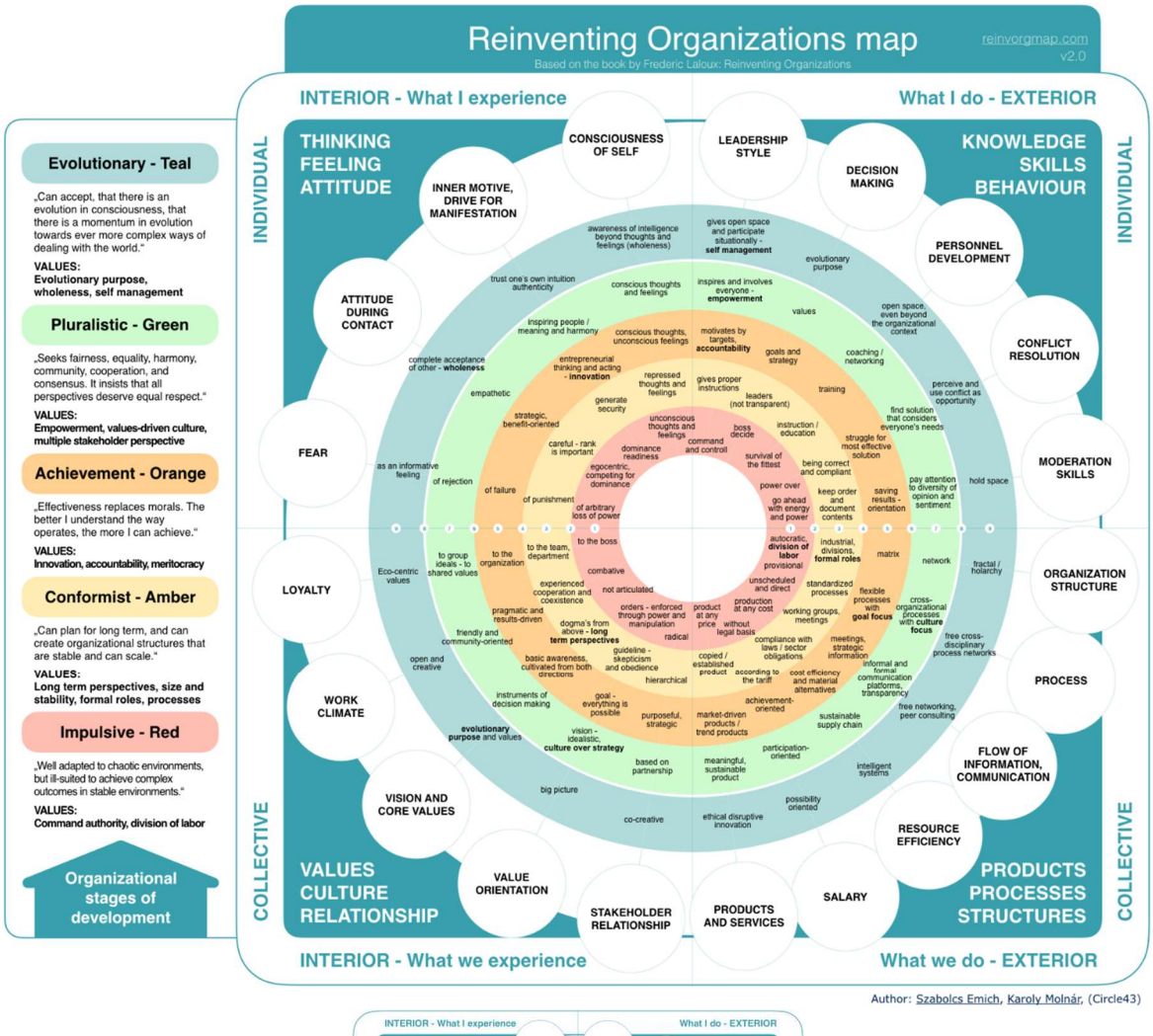
Figure 1: Virtuous Money Impact Assessment Matrix

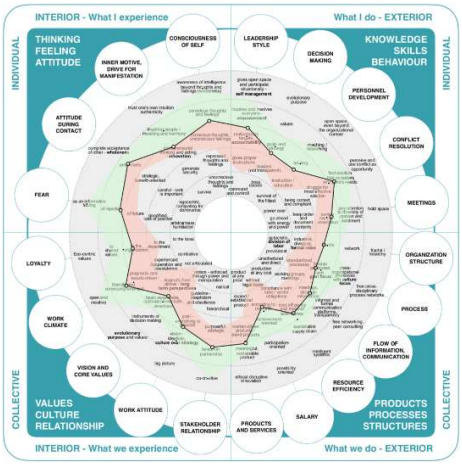


Source: *Doctoral Colloquium* at University of Cumbria (PLACE, 2019b).

Annex

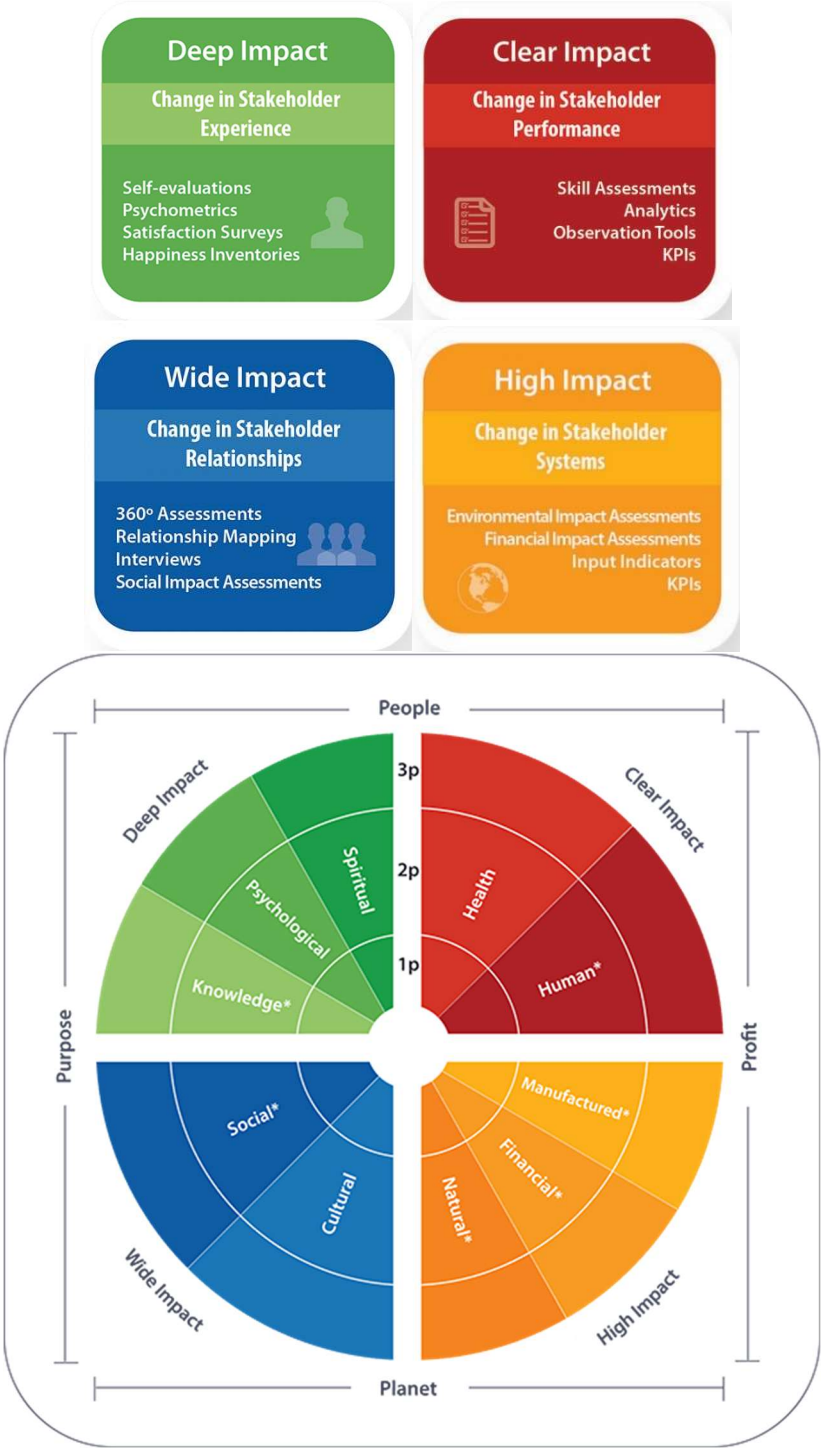
Figure 2: Reinventing Organizations Map[49]





Source: *Reinventing Organizations Map* (EMICH and MOLNÁR, 2018) based on *Reinventing Organizations* (LALOUX, 2014; LALOUX, 2016).

Figure 3: MetaImpact/MetaCapital Framework[50]



* 6 capitals usually considered in sustainable development.

Source: *MetaImpact/MetaCapital Framework* from the International Integrated Reporting Council (IIRC) (ESBJÖRN-HARGENS, 2020).

Endnote

[1] 'Level reductionism' of 'all levels' to one (*alias* extreme vertical 'hierarchical' 'flatland', *e.g.* relativists reduce 'all levels' to their pluralistic and holistic absence of absolute transcendence).
[2] 'Quadrant reductionism' of 'all quadrants' to one (*alias* extreme horizontal 'heterarchical' 'flatland', *e.g.* behaviourists reduce 'all quadrants' to the exterior-individual upper right 'quadrant' of objective reality of observable behaviour).
[3] *Alias* traditional review; *i.e.* to critique a body of literature and identify inconsistencies in a body of knowledge.
[4] *Alias* formal assessment review; *i.e.* a particular method and rigorous appraisal according to some specific criteria of inclusion and exclusion of the literature to be reviewed—to reveal what is known or remains unknown as sorted and organized results—quantitative statistics or qualitative synthesis—of a transparent, thorough and comprehensive search of selective keywords in relevant bibliographic databases in order to condense and make sense of a large body of research.
[5] "The databank comprises 1'099 titles […]. The database identifies 201 contributions with information about specific exchange systems or groups of systems — these are systematic empirical studies, sometimes country surveys of certain types of systems, and sometimes reports from activists." (SCHROEDER *et al.*, 2010, p. 216–222 *apud* SCHROEDER *et al.*, 2011, p. 34, 38).
[6] *I.e.* analytical review of of the results of broad conditions or competing interventions from multiple literature reviews of compiling and compelling evidence—by analyzing secondary knowledge sources of data known as reviews of studies.
[7] Among the 1'251 sources of the Bibliography of Community Currency Research database in 2012, 406 were in English, and only 76 appeared by searching the following keywords: impact, evaluation, measure, rating, audit, indicator, scorecard, assessment, monitoring, performance (30, 21, 14, 5, 3, 2, 1, 0, 0, 0 sources extracted respectively).
[8] *I.e.* analytical review of a preliminary assessment of the potential quantitative size and qualitative scope of all the available literature on a specific topic without any restriction on the materials sourced—by identifying the nature and extent of the research evidence according to the quality of its study design and by including viable and ongoing research in progress.
[9] Among the 102 papers, published from 1997 to May 2013 in the 17 volumes and 2 special issues, 13 papers are dealing with pertinent impact analysis: WILLIAMS Collin C. in volume 1 of 1997; INGLEBY Julie in volume 2 of 1998; LAACHER Smaïn in volume 3 of 1999; CAHN Edgar S. in volume 5 of 2001; SEYFANG Gill in volume 6 of 2002; WHEATLEY Gerald, JACOB Jeffrey, BRINKERHOFF Merlin, and JOVIC Emily in volume 8 of 2004; SCHROEDER Rolf F.H. in volume 10 of 2006; GELLERI Christian in volume 13 of 2009; NAUGHTON-DOE Ruth in volume 15 special issue of 2011; SOTIROPOULOU Irene in volume 15 special issue of 2011; THIEL Christian in volume 15 special issue of 2011; MOLNAR Stefan in volume 15 of 2011; SCOTT CATO Molly, and SUÁREZ CASADO Marta in volume 16 special issue of 2012.
[10] *I.e.* analytical review of an assessment of the established and existing literature about a specific policy or practical issue—by systematically searching and critically appraising a determined size and scope of materials according to their quality and future direction-
[11] *Alias* conceptual review; *i.e.* narrative review of recent or current literature with descriptive summary or categorization survey of a wide range of subjects and published materials through the snapshot of a particular field.
[12] *Alias* qualitative meta-synthesis review; *i.e.* analytical review with an evaluative or interpretive synthesis of the exhaustive literature of multiple qualitative studies only to identify common or new themes, concepts or core elements—by analyzing primary, secondary or tertiary knowledge sources of data and by integrating and transforming their findings into new conceptualizations and interpretations.
[13] *I.e.* analytical review with a statistical analysis and combination of the exhaustive literature of multiple quantitative studies only to enhance their understanding, to detect patterns and relationships, and to provide a more precise analysis of the effect of their results—by measuring this effect numerically and by expecting a certain homogeneity.
[14] *Alias* mixed studies review; *i.e.* analytical review of the results, processes and strategies of the combined literature of both qualitative and quantitative studies to look for correlations between characteristics.
[15] *I.e.* analytical review of existing literature to identify the need for further reviews of primary, secondary or tertiary knowledge sources of data according to the quality of their study design.
[16] *I.e.* narrative review of the most recent and extensive literature conducted periodically with a description of the current state of knowledge, matters and disagreements according to the priority for future investigation.
[17] Four irreducible dimensions of reality or actual aspects of the world that are always present in each moment (*alias* 'quadrants'; *i.e.* individual-interior or subjective quadrant, individual-exterior or inter-subjective quadrant, collective-interior or objective quadrant, collective-exterior or inter-objective quadrant)—that born together and simultaneously arise and mutually inform or implicate each other (*alias* 'co-nascent' and 'dependent co-arising' or 'tetra-mesh'; *i.e.* transcending and including): subjective experience and intentionality; inter-subjective cultural realities and values; objective behaviours and neuronal psychology; inter-objective ecological and social systems.
[18] Ordered and common structures of development and evolution (*alias* 'levels'; *i.e. premodern* level, *modern* level, *postmodern* level, 'post-postmodern' level)—occurring at or correlated with the same 'level' of depth and complexity in a general pattern of development and evolution (*alias* 'holarchy' of whole/part 'holons'; *i.e.* transcending and including): *premodern* society or era level focus on subjective 'quadrant' (*i.e.* many levels of existence, divine origin of man, 'Great Chain of Being'); *modern* society or era level focus on objective and inter-objective 'quadrants' (*i.e.* rise of science, autonomy of the ego, cultural progress); *postmodern* society or era level focus on inter-subjective 'quadrants' (*i.e.* meaning based on context, human ego not absolute, multiculturalism); 'post-postmodern' society or era level focus on 'all quadrants' (*i.e.* multidisciplinary, interdisciplinary, transdisciplinary, complexity, holistic, integral).
[19] *I.e.* when he was invited to "'The Money Crunch: Complementary Currency Solutions' conference in Boulder, Colorado, in May 2004, where [Bernard] LIETAER and [Stefan] BRUNNHUBER met and had a long conversation with Ken WILBER, whose integral philosophy [Bernard] LIETAER valued highly as it shared so much with his own world view." (LIETAER [p.c.] *apud* KRAUSE, 2021, p. 102–103).
[20] Sustainable development is usually articulated around 3 to 5 pillars or dimensions: economic, social, and environmental—sometimes even extended to governance and cultural.
[21] *I.e.* as the first ever article about the application of integral research approach to currency impact assessment in the *International Journal of Community Currency Research*—to the best of my knowledge.
[22] *Resp. Monnaie Léman* in Greater Geneva in France and Switzerland (PLACE, 2015a *apud* PLACE, 2018c); *Le Val'heureux* in Liège, *Troeven* in Turnhout, *L'Accorderie* in Mons, *RES* in Belgium (MOSSAY, 2018); *Le Florain* in Nancy, *Le Cairn* in Grenoble, *La Gonette* in Lyon in France, *GEM Going the Extra Mile Project* in South Africa (LANGEDER, 2018); Lake District Pound in the Lake District National Park in Cumbria in England in United Kingdom (PLACE, Forthcoming).

[23] *I.e.* the merger of Edgar MORIN's Complex Thought (subject, epistemology), Ken WILBER's Integral Theory (framework, methodology), and Roy BHASKAR's Critical Realism (object, ontology) into Sean ESBJÖRN-HARGENS's Complex Integral Realism (paradigm, theory).

[24] Eight methodological families associated to multiple methods, practices and techniques (*alias* 'zones'; i.e. *phenomenology* or subjective inside zone, *structuralism* or subjective outside zone, *hermeneutics* or inter-subjective inside zone, *ethnomethodology* or inter-subjective outside zone, *autopoiesis* or inter-objective inside zone, *empiricism* or inter-objective outside zone, *social autopoiesis* or objective inside zone, *systems theory* or objective outside zone)—to insure a pragmatic and inclusive approach in the investigation of a phenomenon (*alias* inside/outside zone of each 'four quadrants' and methodological family of each 'development level'; *i.e.* transcending and including): *phenomenology* of direct experience (*i.e.* 'phenomenological-inquiry'); *structuralism* of recurring patterns of direct experience (*i.e.* 'structural-assessment'); *hermeneutics* of understanding between people (*i.e.* 'hermeneutical-interpretative'); *ethnomethodology* of recurring patterns of mutual understanding (*i.e.* 'ethnomethodological'); *autopoiesis* of self-regulating behaviour (*i.e.* 'autopoiesical'); *empiricism* of observable behaviours (*i.e.* 'empirical-observation'); *social autopoiesis* of self-regulating dynamics in systems (*i.e.* 'social autopoiesical'); *systems theory* of observable whole (*i.e.* 'systems analysis').

[25] *Hermeneutics*: participatory action research (19 stakeholders' mapping to analyze its business model): by considering 10 stakeholders (*i.e.* Independent Money Alliance, Lake District National Park Authority, Lake District Foundation, Cumbria Community Foundation, University of Cumbria, project leader, impact investors, bureaux de change, stores, residents/visitors), the revenue model was based on a numismatic currency to be kept/collected rather than an economic currency to be spent/saved. *Systems theory*: econometrics accounting (7 months' ledger to estimate its circulation and leakage): this pioneering revenue model has been validated (2/3 kept, 1/3 spent) after a year of operation, but only represented less than one-tenth of their projected target—not enough to generate any profit for two charities (environmental conservation, community support). *Structuralism*: autoethnography (8 relatives' experiential feedback to study its value proposition): its value proposition was in line with related experiences: having a fun and unique experience on holiday—although having received too little change back in the complementary currency from participating stores. *Empiricism*: case study (269 participants' surveys to assess their behaviours and collaborations): the lack of commercial incentive, the inconvenience of exchanging cash in some bureaux de change, and the restrictive annual expiration date caused his premature end—despite the success of the marketing strategy. *Ethnomethodology*: ethnography (49 participants' interviews to investigate their beliefs and values): targeting residents as much as visitors, extending the network of participating stores, developing a digital currency, and pedagogically address the money taboo in a bottom-up approach could improve this monetary scheme—which has nonetheless promoted the region. *Phenomenology*: meditation and fasting (7 practitioners' interviews and 1 practitioner's description to evaluate the root of expenditure): these practices can help balance the cravings and aversions of our minds and bodies—including spending and consumption.

[26] *Viz.* Lake District Pound issued during 20 months from 01 May 2018 to 31 January 2020 in the Lake District National Park and World Heritage Site in the county of Cumbria county in England country in United Kingdom—as a world premiere.

[27] *I.e.* the impact of a currency is plural (*e.g.* educational/pedagogical potential for monetary reform/rethink); neither purely empirical, nor exclusively economical (*e.g.* local spending or supply chain for carbon mitigation)—as originally envisaged by the research project.

[28] The rule of Money changes through humankind's history and involves the exterior aspects of an individual or a collective—which are behaviours (individual-exterior) and collaborations (collective-exterior). The concept of Money evolves through one's life and involves the interior aspects of an individual or a collective—which are beliefs (individual-interior) and values (collective-interior).

[29] *Alias* inclusive review; *i.e.* analytical review of a specific subject or guiding issue from the integrated theoretical and methodological literature of both quantitative and qualitative studies with related or identical research hypotheses or questions in order to critically evaluate their rigour and characteristics, to generate new frameworks or perspectives, to define concepts, analyze issues and refine theories or methodologies—by reviewing, synthesizing, criticizing and integrating these studies.

[30] *I.e.* a group of interacting or interrelated elements that act according to a set of rules to form a unified whole.

[31] *I.e.* cohesive groups of interrelated and interdependent components that can be natural or human-made.

[32] *I.e.* economic study of the different competing theories of money; and macroeconomic framework for analyzing the functions of money—such as medium of exchange, store of value and unit of account.

[33] *I.e.* application of statistical methods to economic data in order to give empirical content to economic relationships.

[34] *Viz.* currency, economics, finance, banking, informatics, management, development, law, policy, politics, sociology, history, geography, urbanism, sustainability/environment, arts.

[35] Currency objectives: social (community, others-oriented, local solidarity); economic (commercial, self-oriented, liquidity); environmental (local consumption and production, re-use, eco-friendly behavior incentive); territorial (strengthen and stimulate a territory, a community).

[36] Sustainable development pillars: culture (*e.g.* beliefs, habits, anthropology, philosophy, psychology, *etc.*); governance (*e.g.* transparency, consensus, disintermediated transactions, group decision-making, profit use, *etc.*); social (*e.g.* pride, inclusion, well-being, social and solidarity economy, trust compare to national currency, *etc.*); economic (*e.g.* employment, liquidity, financing of volunteering and projects, local Gross Domestic Product, percentage of dynamic turnover to nominal Gross Domestic Product at current prices, percentage of static balance of client credits to global money supply or monetary aggregate, *etc.*); environmental (*e.g.* encourage local, seasonal, organic, ethical, reuse, recycle, renewable consumption, *etc.*).

[37] *I.e.* collection of 17 interlinked global goals set up in 2015 by the United Nations General Assembly and "designed to be a blueprint to achieve a better and more sustainable future for all" by 2030; *viz.* no poverty (1), zero hunger (2), good health and wellbeing (3), quality education (4), gender equality (5), clean water and sanitation (6), affordable and clean energy (7), decent work and economic growth (8), industry, innovation and infrastructure (9), reduced inequality (10), sustainable cities and communities (11), responsible consumption and production (12), climate action (13), life below water (14), life on land (15), peace, justice, and strong institutions (16), partnerships for the goals (17) (UNDESA, 2015).

[38] *I.e.* behavioural and lifestyle asks for individuals that are carefully aligned with the Sustainable Development Goals (SDGs)— set of personal actions that people around the world can take to help support them—and launched by Futerra on 25 September 2018 because "for the Sustainable Development Goals (SDGs) to be reached, everyone needs to do their part: government, the private sector, civil society and people like you" according to the United Nations so by following the Good Life Goals (GLGs) we can all help make tomorrow better than today; *viz.* help end poverty (1), eat better (2), stay well (3), learn and teach (4), treat everyone equally (5), save water (6), use clean energy (7), do good work (8), make smart choices

(9), be fair (10), love where you live (11), live better (12), act on climate (13), clean our seas (14), love nature (15), make peace (16), come together (17) (WBCSD *et al.*, 2018).

[39] Among the 102 papers, published from 1997 to May 2013 in the 17 volumes and 2 special issues, 12 papers are indirectly dealing with Edgar MORIN's Complex Thought, Ken WILBER's Integral Theory, and/or Roy BHASKAR's Critical Realism: SCHROEDER Rolf F. H. in volume 10 of 2006; SLATER Matthew in volume 15 special issue of 2011; BANKS Mark in volume 15 special issue of 2011; BINDEWALD Leander, BRAKKEN Marc, AUSTIN Preston, and REARICK Stephanie in volume 16 special issue of 2012; HIRAMOTO Takeshi, and NAKAZATO Hiromi in volume 16 special issue of 2012; VOLKMANN Krister in volume 16 special issue of 2012; THIEL Christian in volume 16 special issue of 2012; SOTIROPOULOU Irene in volume 16 special issue of 2012; NISHIBE Makoto, and KICHIJI Nozomi in volume 16 special issue of 2012; NISHIBE Makoto in volume 16 special issue of 2012; WAINWRIGHT Saul in volume 16 special issue of 2012; COLLOM Ed in volume 16 special issue of 2012.

[40] Four types of complex 'mixed methods' design: experimental/intervention design (*i.e.* convergent core design of qualitative during quantitative methods); case study design (*i.e.* convergent core design of qualitative during quantitative methods); participatory-social justice design (*i.e.* explanatory sequential core design of qualitative after quantitative methods); program evaluation design (*i.e.* exploratory sequential core design of qualitative before quantitative methods).

[41] Five key areas of 'creative research' methods: arts based research (*e.g.* visual arts, performance arts, textile arts); embodied research (*e.g.* body, somatic, senses, emotion, intuition); research using technology (*e.g.* software, social media, computer/video games); multi modal research (*alias* mixed methods research; *i.e.* mix of quantitative and/or qualitative methods); transformative research frameworks (*e.g.* participatory research, activist research, feminist research, decolonizing methodologies, community based methodologies, and asset based methodologies).

[42] Standard economic unit of account based on a fixed quantity of gold—used as the international monetary system until the end of the Bretton Woods system when the United States of America unilaterally terminated convertibility of USD to gold foreign central banks—which explains why many central banks nonetheless hold substantial gold reserves to give value to the issue of their paper-based money—as it used to be 100% backed by gold coinage or bullion during the gold standard to be fully convertible at any time.

[43] Climate change cause by unnatural human-induced increase of the greenhouse effect—as concentration increase of Greenhouse Gas Emissions (GGE) primarily due to the burning of fossil fuels or hydrocarbons (*i.e.* coal, oil, and natural gas).

[44] *E.g.* SCM Stakeholder Capitalism Metrics of IBC International Business Council of WEF World Economic Forum, IFRS International Financial Reporting Standards, ISSB International Sustainability Standards Board, TCFD Task Force on Climate Related Financial Disclosures, TNFD Taskforce on Nature-related Financial Disclosures, SASB Sustainability Accounting Standards Board, CSRD Corporate Sustainability Reporting Directive of EFRAG European Financial Reporting Advisory Group, SFDR Sustainable Finance Disclosure Regulation, DJSI Dow Jones Sustainability Index, CPD Carbon Disclosure Project; *etc.*.

[45] *Alias* Environmental, Social, and corporate Governance (ESG); *i.e.* impact assessment framework of an organization's strategy to create enterprise value and objectives by including the identification, assessment and management of sustainability risks and opportunities in respect to all organizational stakeholders (including but not limited to customers, suppliers, employees, and the environment).

[46] Moment at which economically viable extraction of petroleum starts to permanently decrease—since it cannot be extracted economically at a given price.

[47] *Universitas Virtuosus Virtutis* in Latin and its motto 'sense of life' [la: *vitam sensu*], conceived as a 'univers–ity' or 'multivers–ity' or even 'metavers-ity' on 19 November 2008 during the Great Recession under the code name of Vivaltruism and registered as VirtoŜanĝo on 17 January 2017 before the Great Lockdown—and officially launched on 17 March 2017.

[48] I got a foot on the ladder of currency innovation since I attended a conference of Bernard LIETAER on complementary currency held at the French Ministry of Economy and Finance on 05 February 2009—while the fledgling Bitcoin network came into existence on 03 January 2009 and was still in its infancy.

[49] *Alias* Integral Organization/Management; *i.e.* radar assessment of organizational or managerial *integral quadrants* and *evolutionary development* levels and lines through in-person observations of meetings for team dynamic and behaviour, and in-person conversations with director, leaders, managers, administrators, *etc.*.

[50] *Alias* Wisdom Economy; *i.e.* 4 bottom lines (people, profit, planet, purpose), 4 types of impact (clear, high, wide, deep), 10 types of capital (health, human, manufactured, financial, natural, cultural, social, knowledge, psychological, spiritual), 3 types of data (first-person: 1p, second-person: 2p, third-person: 3p).

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Social & Sustainable Finance

Smoothing Away the Stagnation Problem of Community Currencies with "Customized Communities" based on Satisfaction Prediction by Neural Network

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ABSTRACT: Every community, no matter how money poor, has a wealth of abilities and capability to stimulate the local economy. From this point, the idea of community currency (CC) emerged. This new type of currency was proposed as a tool to achieve sustainable development in the local economy. We learned that creating a CC was not enough to energize the local economy without addressing the stagnation problem. Thus, in the current research, we proposed a new framework or sequence of steps to build a "customized community" where the needs of members were met with the offered market to solve the stagnation problem. In this study we used real data recorded by a CC-based platform called C.C.Wallet to better estimate the degree of satisfaction of the members of the community to be used thereafter as a bridge to build "customized community". Considering this, the backbone of the proposed framework is estimating the degree of satisfaction of the members of the community by utilizing a Neural Network (NN) and this degree of satisfaction was used as an index to determine the members who would be given thereafter a "preference" in terms of bonus premium points to be added to their initial purchase of the CC with legal tender. The proposed index was created based on the number of purchases of the same products and services as well as by analysing C.C.Wallet users' messages (text-based comments and impressions) regarding the offered products and services after completing the transactions in the Japanese language. Thus, to analyse the comment text recorded in C.C.Wallet, it was necessary to use the technology of Natural Language Processing (NLP) where those comments were tokenized into tokens by using a python language-based module. In the current study, the engagement of the members with the provided market was monitored by computing a visual map of Shannon Entropy (*SE*). Our main findings suggest that the proposed framework should be considered as a tool to construct the concept of a "customized community" where the circulation of CCs is accelerated with the result of further boosting the local economy.

1. Introduction

Money can be defined as a stand-alone information medium of exchange or a measure of value and the important condition of it is to be accepted by a group regardless of its size whether big or small groups (Kichiji, Nishibe, 2012). In regard to this, shopping points, electronic money, mileage, exchange coupons and community currency are all a form of "money".

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In evolutionary economics, community currency (CC) can be defined as a currency that organized and managed by a local community or a community of interest, which involves the exchange of products and services. There are two main purposes of CC. (1) Socio-cultural Purpose: the cooperation between community members is reinforced and mutual aid is promoted. (2) Economic Purpose: CC is used to increase the local production for local consumption (i.e., improve the self-sufficiency rate) of resources, energy, and services, this helps protect the local economy from any regional economic shock and enhances resilience and autonomous decentralization. Thus, since CC unlike legal tender in pursuing a socio-cultural purpose and an economic purpose, it is becoming an "integrated communication medium" that mediates between the social culture and the global economy, and hence it goes beyond the classical meaning of "currency" as defined in economics (Nishibe, 2012, 2021).

Based on the characteristics of the participants of the community, the above-mentioned purposes will have varying degrees of impact to the community. To clarify further, if the community has a strong socio-cultural aspect, such as neighborhoods, the socio-cultural purpose's impact will be greater. If the economic aspect is stronger, such as a community with financial institutions, commercial and industrial organizations, and/or shopping districts, the economic purpose's impact will be greater. Although the proportion of the two purposes depends on the characteristics of the members of each community, CC is unique in that it fuses the two purposes.

In Japan, various types of CC were widely practiced for about ten years from the end of the 20th century, but the boom quickly ended due to some problems and shortcomings.

The cost (labor and funds) was high, and there were major operational problems such as the inability to survive without government subsidies.

Since then, many types of CCs have been set up and proposed, but it seems that those CCs have also some drawbacks in terms of stagnation. For instance, "Eco-money" which was proposed by Toshiharu Kato (Kato, 2001) as a special type of CC was used in volunteer activities among citizens to activate mutual aids and stimulate social welfare services.

Eco-money was designed to be used in volunteer activities and social welfare services. Eco-money was accumulated in the hands of participants (especially younger generations) who significantly contributed to the volunteer activities.

However, they could not find desired services and products in the market to spend their "Eco-money" and hence stagnation occurred. The double triangle system (DTS) was proposed by Makoto Nishibe (Nishibe, 2004) to cope with the stagnation issue.

As shown in Figure 1, DTS tried to make a bridge between non-commercial (volunteer related activities) and commercial transactions to stimulate the participants to buy products and services in the local markets. To prove the effectiveness of the DTS as a CC system, the currency circulation of DTS was examined theoretically and empirically by applying it on a community whose members were selected from Tomamae-cho city located in the prefecture of Hokkaido in Japan (Kichiji, Nishibe, 2006, 2008). The effectiveness of DTS was determined because the volume of commercial and non-commercial transactions increased. However, some Tomamae-cho CC was accumulated at specific business partners and could not circulate smoothly due to the limited market (Kichiji, Nishibe 2008).

On the other hand, numerous reports have been compiled that shows the ability of CC to foster the social sustainability and have been assessed by Arnaud (Arnaud, Marek, 2015). Arnaud showed that economic benefits of CCs are limited due to their small scale. To understand this limitation, we need to give an overview about LETS which stands for "Local Exchange Trading System". LETS is one of the account type Community Currencies for whoever wants to use it and was initiated in 1983 by Michael Linton in Comox Valley, Vancouver Island, Canada (Kichiji, Nishibe, 2012).

Transactions using LETS are recorded in each participant's account. Participants can buy and sell products and services from each other with specific terms of price and quantities on a peer-to-peer basis. LETS can only circulate within finite physical or virtual domains. If you have a positive deposit in your account, you will not gain any interest from your savings.

In contrast, if you have no money and you want to buy something, you still can buy it by going below zero in your account by creating money units. The money in LETS can be created by individuals to buy products or services without any limit or with a certain upper limit according to the rules of each LETS and this is the advantage of LETS. However, this is completely different from conventional money issued based on the value of commodity as money or the authoritative power of governments as issuers.

By conventional money, the seller will accept credit from the buyer and hence, the buyer incurs a debt to the seller. Considering this, the debt is generated on the side of the payer. When the

central bank issues central banknotes, it gives a certificate of indebtedness stating that I (the central bank) owe you (a recipient), and this is called an “IOU”.

However, a buyer is not directly in debt to a seller in LETS. Rather, the buyer is thought to be in debt to the community, composed of all the participants in the LETS. The buyer should have an ethical responsibility to repay the debt to the LETS community. In such systems as LETS, debts and credits do not bilaterally but multilaterally balance out. In other word, LETS do not adopt bilateral netting but multilateral netting. Then we call this kind of money as in LETS, not an “IOU” but an “IOC”, which signifies “I owe Community”. Considering this, the larger the community of LETS becomes in terms of the number of participants, the more the degree of anonymity will become, and under such circumstances, it’s hard to maintain trust among the participants of the community and the stagnation related issue may arise again.

Over the past few years, various CC platforms have been developed using smartphone applications. Digital regional currencies such as “Takayama City Sarubobo Coin” and “Kisarazu City Aqua Coin”, which are digitalized prepaid payment, are famous, but most of them are exchanged at stores, and the smooth circulation of the currencies was not realized.

Considering this, since LETS-type IOC digital currencies, which cannot be converted into legal tender, are likely to circulate more than digitalized prepaid payment, a new platform was proposed and this platform is called C.C.Wallet (Maeda, et al., 2019).

Over the past two years, Global Communication Planning Co. Ltd (called GCK). which is a company located in Chiba prefecture in Japan, used C.C.Wallet to set up a community of employees, and used an onsite “internal mall” (called GC Mall) to exchange products among the employees. All the transactions were investigated and analyzed in the current research.

Apparently, to accelerate the circulation of CCs among the participants of the community, stagnation related problems need to be addressed. Thus, in our previous study (Alaraj, Nishibe, 2019, 2020), we showed through random network simulation that the concept of “customized community” can be used as a tool to solve the stagnation problem, but in the current study we will introduce a computational framework or sequence of steps to build such customized communities by estimating the degree of satisfaction of the participants using Neural Networks. Thus, the main purpose of this paper is to propose a computational framework (or sequence of steps) based on real data to build the “customized community” where the needs of members are met with the offered market.

The framework was created by applying a neural network to estimate the degree of satisfaction of the members who will be given thereafter a “preference” in terms of bonus premium amount to add to their initial purchase of the CC with money.

Entropy maps were then computed to monitor the engagement of the members with the provided market to achieve our goal that related increase the circulation of CCs among the members of the community and hence, the stagnation related problems will be reduced as a result.

For the practical purpose of improving the sustainability of CC, we will introduce the theoretical framework of the customized community, and we will also talk about random network models and Shannon entropy in section 2.

Next, in section 3, we will not talk only about the proposed approach to build such customized communities by estimating the degree of satisfaction of the participants through applying a neural network, but also, the methods of building neural models will be explained as well.

Section 4 we will discuss the proposed approach and clarifies the link between estimating the satisfaction of the participant and customized community.

Finally, the conclusions and the possible extensions of the current work will be exposed in section 5.

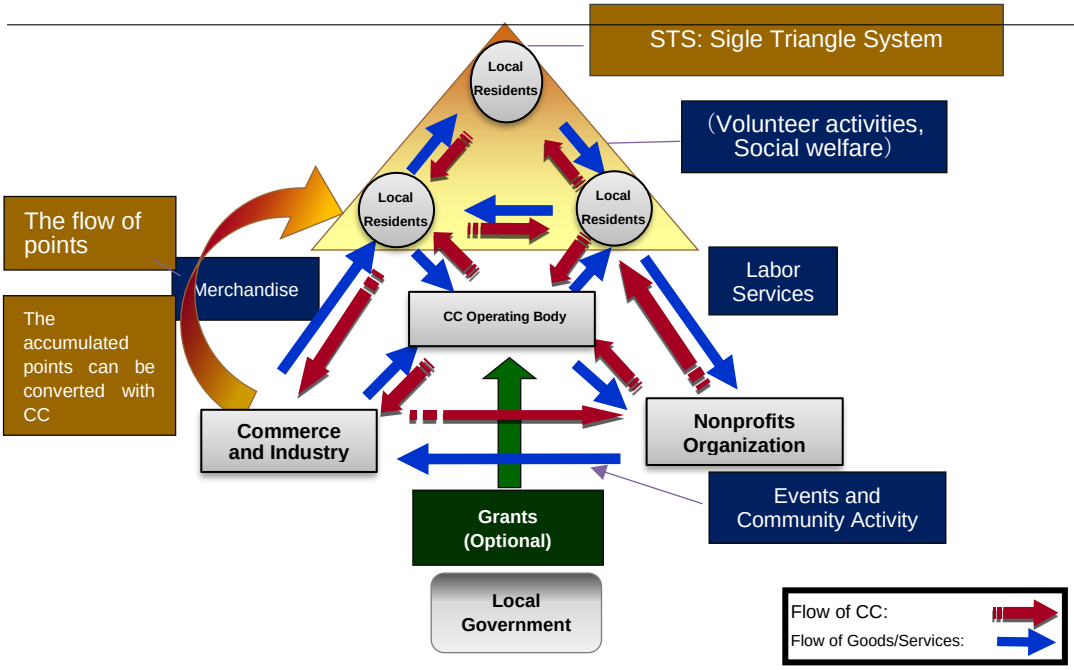


Figure 1 Double Triangle System (DTS) (Kichiji, Nishibe 2006)

2. Theoretical framework of customized community

Currency stagnation occurs when the circulation of currency in specific areas become less than other areas due to many factors such as small number of participants or dissatisfaction with the local market.

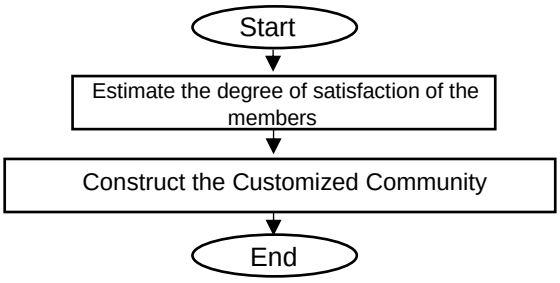


Figure 2 The proposed framework

Thus, to revitalize the local economy by using CCs, we don't need only to increase the number of persons who would like to join the community, but also, we need to increase the number of transactions using CCs. Such increasing in terms of number of participants and number of transactions will assist us to revitalize the local economy as the circulation of CCs among the members of the community will be increased.

Such increasing is important because it will reinforce the cooperation among those members of the community as the earned CCs from performing non-commercial transactions will be "absorbed" by its subsequent commercial transactions and prevent CCs from stagnating halfway through the circulation as shown in Figure 1. Thus, we need to construct a market where the demands matched the offered services and products of the other members. For example, if the number of members who are raising children in the community is few, child-related merchandises will not be likely purchased by CCs through the community, as there is a mismatch between the demands and the needs inside the community. In such cases, the problem of CC stagnation will occur. Thus, we need a more appropriate market where the demands of the members can be satisfied. To this end, in our previous research (Alaraj, Nishibe 2019, 2020), we clarified through simulation that building a customized market where the demands of

members matched the offered services and products of the other members inside the community would accelerate the circulation of CCs. In this regard, we need to give an overview about customized community.

A customized community is a type of community of interest (COI) based on the commonality of members' preferences for various categories of products and services. If we can identify these preferences of the members by estimating members' satisfaction regarding a particular category of products or services, we can build a customized community.

For better understanding the approach of the current research, we will first explain the concept of "customized community" and then we will discuss how to build such communities. However, in practical cases, we need to reverse the order of execution as shown in Figure 2.

2.1 What is Customized Community?

As stated above, to strengthen cooperation among members of a local community by using CC, it is better to increase "commercial transactions" after "non-commercial transactions" such as exchanges and mutual aid among members. The DTS suggests that if the members of the community use the CC acquired from non-commercial transactions in commercial transactions, this will increase the number of "commercial transactions", and the process of "absorption" into the market will be accelerated, rather than remaining in the hands of the members. Here, if any business partners inside a particular community receive CCs and expect that such CCs will be accepted by other shops, even if the business is a for-profit business, the conditions to consider accepting CCs as money can be satisfied. As a result of this situation, the newly created CCs through the execution of "non-commercial transactions", can be called a "currency of trust" issued by the community rather than a "currency of credit" which is issued by banks and such "currencies of trust" will have an effect on the "commercial transactions" and will revitalize the local economy as a result. However, on the contrary, if the number of "commercial transactions" is increased, it will be difficult to distinguish them from ordinary market transactions because of the prominence of commercial activities for the purpose of legal tender, and as a result, there is a strong risk that cooperative relationships based on trust among members will not be formed or will be lost.Therefore, by reshaping the CC-based market to meet the demands of the members as much as possible and avoiding the problem of currency stagnation in the middle, the "commercial transactions" will be increased.

Customized community can be constructed by giving specific members who has a frequent transaction a kind of "preference" in the form of a bonus premium amount added to the purchased CCs with legal tender (e.g., Yen, USD, Euro etc.) to be used with business partners inside the community. Such a kind of "preference" can be considered as a strong incentive not only for the people who are inside a community, but also to induce other people from outside the community to join the community and contribute significantly in it. Thus, in this regard, we would like to demonstrate that we used the term "customized community" rather than "customized market" to highlight the importance of participants who have high participation rate in performing transactions within the community.

Customized community needs some parameters and rules to "filter out" who can join the community, and such rules can be determined based on information about members who frequently participated in the transactions of the community. For example, if we can select members who frequently trade in baby products, we can form a community customized with the "commonality" of "child-rearing". This would include not only fathers and mothers who are raising babies, but also grandparents, relatives, and other blood relatives who are interested in their grandchildren and cousins.

Also, "commonality" can be identified in terms of the estimation of the satisfaction degree of the members based on two factors as shown below:

1. The impressions of the member who wrote his/her impression in text form, after finishing the transaction using a CCs based computational platform called C.C.Wallet.
2. The number of purchases for a particular service or product by a member in the community and hence, some concerns will be arisen due to privacy-related issues and such issues can be addressed by setting up a privacy policy and term of services in advance for the community.

2.2 The Simulation of the Customized Community

The simulation of customized community was examined throughout a random network applied using python and the details of the development environment is shown in Table 1.

Table 1 The Development Environment of The Simulation

Application Name	Version
Jupyter Notepad	6.0.3
Python	2.7.17
Anaconda	4.5.4
Gephi	0.9.2

The efficiency of the principle of "customized community" was examined throughout a simulation using a random network. This simulation was performed by assuming that the community size consisted of 100 members (nodes) and the transactions were done among them randomly by selecting a buyer node and a seller node through generating an asymmetric adjacency matrix (*Adj*), where each value in this matrix represented the volume of transactions between each buyer and seller in the community.

$$Adj = \begin{bmatrix} a_{11} & \cdots & a_{1j} \\ \vdots & \ddots & \vdots \\ a_{i1} & \cdots & a_{ij} \end{bmatrix}, \; i = 1, \dots, 100 \;\; and \;\; j = 1, \dots, 100 \qquad a_{ij} = 0 \quad when \; i = j$$

The principle of "customized community" was founded by calculating the entropy map of the transaction participation rate of all members of the community. Thus, it is needed to track the transaction history of community members over a period, and this period was assumed 50 days as shown in Figure 3.

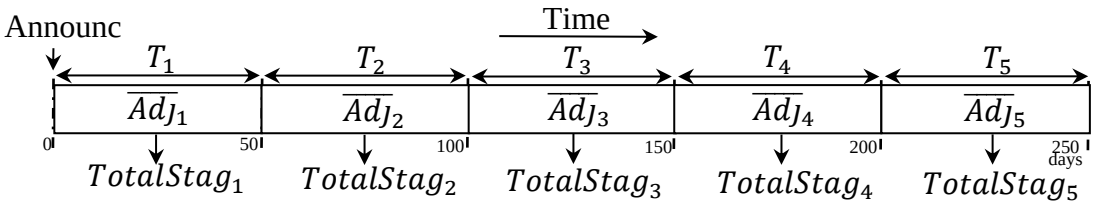


Figure 3 Schematic representation of the duration of CC simulation

Figure 4 represents the asymmetric adjacency matrix (*Adj*) where the rows represent the buyers (consumers), while the columns of *Adj* represent the sellers (providers). The flows of CCs from the buyer to the seller was represented by using arrows in the directed graph, as shown in Figure 4.

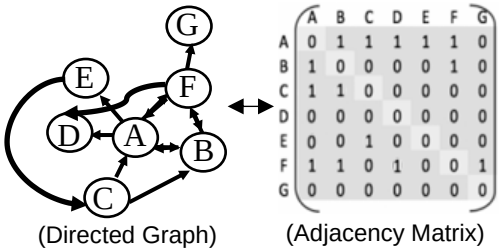


Figure 4 Example of Asymmetric Adjacency Matrix (Rows are buyers, columns are sellers)

This matrix is "asymmetric" because member *X* is a buyer, and another member *Y* is a seller, and it does not necessarily mean that the reverse is true: one member *X* is a seller, and another member *Y* is a buyer. For example, Figure 4 does not only show the case where *A* is the buyer and *B* is the seller (the corresponding element in row *A*, column *B* is 1), but also when *A* is the seller and *B* is the buyer (the corresponding elements in row *B*, column *A* is 1).

Also, Figure 4 does not only show the case where *A* is the buyer and *E* is the seller (the corresponding elements in row *A*, column *E* is 1), but also when *A* is the seller and *E* is not the buyer (the corresponding elements in row *E*, column *A* is 0).

Considering this, the adjacency matrix (*Adj*) indicates that each member wants to purchase the product or service offered by another member, but this does not necessary mean that the transaction was realized as it depends on the balance of CC that the buyers (consumers) had.

Next, the entropy map, as we will see later, represents a prototype for building a customized community based on the "commonality" of the offered products and services from the perspective of sellers and buyers.

2.2.1 The Assumptions of the Simulation

The execution of this simulation was based on the following nine assumptions. In the start of the simulation, we assumed that there were 100 members in a virtual community and the initial amount of CC was 10000 CC per person. This means that the total money stock was 1 million CCs, as shown in Figure 3. The period of simulation was assumed to last for 250 days divided into 5 periods （T_n, *n* = 1,…,5）.

1. It is assumed that the product initial price (*PCom*) is randomly generated within the range of 50 <*PCom* ≤ $Ini_n, \forall n = 1, \ldots, 5$, where *Ini* is the initial amount of CC. Products and services provided by each seller (provider) were not bartered and should be exchanged with CCs. As Figure 3 shows, the amount of CC, which was not used in community transactions for 50 days (T_n = 50, $\forall n$ = 1,…,5), was considered to be the stagnation amount.
2. It was assumed that the provided products and services can be categorized, and the members of the community who make bilateral transactions can buy and sell products and services using CCs. Any transaction can be realized if the member has an amount of CCs more than the price of the product or service (*PCom*) that they want to buy. If this condition is satisfied, the price of product or service will be deduced from the CC which is held by the member.
3. It was assumed that the transaction is executed randomly. That is, a pair of buyer and seller was randomly selected using an asymmetric adjacency matrix. The Shannon entropy (*SEn*) was computed after a certain period of time(50 days).
4. The buyer executes the transaction using the CC given at the initial stage. However, there will be some members in the market who do not use CC and hold some or all of it. If the remaining amount of CC was not used until the end of the period (50-day), this amount of CC was considered as a "stagnation". Considering this, when the participation rate (*PR*) decreases, the flow of CC among the members of the community will decrease as a result and hence, stagnation will occur. In the current study, the "participation rate" was defined as a "willingness to purchase" which was represented by the "buyer-to-seller" arrow in the network, where the buyer who was represented in the rows of the adjacency matrix, wants the seller's product or service which was represented in the column. The realization of such "willingness" was based on the CC balance that the buyer has, and if this balance exceeds the price of product/service, the transaction would be realized. Thus, from this perspective, the term "participation rate" rather than "transaction rate" was used in this research.
5. As shown in Figure 3, it was assumed that the CC-based market was open for 250 days. The amount of CC stagnation in each group and the total amount of CC retention in all groups were calculated every 50 days T_n). Therefore, the stagnation amount every 50 days (T_n= 50, $\forall n$ = 1,…,5) was defined by ($Stag_m, \forall m = 1, \ldots, 6$), and the total amount of stagnation was defined by ($TotalStag_n, \forall n$ = 1,…, 5), as shown in Figure 3.
6. As shown in Table 2, the participation rate in each group (Group *A*, *B*, *C*, *D*, *E* and *NS*) was described in Table 2 and was assumed to be constant throughout the whole simulation.
7. Also, the number of people in each group and the participation rate (*PR*) of the entire group was assumed to be constant throughout the whole simulation, as shown in Table 2.

8. As shown in Figure 4, the transaction was performed throughout the following steps.
    a. Set the adjacency matrix.
    b. The commodity price was randomly generated in the range of *PCom*, 50 <*PCom* ≤ $Ini_n, \forall n = 1, \dots, 5$.
    c. Randomly select a pair of members to be sellers and buyers. For example, select *A* and *B*, and randomly decide "A is the seller and B is the buyer".
    d. The transaction was realized when the generated commodity price (*PCom*) was below the CC balance. If the buyer ran out of their, CC balance, the transaction could not be performed if the commodity price was higher than the balance of CC and the rest of the CC would become stagnant.
9. The adjacency matrix was assumed to be calculated twice a day within 50 days. The average of those two times was calculated and represented as $\overline{Adj}$, as shown in Figure 3.

Table 2 The Groups of the Simulation

	Stagnation Group					Non-Stagnation Group
Index of Group (*m*)	1	2	3	4	5	6
Symbol of Group Name	A	B	C	D	E	NS
Participation Rate (*PR*) (%)	90	80	70	60	50	100
Number of persons (*Nr*)	10	10	10	10	10	50

2.2.2 The Formation of Customized Community Concept

The concept of "customized community" was implemented in the simulation by creating a market in the community by gradually redistributing the resulted stagnation amount during a 50-day period to the members who were frequently engaged in the transactions in the subsequent 50-day period. This was achieved by giving a bonus premium amount when those members purchased CC. In other word, the premium amount to be awarded was calculated by the initial amount of money (*Ini*) of the previous period of time (*T*) plus stagnation amount from the previous period of time divided by the total number of members who were engaged frequently in that period. Thus, the initial money at the beginning of each period of 50-day period will be defined by Eq. (1), as shown below:

$$Ini_{k+1} = \frac{TotalStag_k}{Nr.of\ members\ in\ NS_k} + Ini_k \text{ where } Ini_1 = 10000\,, \forall k = 1,\dots,4, \qquad (1)$$

As can be noticed in the denominator of Eq. (1), we used the number of members who were involved in the non-stagnation group (i.e., *NS* Group) because those members have the highest participation rates for transactions within the community.

2.2.3 Random Network Simulation

The simulation was developed using python. As mentioned in the previous section, the price of the products and services (*PCom*) was randomly generated in the range of 50 <*PCom* ≤ $Ini_n, \forall n = 1, \dots, 5,$ as shown in Figure 3. This simulation was performed by assuming that the community size consisted of 100 members (nodes) and the transactions were done among them using an adjacency matrix (Adj), where each value in Adj represents the volume of transactions between each buyer and each seller in the community, as shown in Figure 4.

Since that Adj was generated two times per a day within the 50-day period, the average of Adj was calculated as shown in Eq. 2.

$$\overline{Adj}_n = 0.5 * (Adj_1 + Adj_2)\,, \forall n = 1, \dots, 5 \qquad (2)$$

The stagnation amount was defined as an amount of CC which was not used in the transactions of the community during a period of 50 days. To determine the amount of stagnation, we assumed the buyer who is the member of the community is interested in the offered market, and he/she will buy the commodity whose price is *PCom* (*PCom* is generated randomly). Amount of stagnation ($Stag_m$) that corresponds to each group was computed using Eq.3

$$Stag_m = Nr_m \times (1 - PR_m) \times Ini_n \quad \forall m = 1,\ldots,5 \text{ and } \forall n = 1,\ldots,5 \qquad (3)$$

Table 3: Stagnation amount in terms of CC for each group in T_1

Group Name	Group Index (m)	The initial amount (*Ini*)	Participation Rate (*PR*)	Amount of Stagnation ($Stag_m$)
Group A	1	10000	90%	10000
Group B	2	10000	80%	20000
Group C	3	10000	70%	30000
Group D	4	10000	60%	40000
Group E	5	10000	50%	50000
Group NS ※	6	10000	100%	50
Total of Stagnation ($TotalStag_1$)				150050

※As shown in Table 3, the *NS* group with $m = 6$ has retention amount of 50. This is because commodity price *PCom* > 50, so if the CC balance becomes 50 or less, the transaction cannot be realized, and that amount will remain.

By contrast, if some members in the community are not interested in the offered market as much as others, they will keep some or all of CC and this amount of CC will also be considered as stagnation. Thus, the participation rates (*PR*) of the members will be reduced and hence different ratios of stagnations will result and the flow of currency among the members of the community will slow down accordingly.

The total amount of stagnation which resulted from the amount of stagnation from each group was computed using Eq.4, and then used thereafter to compute the ratio of stagnation relative to overall money stock as shown in Eq. 5.

$$TotalStag_n = \sum_{m=1}^{6} Stag_m, \qquad \forall n = 1,\ldots,5 \qquad (4)$$

$$StagRatio_n = \frac{TotalStag_n}{Aggregation\ Money\ Stock}, \quad \forall n = 1,\ldots,5 \qquad (5)$$

2.2.4 Shannon Entropy (*SEn*)

Shannon entropy (*SEn*) is a measure of predictability and is closely related to the probability of a random variable. The higher the participation rate, the lower the entropy, and the lower the participation rate, the higher the entropy. This is because if the probability of a specific variable is small, the predictability will be small, and the entropy value will be high.

Conversely, if the probability of a specific variable is high, the predictability will be high, and the entropy value will be low. Calculating a network map of participation rates for transactions among all participants in the community will give us an idea of how often buyer and seller transactions are taking place. This was because the stagnation problem was considered as a result of a decrease in the participation rate in transactions within the community, so the retention location can be visualized as shown in Figure 5.

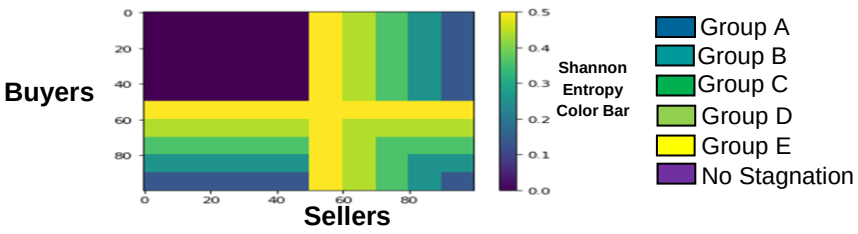


Figure 5 Color map of Shannon entropy for all the transactions during the simulation (Alaraj, Nishibe, 2019, 2020)

The *SEn* of the random variable *X* can be defined as in Eq. 6. Here, P_i was defined by Eq. 7, x_i indicates the *i-th* possible value of *x* among the *r* symbols, and $P_i$indicates the possibility of $X=x_i$.

$$H(X) = H(P_1, \ldots, P_r) = -\sum_{i=1}^{r} P_i log_2 P_i \quad (6)$$

$$P_i = Pr(X = x_i) \quad (7)$$

Figure 6 represents the schematic representation of the "customized community", while Figure 7 represents the flowchart of the overall method of creating the "customized community".

2.3 The Results of the Simulation

The stagnation amount of CC of the six groups in T_1 was calculated using Eq 3.Then, the total stagnation amount of CC was calculated using Eq 4, while the stagnation ratio was calculated using Eq. 5. As a result, the stagnation ratio in T_1 will be $\frac{150050}{1000000}$=15%.Thus, after increasing the (*Ini*), the stagnation amount of CC in subsequent time sections (i.e., T_2, T_3, T_4, T_5) showed that the stagnation ratio decreased due to the above-mentioned redistribution of the premium amount. As shown in Table 4 below, implementing the customized community concept reduced retention rates from 15% to 3% after 250 days.

Table 4: Stagnation amount after implementing "customized community" concept

#	Passage of Time (T_n) (days)	Initial amount (*Ini*),	Ratio of Stagnation ($StagRatio_n$)
1	50	10000	15
2	100	13000	9.5
3	150	14900	6.2
4	200	16150	4.2
5	250	17004	3

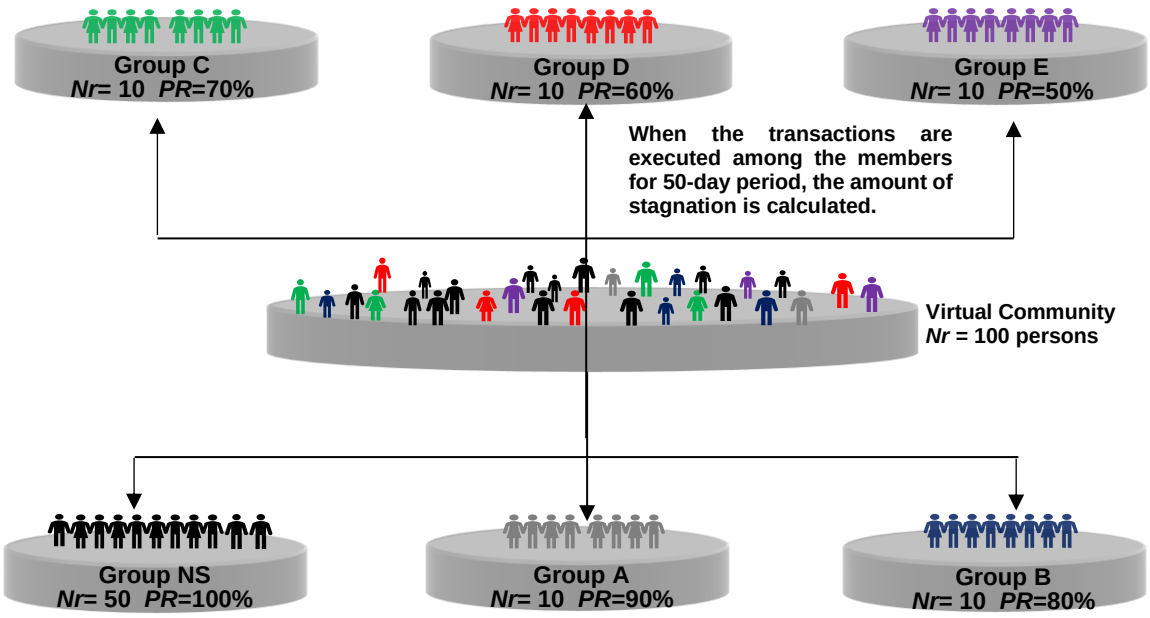


Figure 6 The schematic representation of the "customized community" during the simulation

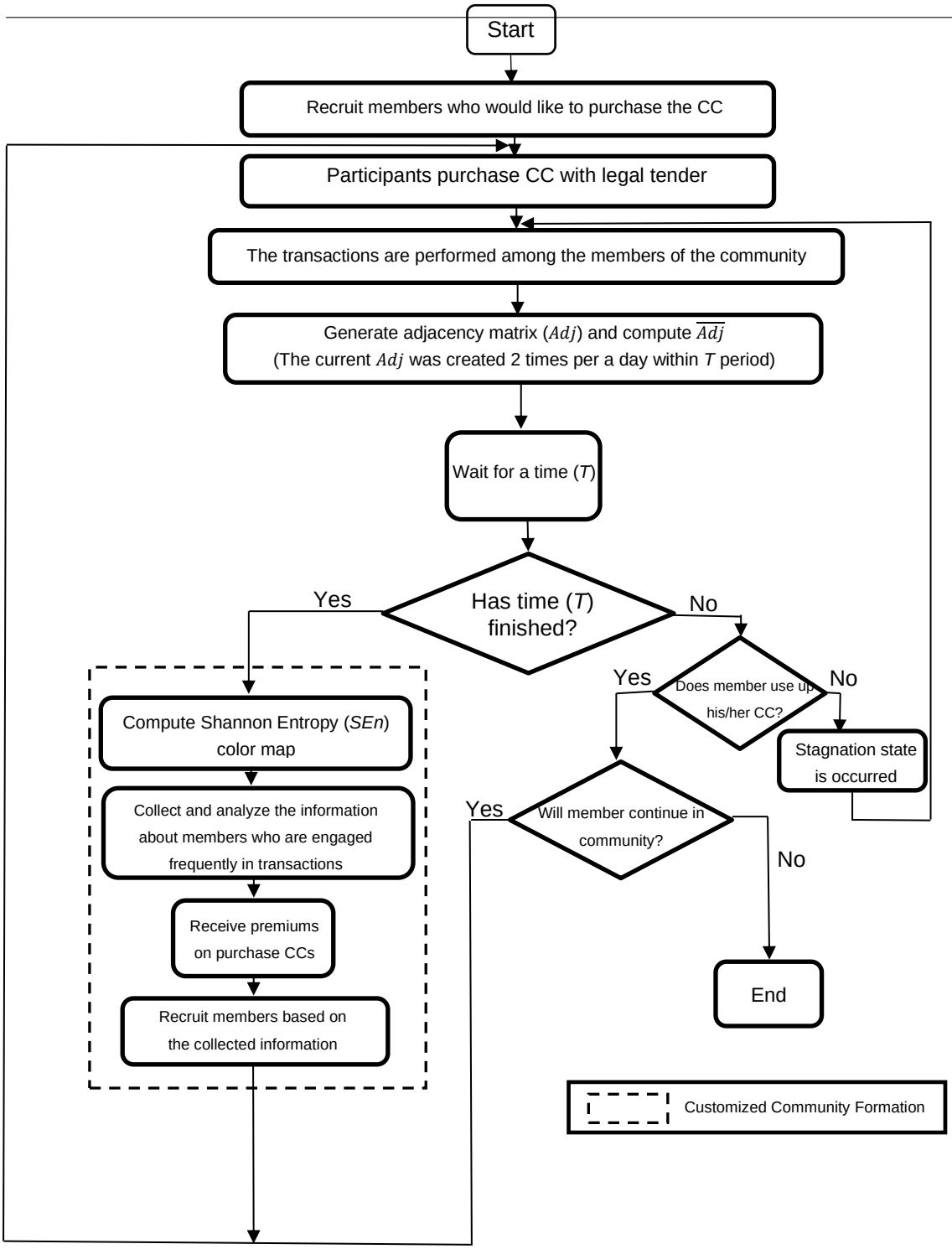


Figure 7 Flow chart of the overall method of creating "customized community"

3. The Estimation of the Degree of Satisfaction

3.1 C.C.Wallet Platform

C.C.Wallet is a platform provided for members by the General Incorporated Association Community Currency Research Consortium for a Sustainable Society (3C3S: https://www.3c3s.org/project). It enables the design and management of LETS on real/virtual communities according to its characteristics and has already been adopted by several regions and organizations. For example, in March 2021, the Society for Evolutionary Economics

established an intra-society currency, called JAFEE, for the purpose of promoting mutual exchange and mutual aid (e.g., journal review/editing, various committee activities, etc.) among members.

In the current research, all the data was obtained from the C.C.Wallet platform. C.C.Wallet is a CaaS (Currency as a Service) platform where users can issue and manage various community currencies. This platform enables regional development organizations and communities to design and manage depreciating currency and LETS-based metric currency based on the related communities organization's characteristics and needs by using a mobile application to create a new sustainable society. Additionally, this platform is low cost and/or free of charge and is equipped with the following functions:

(1) Transmission Function for QR codes.
(2) Messaging Function.
(3) History Function.

This platform has been examined by using it in various regions and organizations in Japan (Maeda, et al. , 2019), and we will report the main operation of these local currencies.

Figure 8 Community Currency Smartphone Application (C.C. Wallet) Screenshots (Maeda, et al., 2019)

The main screen of the C.C. Wallet application is shown in Figure 8 (a), where any region, shopping district, company, or any organization can request to set their own currency, issue, and operate it. Also, we can also see in Figure 8 (b), the currency amount (i.e., number of points), message and textbox for the addressee of the destination. In Figure 8 (c), we can see different skills/activities that the user has registered on the application like Herbology Class, 800pt, Chest Art Experience, 1500pt, Haircut, 2000pt, and a pick-up from some place, 1000pt. Finally, the QR code which is used for transmission can been seen in Figure 8 (d). C.C.Wallet is available and can be download from Apple's App store or Google's Play store. The full details about C.C.Wallet as well as the implementations of this platform are reported in (Maeda, et al., 2019).

3.2 Transaction Data

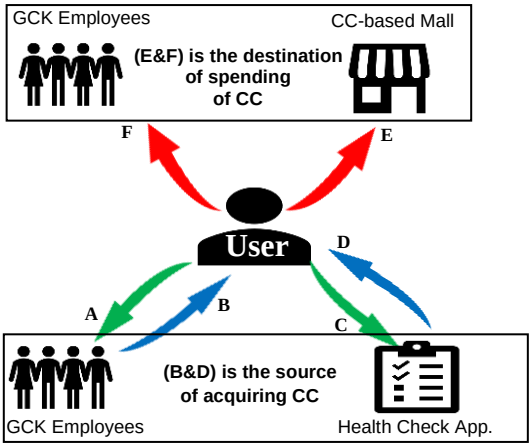
All the data was obtained from Global Communications Planning Co. Ltd. (hereafter abbreviated as GCK). The data was generated by C.C.Wallet as a CSV file form and the template of the file is shown in Figure 9.

1	2	3	4	5	6	7	8	9	10	11
A	B	C	D	E	F	G	H	I	J	K
Currency Code※1	Time Stamp	C2C	GPS Data	Trans. Point	Seller Name	Seller Balance	Seller Message※2	Buyer Name	Buyer Balance	Buyer Message

※1：00112: Currency of Chiba Prefecture
※2 ：Almost null

Figure 9 Template of CSV file generated by C.C.Wallet

The data file generated by C.C.Wallet platform was not only related to bilateral transactions of products and services which were purchased by users of C.C.Wallet (members of the community), but also from the transactions at CC malls (CC-based malls) as shown in Figure 10.



A. Offering products or services
B. Receive CC regarding products or services
C. Performing health check daily
D. Receive CC regarding performing health check
E. Purchasing the offered products through CC-based malls
F. Purchasing the offered products or services through bilateral transactions

Figure 10 CC flow paths

Table 5 Transaction Data

Total # Transactions	Total # Nodes	Period of Transactions
27968	738	2019.5.9 ～ 2021.3.16

The flow of CC is shown in Figure 10, while the details of transaction data is shown in Table 5. Specifically, the direction of blue arrows was used to represent the sources of CC where the CC can be earned throughout the bilateral transactions or regarding user's cooperation in recording his/her health status before starting work on a daily-basis as one of the countermeasures against Covid19, In this regard, the employees of GCK earned 5 points of CC every day when they record their health conditions such as body temperature or complied with the rule of washing their hands for 30 seconds or more etc. and inputted this in the terminal where health check application is installed in, as shown in Figure 11. On the other hand, the direction of red arrows was used to represent the destinations where CC can be spent. The green direction points to the products and services which were provided by the user.

Figure 11 The graphical user interface of health check application in GCK

Since C.C.Wallet does not have numerical data that directly indicates the satisfaction of the user, such as five stars for indicating the fully satisfaction regarding the offered products or services, so it is necessary to predict user satisfaction in numeric form to determine the most popular products and services within the community to be used thereafter as a tool to construct the “customized community”.

Thus, it was first necessary to grasp the name of the purchased products and services not only from what was written directly in the comments of the member (i.e., Direct Transaction Trust “*DTrust*”), when he/she finished the transaction, but also, we need to calculate how many times that a particular product or service was purchased (i.e., Indirect Transaction Trust “*InDTrust*”). In the current research, the *DTrust* and *InDTrust* could be obtained when the user finished the transaction with another user through C.C.Wallet. As a result, *DTrust* and *InDTrust* could be used as indicators for the estimating the degree of satisfaction of the user regarding the offered products and services, while *InDTrust* could be obtained only when the user purchases a particular product from a CC-based mall.

The network of transactions can be represented by a directed graph as shown in Figure 12 where each node represents a user and each edge represents a transaction. All the details of this network are shown in Table 5.

In Figure 12, the source of the arrow represents the “buyer” and the target of the arrow represents the “seller” (i.e., “buyer” → “seller”). In graph theory, the number of edges pointing out from a particular node is called the “out degree” and hence, the user who has more “out degree”, he/she has purchased more products/services than other users. Considering this, since GCK gives CC for each employee who records his/her health status almost everyday, the out degree of GCK will be more than any other ordinary user as shown in Figure12.

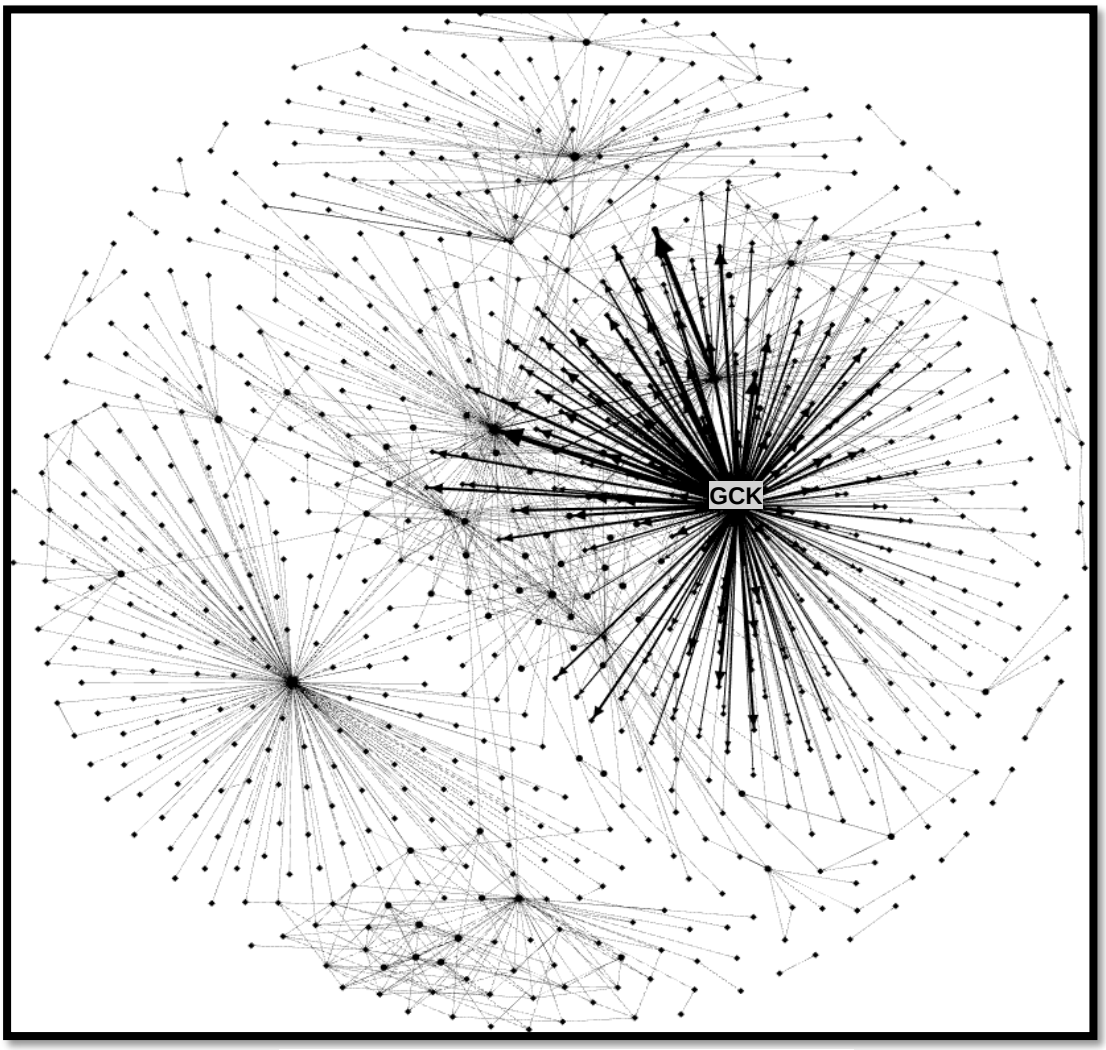


Figure 12 The network of the transactions of C.C.Wallet

3.3 The Analysis Method

To analyze the comment text entered in C.C.Wallet, it is necessary to use the technology of Natural Language Processing (NLP). NLP is a scientific discipline that aids computers to understand human languages seamlessly. The ultimate objective of the NLP techniques is to extract meaningful information from human languages. Thus, to extract the meaningful information from the comments which were entered using Japanese language by the users (members of the community), those comments are needed to be tokenized (i.e., divide) into tokens by using python language-based module called “nagisa”, as shown in Figure 13.

Next, based on the entered impression and the number of purchased of the same products or services, we can estimate the satisfaction degree of the user using 5-stars scale from “5” stars to “1” star, as shown in Figure 14. However, when the user did not evaluate the purchased products, “0” was used as an index indicating “no evaluation” instead of satisfaction degree.

The analysis process was focused on the 11th field of CSV-related template as shown the Figure 9 where the user (member of the community) records his/her message regarding the purchased products or services when the transaction was done between user and another user.

On the other hand, since CC-based malls are registered as users in C.C.Wallet, the sentence in 11th field of the generated CSV-related template was consisted of the following format:“User *X* purchased product *Y* at the mall.”, where *X* represents the name of the user while *Y* represents the name of the product. Thus, the name of the buyer and the name of the purchased products (products) were extracted from the 11th field.

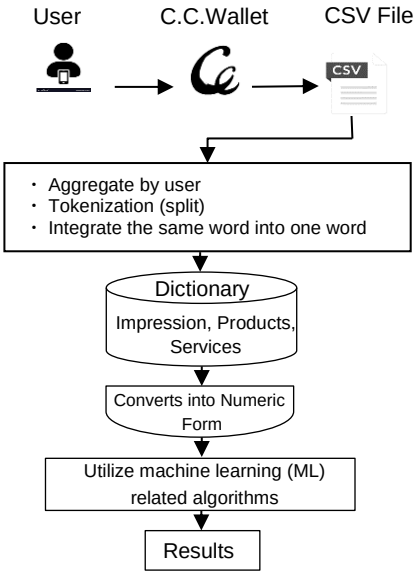


Figure 13 Overview of the analysis process

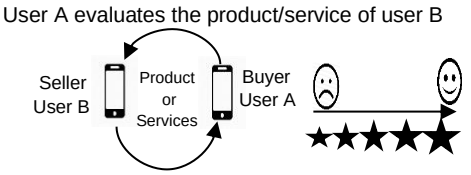


Figure 14 The evaluation process

Contrary to what happens in the negotiated transaction between one member and another within the community, the member cannot record his/her impression when he/she bought a product from the CC-based mall.

In the current study, we did not consider the price of the products/services as purchasing something expensive does not necessary mean that the user is satisfied with that product or service however repeatedly purchasing the same product or service does reflect that the user was satisfied, therefore to predict the degree of satisfaction of the purchased product, the number of times that the user repeatedly purchased the same product (*InDTrust*) was considered as an indicator of the degree of satisfaction which was evaluated on a five-point scale from a “5” star rating to a “1” star rating.

For example, if the same product is purchased only once, the degree of satisfaction is set to “1”, if the same product is purchased twice, the degree of satisfaction is set to “2”, and if it reaches 5 times or more, the degree of satisfaction will be set to “5” and so on.

Table 6 The list of impression-related words in Japanese with its translations

Highly Satisfied	Satisfied	Relatively Satisfied	Not Satisfied	Not all Satisfied	No impression
5	4	3	2	1	0
広め:Wide	ありがとう: Thank you	ごめん: Sorry	恐喝: Extortion	くそ: (foul language)	
わざわざご足労: Take the trouble to work	よろしく: Thank you	すみません: Sorry	できない: I can not	やだ: I don't like	
わざわざ: Take the trouble	宜しく: Thank you	すいません: Sorry	何となく: Some how		
本当にありがとう: Really Thank you	有難う: Thank you	あげる: give			
礼: Thank you	サンキュ: Thank you				
世話: Looking After	楽しん: have fun				
嬉しい: Happy	楽しみ: have fun				
甘く: Sweet	美味しい: Delicious				
さすが: As expected	美味し: Delicious				
心遣い: Thanks for consideration	美味しかっ: was Delicious				
大好き: really like	美味しく: Delicious				
ちそう: Hospitality	めでとう: Congratulations				
馳走: Hospitality	疲れ:Effort				
Go※ ※it means「Let's Start CC」	久し: After a long time				
貴重な経験: Valuable Experience	頑張っ: Do your Best				
親切: Kindness	お試しに協力してくれてありがとう: Thank you for your cooperation				
良い: good	確認が取れました。ご協力ありがとうございます！: Thank you for your confirmation				
面白い: Interesting	おいしかっ: It was delicious				
感謝: Appreciated	立派: fine				
もう一つ: Another one					
ウインナー: Wiener					
最高: Best					
やりたいなぁ: I want to do it					
早速: Immediately					

3.3.1 Regression Analysis and Machine Learning

Regression is a method used in statistics to investigate the relationship between independent variables or features and a dependent variable or outcome. In this research, we use it with machine learning to predict the outcome of a continuous variable. Regression analysis measures "how an increase in one variable *x* affects another variable *y*". In regression analysis, for a given two variables *x* and *y*, it is necessary to make a clear distinction between *x,* the "explanatory variable", and variable *y* which is called an "objective variable".

Since the "explanatory variable" is used in the learning process to generate the objective variable, we need first to determine which variables are the "explanatory variables" and which are the "objective variables".

The "explanatory variable" is determined from asking the following question, "What should we use to predict something?", while the "objective variable" as its name implies, is the variable that determines the degree of satisfaction which we want to predict in this research.

Table 7 AI-based Learning Data Model

Name of Variable	Meaning of Variable	Type of the Data	Type of Variable
Satisfaction	The satisfaction of the user※	Numeric	Objective variable
Repetition	repetitions of purchases for the same category product/service	Numeric	Explanatory variable

※When products are purchased through normal negotiated transactions, the satisfaction degree is calculated based on Tables 8 and 9, but when purchased at the C.C.Wallet mall, the satisfaction degree is calculated based on Eq. 8.

To use "objective variables" in the model, "impression-related words" (i.e., words expressing satisfaction) which was recorded as comments in the Japanese language (*DTrust*) after finishing the transactions in C.C.Wallet, was extracted as shown in Table 6. Those impression related words were linked to the satisfaction degree which was set to 5 levels ("5": highly satisfied, "4": satisfied, "3": relatively satisfied, "2": not satisfied, "1". not all satisfied, "0": No satisfaction-related words).

The full list of Japanese impressions-related words was classified in terms of degree of satisfaction. This is shown as a five-point scale above in Table 6.

In the current study, we considered the category of the product rather than the offered product itself as well as the category of the service rather than the offered service itself as described in Tables 10 and 11.

If multiple "impression-related words" was recorded regarding multiple product or services where each of which was purchased throughout different transactions as well as classified in the same category, and those "impression-related words" had different degrees of satisfaction, the average of those degrees of satisfaction was calculated.

For example, if the impression of a particular user (member of the community) regarding a particular product as "I really like it" which has a degree of satisfaction of "5", and then in another transaction, the impression of the same user regarding a particular product whose category was the same of the previous purchased one, was "thank you", which has a degree of satisfaction of "4", the average of the degrees of satisfaction was calculated and hence, "4.5" was considered the degree of satisfaction regarding the purchased product's category.

However, since the impression-related words cannot be grasped through the transactions of the CC-based mall, we calculated how many times each user bought the same product (*InDTrust*) from the CC-based mall, and we considered such repetitions of purchases for the same category product as an indicator of the user's degree of satisfaction regarding the purchased product.

Thus, the fixed format sentence "User *X* purchased the product *Y* in the mall" where *X* represents the name of the user (member of the community), while *Y* represent the name of the product's or service's category was recorded when the user of C.C.Wallet purchases a product from the CC-based mall in the 11th field of the CSV file. This field was extracted and evaluated on a five-point scale from a "5" star rating to a "1" star rating according to the number of purchases of the same product (*InDTrust*), and the degree of satisfaction of the user who purchased from the CC-based mall can be computed by the following Eq. 8.

$$The\ satisfaction\ degree\ of\ user = the\ number\ of\ parchases\ of\ same\ product$$
$$\forall InDTrust \quad (1 \leq InDTrust \leq 5) \qquad (8)$$

In the current study, the number of purchases of products and services was extracted per user as shown in Tables 8 and 9.

Table 8 The 1st explanatory variable (number of products) (*InDTrust*)

Product Name	$User_1$	$User_2$	$\cdots$	$User_n$
Pro_1	For $User_1$ Pro_1 *and* 「$impression - related\ word$」 is extracted	For $User_2$ Pro_1 *and* 「$impression - related\ word$」 is extracted	・ ・ ・	For $User_n$ Pro_1 *and* 「$impression - related\ word$」 is extracted
Pro_2	For $User_1$ Pro_2 *and* 「$impression - related\ word$」 is extracted	For $User_2$ Pro_2 *and* 「$impression - related\ word$」 is extracted	・ ・ ・	For $User_n$ Pro_2 *and* 「$impression - related\ word$」 is extracted
・ ・ ・	・ ・ ・	・ ・ ・	・ ・ ・	・ ・ ・
Pro_m	For $User_1$ Pro_m *and* 「$impression - related\ word$」 is extracted	For $User_2$ Pro_m *and* 「$impression - related\ word$」 is extracted	$\cdots$	For $User_n$ Pro_m *and* 「$impression - related\ word$」 is extracted

Where *m* represents the total number of products and *n* represent the total number of users who purchased the products.

Table 9 The 2nd explanatory variable (number of services) (*InDTrust*)

Service Name	$User_1$	$User_2$	$\cdots$	$User_q$
Ser_1	For $User_1$ Ser_1 *and* 「$impression - related\ word$」 is extracted	For $User_2$ Ser_1 *and* 「$impression - related\ word$」 is extracted	・ ・ ・	For $User_q$ Ser_1 *and* 「$impression - related\ word$」 is extracted
Ser_2	For $User_1$ Ser_2 *and* 「$impression - related\ word$」 is extracted	For $User_2$ Ser_2 *and* 「$impression - related\ word$」 is extracted	・ ・ ・	For $User_q$ Ser_2 *and* 「$impression - related\ word$」 is extracted
・ ・ ・	・ ・ ・	・ ・ ・	・ ・ ・	・ ・ ・
Ser_p	For $User_1$ Ser_p *and* 「$impression - related\ word$」 is extracted	For $User_2$ Ser_p *and* 「$impression - related\ word$」 is extracted	$\cdots$	For $User_q$ Ser_p *and* 「$impression - related\ word$」 is extracted

Where *p* represents the total number of services and *q* represent the total number of users who purchased the services.

3.3.2 Neural Network Model

Typically, there are various types of neural networks (hereinafter abbreviated as NN), but the simplest form is a three-layer feedforward neural network as shown in Figure 15.

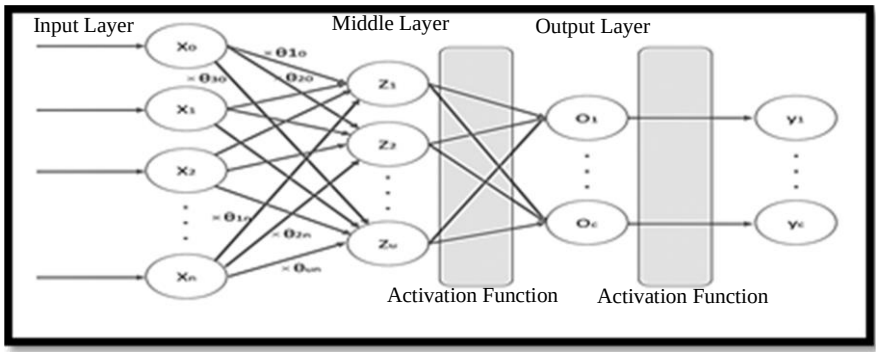


Figure 15 Three-layer feedforward neural network

3.3.3

In the current study, learning process of NN model was performed on the hypothesis that the degree of satisfaction regarding the offered productservice can be predicted based on user's number of purchases and hence, the goal of learning is to derive a model that can make such predictions.

3.3.4 The Necessary Steps for Building NN Model

When building the NN model, a series of processes are executed as shown in Figure 16. In the current study, we will explain those processes as shown in the next section.

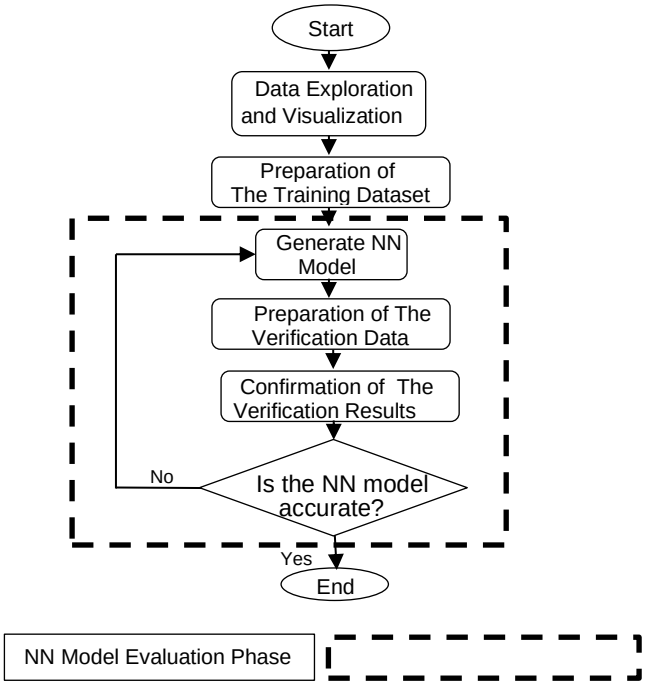


Figure 16 The process of building a NN model

3.4 Results

3.4.1 Data Exploration

The obtained data includes some of billing-related information and such data was excluded from the analysis as it is not related to the scope of the current research.

Each participant (node) trades as a “seller” or “buyer” and the number of sales and purchase transactions does not always match. In addition, some participants purchase and sell a large amount of products and services of various types, while others purchase and sell only a small amount of products and services and the number of transactions performed by each participant was not equal.

Since that there were many products and services, we tried to categorize the products with almost the same contents and meanings into the same category. For example, all items written in various expressions such as “pan price”, “pan”, and “pan help” as the names of products are put in the “pan” category and so on, as shown in Table 10. Similarly, services names like “drinking party”, “dining party”, “banquet”, “evening party”, “dinner” and “second party”, etc. , were categorized as “Social Gathering” and so on, as shown in Table 11.

Table 10 Example of the Extracted Products in Japanese with its Translations/Phonetic Spelling

#	Product Item	Category
1.	あすばら Aspara	アスパラ Aspara
	Aspara	
	アスパラガス Asparagus	
2.	パン代 pan price	パン pan
	ぱーん Pan	
	フラパン Fry Pan	
	プラパン Plastic Pan	
	Bread	
	パソヘルプ Pan Help	
3.	. . .	. . .

Table 11 Example of the Extracted Services in Japanese with its Translations/Phonetic Spelling

#	Service Item	Category
1.	運転手 Driver	運転 Driving
	運転 Driving	
	運転資金 Driving Fare	
2.	飲み会 Drinking Party	懇親会 Social Gathering
	食事会 Dinner Party	
	夜会 Evening Party	
	晩御飯 Evening Meal	
	二次会 After-Party	
3.	. . .	. . .

Japanese language had 3 writing systems: Kanji, Hiragana and Katakana, and all of them can be used to write the same word. Since that some of the names of the products and services were written in Kanji, while the others whose had similar names were written in Hiragana, we need to unify them into one category. It is worthy mentioned that to reduce the computational time of the processing, it is important to unify and categorize the products and services into one category.

3.4.2 Data Visualization

To better understand the data, we used the python language to generate statistical graphs related to the products and services. The data identified 107 types of products (including products provided by the mall) and 68 types of services.

The average purchases for the products and services were shown in Figures 17 and 18 respectively. In other words, such graphs can indicate how popular those products and services were among all the members (whose real names were replaced with animal names for anonymization and keeping privacy) of the community.

Also, a function to display the number of purchases for a particular product or service for the member after writing the user's name (i.e., animal name) was developed as well. As an example, Figure 19 is a graph showing the number of products purchased by a specific user ("fin whale") at a mall, while Figure 20 is a graph showing the number of products purchased by a specific user ("fin whale") at a CC-based mall and throughout the bilateral transaction.

3.4.3 Generating NN Model

To set the learning process of NN by using python language, we used 2 patterns of NN as shown below:

1. "1st pattern": the values of the parameters were set as below:

```
nn = (hidden_layer_sizes=(2),
      activation='relu',
      max_iter = 10000,
      verbose=True,
      learning_rate='constant')
```

2. "2nd pattern": the values of the parameters were set as below:

```
nn = (hidden_layer_sizes= [(2), (3), (4), (5)],
      'activation':['relu', 'logistic'],
      max_iter = 10000,
      verbose=False,
```

The explanation of the parameters is shown in Table 12.

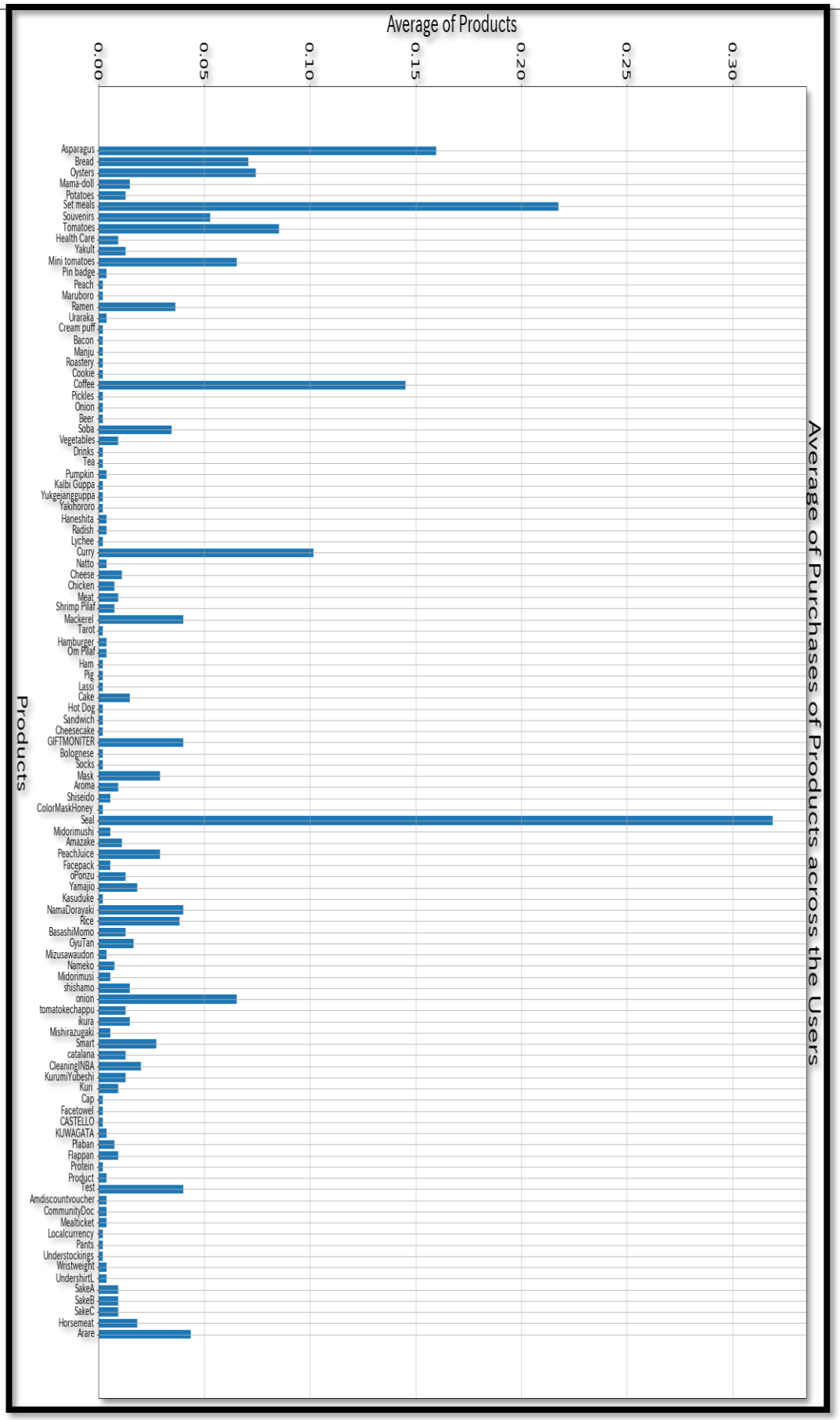


Figure 17: The average of purchases of the goods across the users

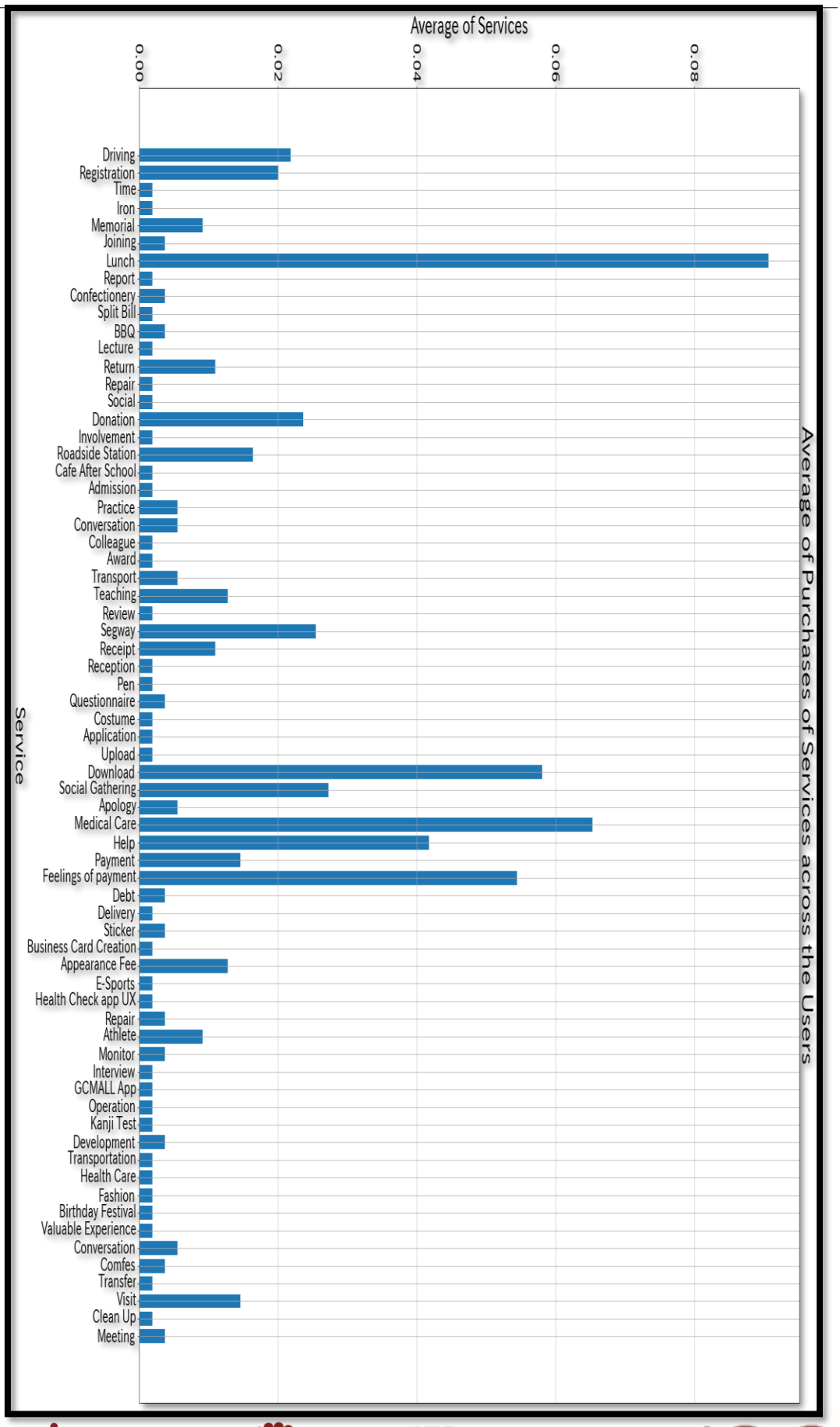


Figure 18: The average of purchases of Services across all users

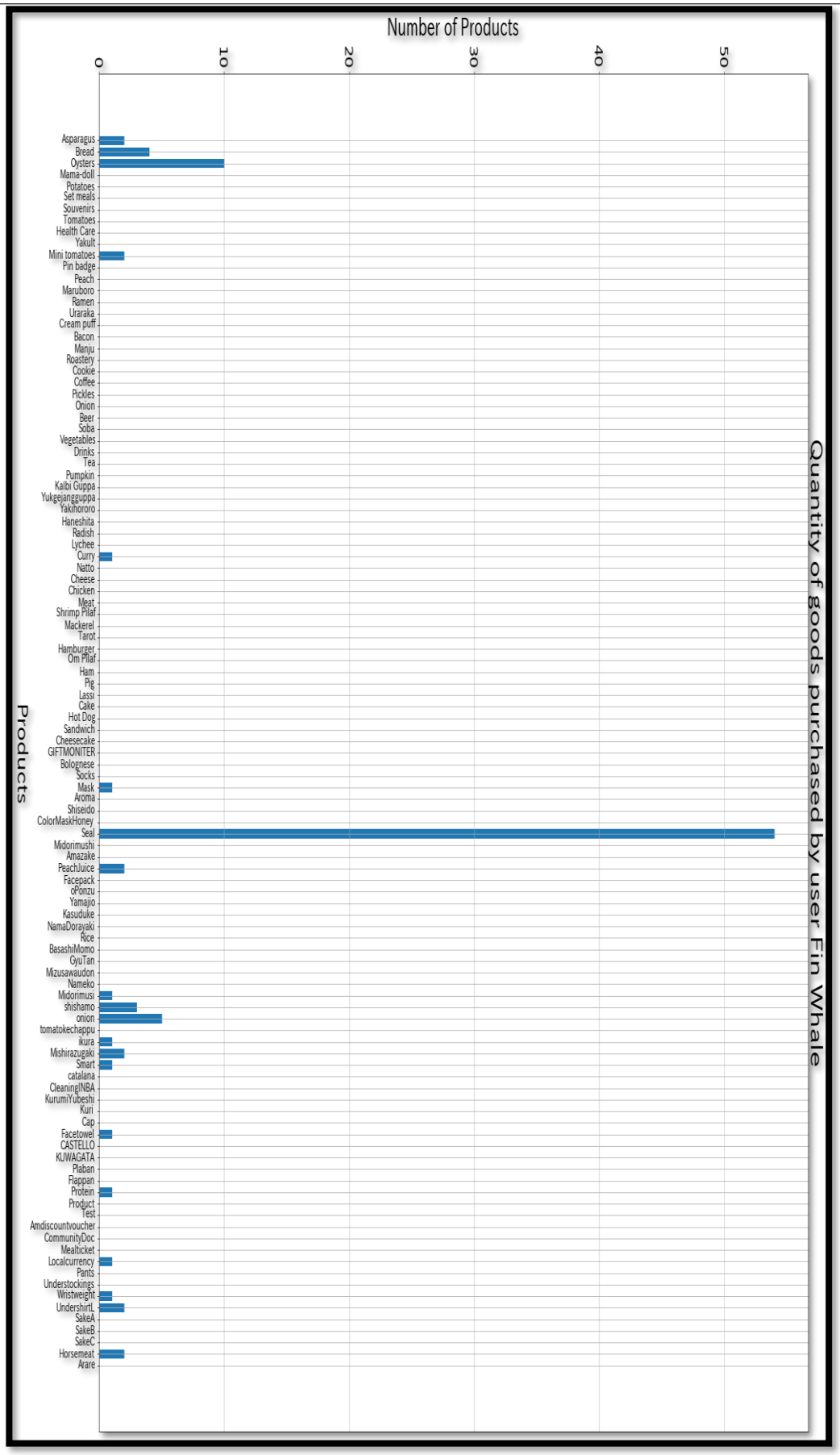


Figure 19: The number of products purchased by user "Fin Whale" at Mall using C.C.Wallet

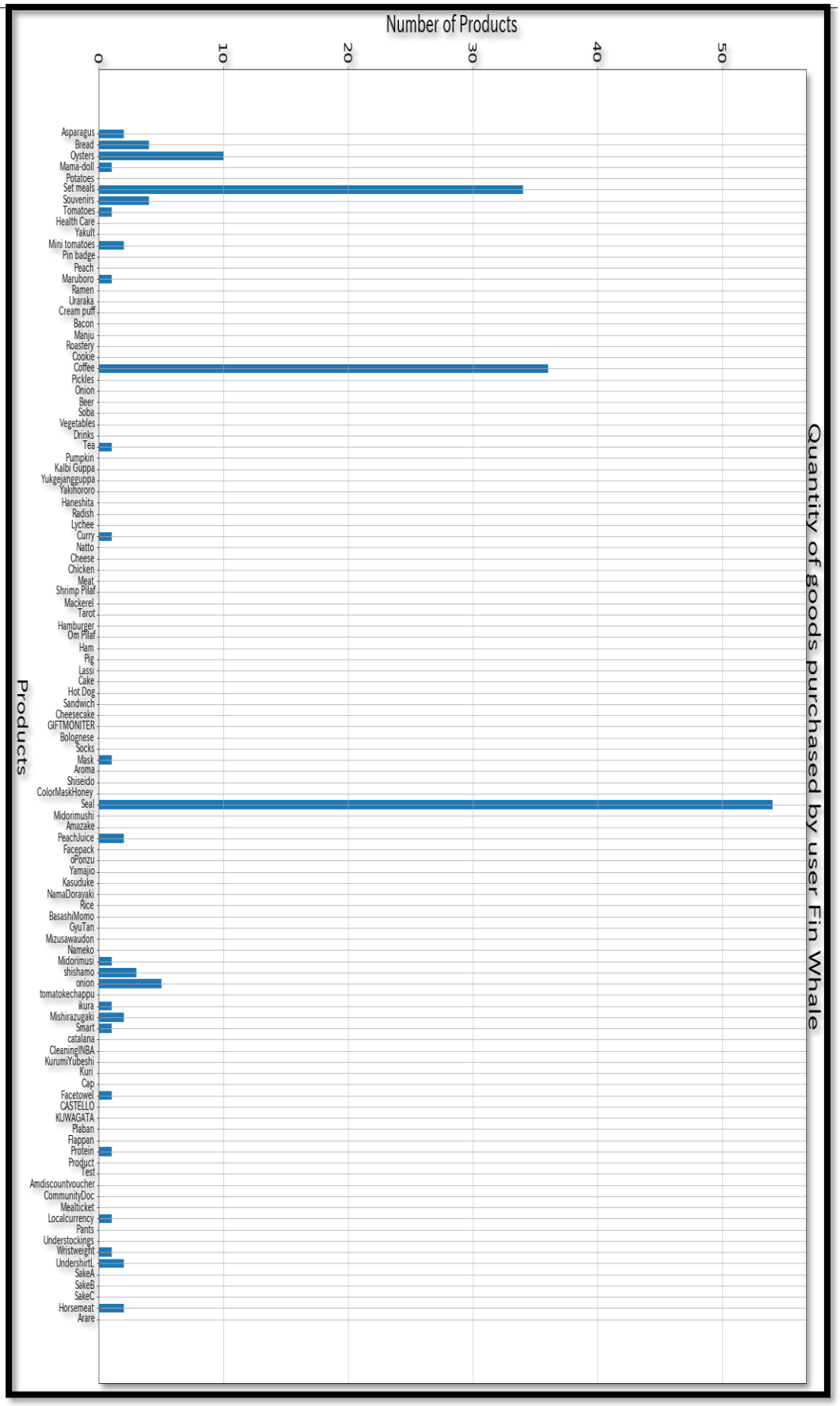


Figure 20: The number of products purchased by the user "Fin Whale" in both regular bilateral transactions and CC-based MALL

Table 12 The Explanation of NN Parameters

The Name of Parameter	Meaning	The Meaning of Values
hidden_layer_sizes	**Number of Elements:** Number of calculations in the middle layer **Value of each Element:** number of neurons in each middle layer	・Two in the first layer ・ 2 in the 1st layer, 3 in the 2nd layer, 4 in the 3rd layer, 4 in the 5th layer. Since the number of calculations in the middle layer is two or more, this learning is called [deep learning].
activation	Specifying the activation function	・relu：ReLu Function (If the input value is 0 or less, it becomes 0, and if it is larger than 0, the input is outputted as is). ・ logstic: Logistic Function (calculates the probability value and classifies it according to whether it is above the threshold value.
max_iter	Maximum number of searches when searching for the optimal solution If -1 is specified, it repeats until it converges.	The optimum model search process is repeated up to 10000 times.
verbose	Specify whether to output a message in the process of model generation	・ ”True”: Message will be displayed. ・”False”: Message will not be displayed.
learning_rate	Update the Weight Learning Rate	・The learning rate is a fixed constant variable. The default is used here.

3.4.4 Prepare the Validation Dataset

After evaluating the prediction results of the above "1st pattern", the prediction results of the "2nd pattern" were evaluated as well. For evaluation, it is necessary to prepare a validation dataset. Basically, NN was trained using a training dataset or learning dataset and evaluated using a validation dataset. Therefore, it is important to divide the obtained data into a training dataset and a validation dataset.

Since the number of transactions in which product transaction data is entered differs for each participant, we used the history data of participants with 10 or more transaction records as a learning dataset. However, when the history data of participants is small, the validation dataset cannot be prepared and hence, it was necessary to synthesize a validation dataset. That is, participants with low participation rates had to be trained using a learning dataset and evaluated using a synthetic dataset (i.e., the validation dataset).

3.4.5 Evaluation of NN Model

At the current stage, we used the number of transactions to teach the NN model, and then compare the predicted degree of satisfaction which was generated by the NN model that corresponded with the participant's actual satisfaction as described in his/her transaction comments. In other words, to confirm the predicted satisfaction degrees are coorect values or not, we compare them with the actual degrees of satisfaction and

hence, the "sum of squared deviations" (i.e., the value obtained by squaring the difference between the correct value and the predicted value of the degree of satisfaction) was calculated.

The larger the value of this difference, the greater the deviation between the correct value and the predicted value, indicating that the answer is incorrect. Using the above differences, the average size of the difference (the degree of divergence from the correct value) for the entire data was obtained using Eq 10. Thus, in the current research, *RMSE* (Root Mean Square Error) was calculated.

$$RMSE = \sqrt{\frac{\sum_{i=1}^{N}(x_i - \hat{x}_i)^2}{N}} \qquad (10)$$

On the contrary, it is considered that the smaller the *RMSE* value, the smaller the divergence between the predicted value and the correct value, and the more correct prediction the target model can make. *RMSE* is defined in Eq. 10, where the observed value is x_i ($i = 1, 2, 3, ..., n$) and the calculated value (predicted value) calculated from the model is $\hat{x}_i$.

Table 13: The value of *RMSE* when the satisfaction degree of "Fin Whale" is estimated using "1st pattern"

Type of Transaction	*RMSE*
Products	1.173
Services	1.380

3.4.6 Regenerating NN Model

The second NN pattern was then used to rebuild the NN model using similar training dataset to improve the accuracy of predictions. In order to adjust the accuracy of the model we have to "tune" the values of the parameters of the NN-model. This "tuning" process was performed using *"Grid Search*" which is a method to find the most accurate model by setting a range of values that can be handled (e.g., 0, 1, 2, 3, etc.) for a parameter used for model generation called *α* (alpha).

Specifically, it is a method of executing the process of generating a model by sequentially substituting numerical values in a specific range into *α* and using the most accurate model among those models as the final model.

When performing a "*grid search*" in the Python language, we used a module called *GridSearchCV*. In the following processing, the parameters (setting values used for model generation) for generating the optimum model were obtained. For example, in the case of "fin whale", the value of the parameters necessary to generate the optimum model were obtained, but such values were different for each participant.

Verification with validation dataset was also performed using the newly generated model. Root Mean Square Error (*RMSE*) was used as an index to measure the efficiency of the "*grid search*" algorithm and the value of *RMSE* is shown in the below Table 14.

```
from sklearn.model_selection import GridSearchCV
parameters={
    'activation':['relu', 'logistic'],
    'max_iter':[10000],
    'verbose':[False],
    'random_state':[4],
    'hidden_layer_sizes': [(2), (3), (4), (5)]
}
cv = GridSearchCV(estimator=MLPRegressor(),param_grid=parameters)
```

```
'activation': 'logistic',
'hidden_layer_sizes': 2,
'max_iter': 10000,
'random_state': 4,
'verbose': False
```

Table 14: The value of *RMSE* when the satisfaction degree of "Fin Whale" is estimated using "2nd pattern"

Type of Transaction	*RMSE*
Products	0.722
Services	1.380

4. Discussion

So far, a community currency based monetary system has been proposed to strengthen cooperation between members by repeating non-commercial and commercial transactions among community members, but sometimes the members cannot find the desired products or services.

Consequently, the CC acquired as compensation for non-profit activities stays in the hands of the members and does not circulate in the system. If such a situation occurs frequently, a stagnation problem will arise, and a new mechanism is needed to circulate CC more smoothly and quickly among the members of the community.

Therefore, we proposed a method so that the feasibility and sustainability of the CC as a monetary system can be enhanced by introducing the concept of a "customized community" where commercial and non-commercial transactions can be integrated.

In the current research, all the data was obtained from the C.C.Wallet platform and by analyzing the recorded evaluation message in terms of linguistic expression (i.e. the impression of the users), the degree of satisfaction was estimated by using NN to be used thereafter as a tool to build the "customized community".

A manual dictionary was created by using C.C.Wallet users' messages (evaluation comments) where satisfaction-related words (i.e., impressions) regarding the offered products and services are recorded after completing the transactions in Japanese language. Thus, when new data that did not exist before, it was necessary to update the dictionary.

Moreover, if there are mistype-related mistakes in the evaluation messages recorded by members, it is necessary to manually correct those words before using them in the dictionary (e.g., "pin batch" should be "pin badge"). Thus, as can be noticed, creating this dictionary takes time, but from the viewpoint of privacy protection, we did not use cloud-based services.

To use the NN model as a tool for predicting participant satisfaction, it is necessary to validate the results obtained by deep learning using data that is different from the training dataset. In this way, the obtained data needs to be divided into two sets, a training dataset and a validation dataset. With reference to the obtained data, the users of C.C.Wallet were divided into three groups according to the number of transactions: Group A, Group B, and Group C.

Users in Group A had enough transactions, and we were able to divide the data into training dataset and validation dataset to build an NN model. Users in Group B did not make many transactions as participants in Group A and hence, only validation dataset was synthesized (i.e., not actual data).

On the other hand, Group C was the group of participants whose number of transactions was insufficient to divide into a training dataset and a validation dataset (see Figure 12 for members with a very small number of transactions), and an NN model could not be constructed.

Typically, the NN model does not have a general format or optimal values for the parameter of NN in the intermediate layers (hidden layers). Since the purchasing behavior was related to the number of purchases for the same products/services which differs from one user to another, it is necessary to specify the appropriate NN parameters for each user.

In the current research, the degree of satisfaction of the member was defined in terms of number of purchases of the same products or services as we assume that the member will repeat the purchase process if he or she is satisfied with the offered product or service. Also, such satisfaction was expressed explicitly in the evaluation message in terms of linguistic expression.

Also, the price of the product or service was not considered as an indicator for the degree of satisfaction of the user because buying something cheap does not necessarily mean that he or she

was satisfied with the offered product or service and thus, the price of the product or service was not used as an explanatory variable of the degree of satisfaction in this study.

In this study, some of the validation dataset was synthesized for two reasons. First, there are many transactions where the name of the products and services as well as the member's expression (i.e., impression) were not expressed explicitly in the evaluation messages of the C.C.Wallet platform and such data could not be analyzed. Second, many of the participants were not engaged frequently in the transactions and hence, the number of transactions of those participants was insufficient to be divided into a training dataset and a validation dataset. Thus, we need new methods to attract new members to engage and participate effectively in the community and this task was left for future work.

It is worthy mentioned here that the concept of "customized community" was based on idea of "commonality" among the members of the community and this "commonality" was identified by the estimators in terms of the estimation of the degree of satisfaction of the members of the community, as we stated above in the section of "What is Customized Community?".

In other words, without estimating the degree of satisfaction, we cannot form a customized community with a "commonality". For example, without estimating the degree of satisfaction regarding a particular category of child-related product, we cannot form a customized community with the "commonality" of "child-rearing". Thus, since the real data (i.e., transactions) of C.C.Wallet where the degree of satisfaction could be estimated was relatively small, we showed the efficiency of the "customized community" using a simulation rather than using real data.

Therefore, to be able to configure a "customized community", it is necessary to estimate the degree of satisfaction using sufficient data (i.e., transactions) to find out the "commonality" among the members of the community, Then, those members will be given thereafter a "preference" in terms of bonus premium amount to add to their initial purchase of the CC with money. Considering this, such a kind of "preference" can be considered as a strong incentive not only for the people who are inside a community, but also to induce other people from outside the community to join the community and contribute significantly (i.e., make more transactions).

In this study, the computational time was shortened by reducing the number of intermediate layers of NN model as much as possible.

Also, in this study, we claim that utilizing neural networks and AI-based techniqiues will help promote the use of CC as it will contrubute to protecting the privacy of the partcipants as this reduces the number of people who directly deal with the personal data of people who are in the community. However, on the other hand, applying such techniques in communites where there is little knowledge of neural networks or AI-based techniqiues may not assist us to promote the use of CC because those communities wouldn't know about those techniques and hence some concerns might be arisen accordingly. Also, as we mentioned above, the neural networks could not be used in cases where a small number of transactions are found and hence such cases will limit promoting the use of CC using neural networks or AI-based techniqiues.

5. Conclusions

This study proposed a new method to accelerate the circulation of CC among the members of the community by constructing a "customized community" through estimating the degree of satisfaction of the members based on a NN model.

First, the degree of satisfaction was predicted by the comment text recorded by the member of the community throughout the C.C.Wallet. Specifically, it was executed by creating a word dictionary from the comment sentences entered by the participants after closing the transaction, thereby converting the meaning-based text into numerical values corresponding to the meaning of each word.

The NN model was constructed to estimate the satisfaction degree where the objective variable was derived based on impression-related words after converting those words from linguistic text to numeric values where five levels of numerical values (i.e., 5-stars scale from "5" stars to "1" star) based on their meaning in Japanese was considered.

On the other side, determining the explanatory variables was rather complicated. It was necessary to determine the explanatory variables after considering various hypotheses because explanatory variables were considered as variables that assist us to explain the objective variable (i.e., degree of satisfaction). Therefore, for each member, the number of purchases of the same category of products and services were calculated. Since the high and low prices of products and

services do not necessarily reflect the satisfaction of the participants, the prices of the products and services were not used as explanatory variables in this study.

In the current study, the estimation of satisfaction of the members was considered as a bridge to build a principle of "customized community" where the circulation of the CC was accelerated based on our simulation. Since the purchase behavior was different from one member to another, we needed to tune the values of the parameters of the NN model so we used the "*grid search*" algorithm. However, some members did not have as many transactions as others, and such situations did not allow us to build a NN model for those members. Also, because some members did not have sufficient transactions, we were unable to divide their data into a training dataset and a validation dataset, so we only synthesized the validation dataset for those participants.

Therefore, if the use of CC is expanded by using various other applications that can acquire CC to purchase products at CC malls, actual data can be increased, and more appropriate results can be obtained.

For example, a new health care application called NUCADOCO as shown in Figure 21, was released for participants who are implementing health management.

To increase the number of participants who use CC in their transactions, we don't only need to use other applications like NUCADOCO, but we also need to offer a wider variety of products in the mall.

In this study, the concept of "customized community" was introduced as a tool to attenuate the stagnation problem in local economics. However, since the obtained data was not sufficient, we decided to utilize simulation experiments to indicate the efficiency of this concept in reducing the stagnation problem.

Thus, building a "customized community" using real data to validate its efficiency is needed to be investigated using actual data obtained from empirical experiments and this task was left for future research.

Figure 21 NUCADOCO Application

Compliance with Ethical Standards

1. **Disclosure of potential conflicts of interests**

   This research was performed based on the mutual research collaboration between Global Communication Planning Co. Ltd. and Good Money Lab at Senshu University.

2. **Authors Contributions**

   All authors contributed to the study conception and design. Material preparation, data collection and analysis were performed by Dr. Maen Alaraj. The first draft of the manuscript was written by Dr. Maen Alaraj and Prof. Makoto Nishibe commented on previous versions of the manuscript. All authors read and approved the final manuscript.

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Central Banks and Climate Change Risks: Potential Monetary Prudential Tools

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ABSTRACT: The negative impact analysis of the climate change on the whole economy is particularly relevant for the central banks since they produce and use data before implementing the monetary policy to ensure the financial and prices stability and therefore mitigate the systemic risk in order to participate to build a healthy and resilient financial system. The goal of this paper is to discuss the development of potential sustainable finance policies in accordance with the central bank's tools and propose some key recommendations at least in the short run to partly overcome the analysis lacuna in this field. After having attempted to capture the notion of sustainability and shortly describe the E.S.G (Environment, Social and Governance) criteria, we justify why the central bank needs to develop sustainable financial tools for their potential monetary policies to fight against the climate change, for instance. From this definition attempt, several significant conclusions have emerged such as the harmonized taxonomy unavailability and the lack of reliable data to gauge with accuracy the climate change impacts on the financial and economic sectors, for instance. In addition, the risks related to climate change are likely difficult to evaluate given their complexity and uncertainty natures. However, this data lacuna should not prevent central banks from developing more sustainable tools based on usual and unusual monetary instruments such as capital requirements or green interest rate in taking into consideration the three climate change risks (i.e., transition, physical and liability risks) exposure.

1. Introduction

Several climate reports warned governments about risks to continue to finance real sphere without controlling for the CO2 emissions, for instance. The most important decision was to reduce the high carbon production to limit the climate change and to ensure an optimal ecological transition. Since the COP21, the climate target is to reduce the increase in global temperature by 2100 (below 2°C above pre industrial levels and even further to 1.5°C according to The Paris Climate Agreement, 2016). The Paris Agreement (PA) entered into force on November 4, 2016 and it has been signed by 195 countries. It defines guidelines to achieve the climate targets and it has proposed a calendar. The PA considers that a negative externality, such as pollution is a wheel to the economic growth. The increased interest in sustainable finance translates the international concern about the climate change, loss of biodiversity, social inequalities and various determinants that may undermine the economic resilience as underlined by the recent Covid-19 sanitary crisis. Soon, it is obvious that financial sector could contribute to play an essential role in the development of the economic sustainability.

Remind that during years central banks have saved the financial system by using and defining traditional and non-conventional tools, namely quantitative easing; low (even negative) interest rate policy etc. They have also enlarged their missions after the last financial crisis by guaranteeing the financial stability (Goldman and Zhang, 2021). Given the history and the mission of the central banks during the financial crisis, it may be logical that the central banks tackle the climate change; however, their actions should be completed by public policies, for instance. Despite the numerous debates on the central banks' functions, all converge towards the following conclusion: central banks play their role of regulators (Dikau and Volz, 2021; D'Orazio and Popoyan, 2022) as underlined by Frank Eldernson, member of the executive board of the European Central Bank (ECB), "the ECB's environmental action is fully in line with its mandate". Moreover, the last 2021 IFC report relative to the sustainable data for central banks concludes that central banks have actively participated to improve the relevant sustainable finance statistical framework and therefore underline indirectly the necessity of central banks to partly take up the climate change issues.

This paper starts by examining the concept of sustainability and climate change risks (i.e., transition, physical and liability risks). Soon, we face the difficulty to define the socially responsible finance and therefore to define with accuracy the climate change risks. Given the impact of the climate change on the whole economy and particularly on the prices and financial stability, central banks - as prices and financial stability guarantor - should play a key task in the climate change struggle. The next section is dedicated to analyse the potential tools assumed to promote the sustainability. The last section concludes.

2. Definitions of sustainability and climate change risks: An impossible mission?

The aim of this section is to provide more clarifications on the sustainability concept and climate change risks, especially the transition, liability and the physical risks.

Sustainability

To apprehend the notion of sustainability two approaches are often used: the definition and the taxonomy.

- Definition

Several definitions have emerged since decades and most of them have similar points. As a matter of fact, they all emphasized on the necessity to promote the development of ESG (environment social and governance) criteria as displayed in Table 1. The ESG scores are more and more necessary to inform the public and particularly the financial actors (like asset managers) on the sustainability concept (Ehler et al, 2022).

Table 1 ESG issues

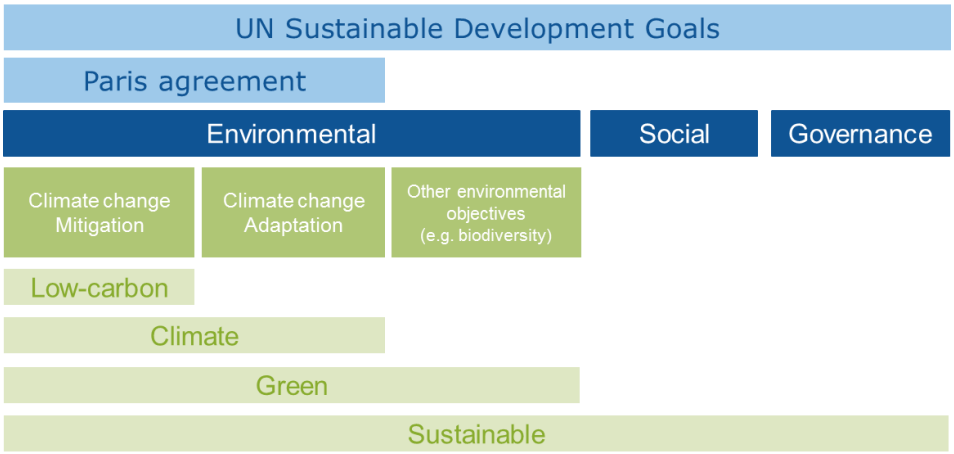
Environment Issues	Social Issues	Governance Issues
Climate change and Carbon emissions	Customer satisfaction	Board composition
Air and water pollution	Data protection and Privacy	Audit committee structure

Biodiversity	Gender and Diversity	Bribery and Corruption
Deforestation	Employee engagement	Executive compensation
Energy efficiency	Community relations	Lobbying
Waste management	Human rights	Political contributions
Water scarcity	Labour standards	Whistleblower schemes

Source: Chartered Financial Analyst (CFA) Institute, Environmental, Social, and Governance Issues in Investing, A Guide for Investment Professionals, 2015, Page 4, Retrieved from: https://www.cfainstitute.org/-/media/documents/article/position-paper/esg-issues-in-investing-a-guide-for-investment-professionals.ashx

Given the high number of ESG components, it may be delicate to invent a unique definition of the sustainability assumed to resume all the characteristics of this concept (Lindenberg, 2014; Gueddoudj, 2022). However, to keep on studying within sustainability framework, the UN taxonomy is often utilised.

Figure 1 EU Taxonomy - Main concepts-



Source: F. Tamburrini, A. Melo, A. Giovaninni, "The EU taxonomy and the European green deal", an internal ECB presentation, January 2020.

The UN Sustainable Development Goals (SDG) have taken into account several items related to the ESG criteria and are assumed to define general guidelines on the notion of sustainability, in addition they have emphasized the climate change issues and their corollaries. Starting from this template, the EU taxonomy is built.

- Taxonomy

Before, exposing the EU taxonomy version, it may be useful to define the general taxonomy function (Table 2).

Table 2 Taxonomy approach

IS	IS NOT
A list of economic activities and relevant criteria	A rating of good or bad companies
Flexible to adapt to different investment styles and strategies	A mandatory list to invest in
Based on latest scientific and industry experience	Making a judgement on the financial performance of an investment – only the environmental performance
Dynamic, responding to changes in technology, science, new activities and data	Inflexible or static

Source: European Commission, Retrieved from: https://ec.europa.eu/info/sites/info/files/business_economy_euro/banking_and_finance/documents/190618-sustainable-finance-teg-report-using-the-taxonomy_en.pdf

Several works have underlined the necessity to develop such classification tools to deal with the sustainability concept (Ehlers et al., 2021; Gueddoudj, 2022). One of the advantages is its flexible nature since the criteria continuously evolve with the environment and the knowledge state. Nevertheless, the taxonomy given its simplicity does not take into account all risks. Moreover, generally it does not cover all economic institutional sectors either.

In line with European Commission (EC) Reports, to be environmentally sustainable, activities have to be in conformity with EC regulation. The EC taxonomy reports different variables related to environment. To be qualified for a "sustainable passport" in accordance with the EC, several conditions are required:

- Intensively participate to the one or more environmental objectives defined by the Proposed Taxonomy Regulation (climate change mitigation; climate change; sustainable use and protection of water and marine resources; transition to a circular economy, waste prevention and recycling; pollution prevention and control; and protection of healthy ecosystems)

- Respect other objectives by avoiding to harm them significantly and to be informed about the technical screening for the notion of Doing No Significant Harm (DNSH)

- Respect the minimum social safeguards (i.e., the eight fundamental International Labour Organization (ILO) conventions).

These points constitute the architecture of the EC taxonomy and provide guidelines to converge towards more sustainable activities. The EC report published in March 2020 shed some light on informative issues. The Technical Expert Group was asked to elaborate recommendations on technical screening criteria for countries. The expert group has hence defined a European flexible taxonomy regulation. The EC instructions consider only activities related to climate change mitigation or adaptation and to the DNSH's notion. In fact, the taxonomy content is based on a questionnaire sent to firms related to climate change; the survey, sent in September 2019, took into account 67 activities. Only 830 responses have been reported and "the vast majority of respondents were based in Europe, and 48% were private individuals, 24% were from the general business sector and 10% were from the financial business sector". (EC Report, March 2020, p.11). It is obvious that the coverage is insufficient. Moreover, the survey is climate change targeted, which is not suitable since the climate change is the tree that hides the forest. Today, the loss of biodiversity is also a great challenge for all countries and may deserve a great attention. It is clear that a more global vision of the environmental damages is more appropriate. The final version of the European commission taxonomy will be available in 2022, however, in the meanwhile several changes appear; recently gas and nuclear sectors are considered as non-polluting since they do not increase the CO2 emissions level. According to Thierry Breton, European Commissioner for the internal market, "Gas is not the best to achieve our goal because you generate some CO2 but at least it's better as a transition than coal … We need to have the right financing in the taxonomy, including nuclear energy." (Financial Times, 01/04/2022).

Given the difficulties to delimit a unique and accurate perimeter for the sustainability, it is clear that the literature on this topic will be flourishing and will provide evolving information. Nevertheless, it will not sure to get consensus on definitions or concepts given the complexity and the geographical aspect of the climate change, for instance.

Despite the lack of definitive and harmonized taxonomy, the risks relative to climate change are already present such as the physical, liability and transition risks.

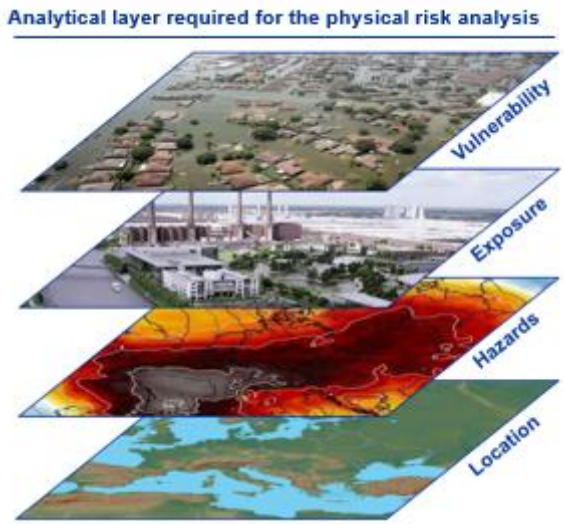
Climate change risks

Starting from the Carney's discourse in 2015 that pointed out three risks: physical risk, transition risk and liability risk, this subsection explores these risks and their difficult measures.

- Physical risk

The physical risk is related to the physical consequences of the climate change on both the short-term and the long-term scopes. The short-term (acute) physical risk refers to the extreme natural catastrophes like floods or earthquakes. The long-term risk is related to the sea-level rise or the rise in temperature. The consequences are at both local level and at world level. The physical risk has direct and indirect consequences on the economic growth and the financial stability. The following paragraph synthetizes the components of the physical risk and the major effects lead by this risk. To fully understand and acutely measure the physical risk, several approaches, and especially the layers approach (cf. Schema 1), are necessary given the complexity of climate risk.

Schema 1. Layers approach



Source: ECB, 2021 Report.

The layers approaches are taken into account several items: Vulnerability (V, degree of severity related to the occurrence probability), Exposure (E, financial lost related to the risk), Hazards (H, probability of frequencies and severity of the natural events), and location (L, city, countries). All these items allow defining and measuring the physical risk. The equation assumed to portray the physical risk (PR) is:

$$PR = V \times E \times H (1)$$

The relationship (1) is calculated within a location framework. However, the huge limit of such approach is the availability of the database and the quality of the available database. Moreover, some questions related to the aggregation algorithm to elaborate synthetic indices have emerged. As already underlined, the location is essential and it may be useful, soon or later, to calculate a global indicator of the physical risk for each country and interconnectivity indicators to evaluate the independence between the countries risk since the climate change is global.

The impacts of the physical risk (PR) affect direct and indirect all economic sectors, and particularly real estate. The PR touches both at micro and macro levels and obviously, it hurts financial and non-financial institutions. The loss calculations are currently available on different national and international institutions (Antofie et al. 2020; ECB/ESRB, 2021).

Concisely, the physical risks cut across all sectors and warrants a comprehensive, coordinated, integrated and sustained response.

- Transition risk

The second type of risks is the transition risk. This latter is more complicated to gauge since it refers to climate change dangers linked to qualitative variables like consumer preferences or reputation. During years, several policies promote the development of more sustainable action aiming for instance to limit pollution. The Paris Agreement has participated to raise awareness about the climate change; hence, changes in the production process consuming lots of energy are currently welcome and more suitable to resolve partially the climate change emergency. Given the nature of the transition risk, the uncertainty is omnipresent and the assessment of such a risk is very delicate. Table 3 displays the main components of the transition risk.

Table 3 Transition risk's components

Risks	Definitions
Technology risk	Technical progress through lower carbon innovations permitting the ecological transition.
Reputation risk	The reputational risk is related to the customers or community perceptions of any institutions (financial and non-financial) assumed to contribute to a lower-carbon economy transition.
Market risk	The impact of climate change on the market is obvious, complex and varied. The market may react to the demand-supply shift for certain commodities because of the impacts of the physical risks.
Policy and legal risk	The implementation of greener policies has created risks since the shift towards green production process for instance is surrounded by uncertainty.

Source: Authors

The main components of the transition risk displayed in Table 3 are all complex to size; the uncertainty prevails given its characteristics. It is manifest that to evaluate with accuracy the potential consequences of the technical process or the promotion of greener policy is quite delicate. The more uncertainty prevails the more difficult is the forecasting impacts exercises (Semieniuk et al., 2021). For such a framework, qualitative variables are required and they are not always optimal. Moreover, some threats depend on the model's parametrisation and some empirical estimations like the consumer preferences.

The impacts of transition risks on the financial stability are undeniable and complex since they are interlinked. In fact, the market risk is likely interconnected to the reputation risk as some goods/services demands would change because of the change in consumer preferences. If the market collapses, the financial stability is in danger because of the interconnection between the market and the banking and insurance systems. The prices stability is also threatened by a shift in consumer preferences; thus, it is suitable that central banks play a key mission in the struggle against the global warming and develop sustainable tools to promote the sustainability as defined by the UN.

- Liability risk

The last risk is the liability risk that is defined as the climate change loss suffered by a third party. This latter could sue the allegedly responsible party and exercise civil remedies. Chart 1 sets out briefly the liability risk and its content.

Chart 1 Liability risk

Source: Prudential Practice Guide, 2021[1]

[1] https://www.apra.gov.au/sites/default/files/2021-11/Final%20Prudential%20Practice%20Guide%20CPG%20229%20Climate%20Change%20Financial%20Risks.pdf

This third risk is currently integrated in the other risks. In practice, the liability risk could be included in the physical risk in case of people who have suffered from floods or earthquakes (or any other physical events) sue the firms responsible of this situation. To avoid any duplicates, only two risks are often cited and analysed in several works.
As strengthened, the climate risk is difficult to fully understand given its nature. The existence of tipping points and non-linearities makes empirical works more complicated and the challenges are to overcome these difficulties (Basel Committee on Banking Supervision, 2021a).

Besides, risks (physical, transition and liability), which are interrelated, have impacts on the financial and prices stability because climate risk drivers are omnipresent in traditional financial risk categories such as credit, market, operational and liquidity risks (Basel Committee on Banking Supervision, 2021b; De Bandt et al., 2021). The next section describes the potential tools assumed to be implemented to guarantee the social welfare (through the financial and prices stability).

3. Potential climate change risks and monetary policy activation

Without radical actions, the planet will experience an increase in temperatures, from +3.7 to +4.8 degrees Celsius by the end of this century. The impacts on earth are obviously dramatic. A rise in temperature has a direct implication in the agricultural sectors and the availability of water (IPCC report, 2022[2]). As early as 2013, the World Bank commissioned work to analyse the potential impacts of a 4 ° C increase in temperature (World Bank reports, 2012 to 2019). The results and conclusions are alarming. In summary, in many cases, extreme heat waves, rising sea levels, more intense storms, droughts and floods will more frequently threaten the world especially the poorest and most vulnerable people. Remind that in 2015, the Governor of the Bank of England delivered a speech entitled “Shattering the Tragedy of the Horizon - Climate Change and Financial Stability”. He echoes Hardin's “Tragedy of the Common” (1968) and highlights the overexploitation of common resources. As already previously exposed, the three types of risks associated with climate change are harmful and hence endanger economies. However, risks, corollaries of those already described, will also emerge. Refugees will no longer be economic or political but climatic. These flows of population will give rise to tensions, unlawful acts and even wars. The supply of water, food, breathable air etc. are likely to be permanent questions that will lead to rationing to manage shortages (of water or food, for example), supposing that these variables are in the government hands. If they are the responsibility of large private companies, violent social conflicts will likely erupt everywhere as well as an explosion of poverty.

To date, climate risks do not yet have found their place in the tools for controlling the formation of imbalances within regulatory bodies. It is clear that risks must be properly analysed to avoid or contain systemic risks (Carney et al, 2019; Guindos, 2021). Climate change threatens financial and economic stability. Recognition of the climate emergency has led to the creation of different EU working groups, analysis centres or workshops. For illustration, the initiative of the Financial Stability Board (FSB) in 2015 is in line with the ESG concerns. The FSB, at the request of the G20, created a task force dedicated to the study of climate change (Task Force on Climate-related Financial Disclosure or TFCD). This group has provided recommendations and information to economic agents, such as investors, insurers, lenders, etc. In 2017, the Network of CBs and Supervisors for Greening the Financial System (NGFS) was created and in April 2019, it released a report that made six recommendations to green the financial system. Four recommendations are geared towards supervisors, and policy makers. They are related, overall, to the integration of green micro- and macro prudential tools in their missions and to the development of a database, harmonized, precise and reliable. Information transparency and data / knowledge sharing are also required to improve the data quality and the cooperation between institutions and countries. Decision-makers should also develop a taxonomy of green activities and actively participate in the publication of reliable public reports on the climate and on the environment, and ensure compliance with climate rules (Alessi et al, 2021). This taxonomy is at an embryonic stage and its current construction is far from meeting the requirements of ecological issues. Today, several efforts are realised to improve the data quality and the data disclosure (NGFS, 2021-2022); nevertheless, there are many obstacles and until now, crucial matters are not resolved.

In December 2019, Christine Lagarde (CL) stressed the need to recognize the importance of climate-related risks. She also detailed three areas (macroeconomic perspective, banks and financial portfolio) in which the ECB should intervene. The ECB should introduce green variables for forecast growth

[2] https://www.ipcc.ch/report/ar6/wg2/downloads/report/IPCC_AR6_WGII_SummaryForPolicymakers.pdf

exercises. It should advise banks on how to compute properly the risks associated with climate change. Stress testing exercises for banks are crucial for financial stability (Budnik, 2021). The ECB should also prioritize green assets in its asset portfolios. On March 18, 2020, CL announced a new Pandemic Emergency Purchase Program (PEPP) following the health crisis that has raged in Europe since the first quarter of 2020. The amount of this operation was 750 billion Euros. On June 4, 2020, the Board of Governors decided to increase the envelope of the pandemic emergency purchasing program (PEPP) by 600 billion euros for a total of 1350 billion euros. In response to the downward revision of inflation linked to the pandemic, the expansion of the PEPP will thus further ease the general stance of monetary policy, supporting financing conditions in the real economy, especially for businesses, and households. Purchases will continue to be made in a flexible manner over time, across asset classes and across jurisdictions. In June 2021, CL has promoted a green and digital recovery[3]. On a regular basis, she pronounces discourses to warn us about the disastrous financial impacts of climate change[4].

All these initiatives have shown that the urgency of climate-related risks is publicly recognized. However, the facts do not illustrate this seriousness. Indeed, there is a kind of ratchet effect. For illustration, we are aware of the ecological risks but CO2 emissions are not reduced drastically. “The dataset (EDGARv5.0_FT) shows that global CO2 emissions of fossil and therefore anthropogenic origin increased by 0.4% in 2016 compared to 2015 and by 1.2% in 2017 compared to 2016 for reach 37.1 Gt of CO2”. There is an indisputable upward trend thus the ecological transition appears to have fallen off the agenda. Only a powerful institution could change the situation and put again economies on the rails of ecological transition, boosting a dynamic that encourages other players in finance. In our opinion, the ECB has an important role to play; it should face up to such a challenge.

The functions of CBs have continuously changed over the years (Ugolini, 2018 and Goldman and Zhang, 2021). Today, with climate change, they must adapt their policies to promote responsible finance. ECB President Christine Lagarde continues to promote environmental protection. Remember that during the 2020 health crisis, the ECB intervened to support European economies. It proposed a 750-billion-euro emergency purchase program (PEPP) to reduce borrowing costs and expand lending in the euro area. This shows that over the years, the CBs have actively participated in avoiding a global economic crisis. Therefore, central banks have the power to promote sustainable policy at both macro and micro-prudential levels to combat climate change (Pfister and Vallat, 2021).

Moreover, the role of CBs in sustainable growth is compatible with their primary mission, which is price stability and later financial stability (because of the financial crisis related to the US subprimes). Besides, Dikau and Volz (2019) have analysed 133 central banks. Only 12% of central banks explicitly report in their missions the support of socially responsible activities ("sustainable economic growth / sustainable growth / sustainable contribution to economic growth / sustainable economic growth / balanced and sustainable economic development / achieving and sustainable growth"). This indicates that many central banks will need to better define their legal framework to implement sustainable policies in the near future.

From a prudential point of view (micro and macro), variables such as liquidity, capital, reserves and loan thresholds are emphasized. Note that Crockett (2000) and Borio (2003, 2006) made a precise distinction between macro-and micro-prudential approaches. The macro prudential tools are integrated into the requirements of the Basel texts (I, II, III).

The objective of what follows is to show how CBs could contribute to moving from a traditional financial system to another system that would respect Objective 2 as specified by the Paris Agreement. However, the success of environmental policies would require a fundamental questioning of the Basel recommendations.

Climate change creates both risk and uncertainty and therefore makes the financial system vulnerable. Uncertainty is the root of instability and particularly the financial instability (Minsky, 1998; Phan et al, 2021; Danisman and Tarazi, 2022). The "Minsky moment" is when the financial world changes from optimism to pessimism. According to Jeffers and Plihon (2019, 2020), climate risks could lead to a Minsky moment to a systemic crisis.

3 https://www.ecb.europa.eu/press/key/date/2021/html/ecb.sp210629~e6458f8392.en.html
4 https://www.ecb.europa.eu/press/key/speaker/pres/html/index.en.html

The instruments of monetary policy (convention or not) are plural (Goldman and Marinova, 2022). We start by presenting, the interest rate tool.

Numerous theoretical and empirical papers have attempted to explore how the interest rate should optimally orient financial flows towards sustainable sectors (Mésonnier et al. 2017; Kempf 2017; Muller, 2019; Chavez et al, 2021). In line with these works, it may be suitable to set an ecological interest rate because climate change has negative impacts on the natural interest rate and economic growth. Nevertheless, the current level of the interest rate is fundamental for the policy success; if the present interest rate is close to 0, the policy will not have the expected results.

This adjustment variable should take into account the externalities produced by greenhouse gas emissions (GHS). This instrument should be lower when the project is sustainable and higher in the case of brown projects. The sustainable interest rate is a useful tool in a context of "rate normality". It is therefore not certain that its implementation will be feasible in an environment of low (or even negative) interest rates. Indeed, this climate-friendly policy is not suitable in the case of an unconventional monetary policy (negative rates) since, most often; a CB uses it because the interest rate instrument is no longer effective. Some papers have attempted to demonstrate that during a long period of low (even negative) interest rates, QE has failed to relaunch the economic growth due to "headwinds" that would typically arise in the wake of recessions and effects of non-linearity of interest rates. A part of the financial literature deals with the question of whether the transmission is different when the rates are low. The effectiveness of monetary policy can vary across different phases of a recession. In the initial phase, expansionary monetary policy can be very effective in countering uncertainty and the risks of an economic collapse. After this first phase, the conditions of opposing supply and demand reduce the stimuli and these headwinds inherited from the past (uncontrolled expansion of credit, increase in the prices of financial assets, reckless risk-taking by agents, etc.) counteract the effects, beneficial policy actions (Borio 2014a, 2014b). The debt accumulated during good times and the loss of the gross domestic product make repayment difficult –even impossible- since the future revenues of the time were overestimated by economic agents. The financial sectors, in particular banking, tend to reduce their credit offers in order to protect themselves despite the interventions of regulators. Uncertainty is pervasive and threatens the economic equilibrium. In such environment, when the interest rate is close to its floor limit (i.e., Effective Lower Bound (ELB)), this has costly effects on the financial stability (Borio and Hofmann, 2017; Borio and Zabai, 2018; Goldman, 2021). Lhuissier et al. (2020) found, by using Structural Vector Auto-Regression (SVAR) modelling, that in some cases, monetary policy could have a positive impact on growth even during periods when the interest rate is close to from 0. A Midas-VAR model provides similar conclusions (Goldman et al., 2021).

Overall, macro-prudential instruments are based on reserves, capital, credit control and liquidity. For this latter, several tools are defined in the Basel III requirements: the Liquidity Coverage Ratio (LCR) and the Net Stable Funding Ratio (NSFR). The LCR is supposed to provide information on short-term liquidity while the NSFR takes into account the long-term outlook. These two ratios should be modified to develop sustainable activities because, as they are currently calculated, they penalize long-term projects and favour short-term investments. Socially responsible activities require long-term investments and therefore lower liquidity ratios are necessary (European Banking Federation, 2018; Barmes and Livingstone, 2022). For credit, priority should be given to sustainable projects. A classification of credits linked to ceilings according to priorities should be established (Fry, 1995; Volz, 2017). Support of environmental credits to the detriment of brown credits should be an obligation for financial institutions (Fry 1995; Schoenmaker et al., 2015; Schoenmaker and Van Tilberg, 2016). Capital Ratio (CR) requirements should also be reviewed on the basis of sustainable activities since CRs encourage brown activities because of their short-term scope. The risk-weighted assets needed to calculate CR should introduce climate risks. In addition, differentiated reserve requirements (DRE) in favour of banks that finance sustainable projects should be put in application (Volz 2017; Jeffers and Plihon, 2019 and 2020; Goldman and Marinova, 2022). Finally, it is quite possible to green the countercyclical capital buffer (CCB) by introducing counter-cyclical capital buffers in times of excessive non-ecological credits, for example. Thus, banks will be more resilient during phases of cyclical downturns and more sensitive to environmental requirements. Remember that the CCB rate is based on the difference in bank credit granted to households and non-financial companies compared to the gross domestic product (Basel definition), a questionable variable as mainly discussed by experts, this variable excludes parallel production, ESG concerns, leisure time, and the household production.

Furthermore, all of these adjustment tools can promote a sustainable transition if they are calibrated optimally and if they use reliable databases. However, we need more qualitative statistics, studies and

hindsight to appraise correctly the impacts of green tools on economic growth and financial stability. It is therefore pressing to develop metrics and stress tests including the risks climatic at the earliest.

Regarding the micro-prudential perspective, according to Dikau and Volz (2018), regulators should propose regulatory standards geared towards sustainable activities, provide strict disclosure rules and define an unambiguous legal framework to protect consumers (depositors and investors).

With regard to unconventional monetary policy, namely Quantitative Easing (QE), it may be interesting to implement a program of buying "green" debt to promote sustainable sectors and stop to finance brown activities. In the debate on the greening of the financial system (cf. the work of the NGFS) and the promotion of climate-related financial publications (cf. the studies of the TCFD), increasing attention is being paid to Quantitative Easing via its Corporate Sector Purchase Program. (CSPP). Various articles have sought to identify the sectors supported by the CSPP. They conclude that there is discrimination between polluting and non-polluting sectors. Buy-back policies create distortions in favour of carbon-intensive sectors (Matikainnen et al. 2017; Monnin 2018; Schoenmaker and Schramade 2019). In addition, the work of Battiston and Monasterolo (2019) based on 1557 securities issued by 282 companies concluded that more than 60% of the shares purchased financed brown companies (production and distribution of fossil fuels, automotive sectors, production of electricity). The same paper also found that the Bundesbank and Banca d´Italia are the most exposed to automotive companies and other CO2 emitters. These findings should be taken into account in the next round of the ECB's private debt purchases.

Nowadays, it is essential to determine what can really be expected, in the very short term, from this type of green macro-prudential tool.

It should therefore be stressed from the outset that the green instruments as proposed appear insufficient and certainly doomed to failure. A complete overhaul would be the solution most in line with the climate objectives of COP21. The approach should be both quantitative and qualitative, although this represents an additional difficulty in accurately capturing the nature of the non-quantifiable variables. A return to planning in the noble sense of the term should be a prerequisite. Economic players should be forced to focus their projects on the long term even if the accuracy of forecasts would be tricky.

Before discussing the methodology for promoting green finance, the following issue should be dealt: why the macro-prudential instruments described above are not efficient or even dangerous with regard to the loss of time and credibility of regulators.

The capital requirements are represented by ratios defined in the framework of Basel II and III (Pillar 1). The current versions of capital constraints raise strong reactions. The unfounded nature of the weights supposed to quantify the creditworthiness of loans is often questionable. A total opacity of the calculations linked to the weighting coefficients reigns. Besides, they are often the result of heavy statistical programs incomprehensible and unverifiable by auditors / regulators. The development of artificial intelligence and big data will bring more complexity and make verifications difficult. Good regulation requires good supervision. Today, the regulatory body has no supervisory organ able of deciphering all business plans. Such a mission requires titanic logistical resources. It would therefore be useful to impose business plans defined by supervisors on financial entities.

The counter-cyclical buffer is not to be outdone. Many limits invalidate this cyclical tool based on the credit-to-GDP[5] ratio gap. The choice of this variable is closely linked to the works of Drehmann et al. (2010, 2011, 2013, 2014), who developed the argument according to which the credit reported to the GDP would be the most adequate indicator to predict financial crises (leading indicator of crisis). Credit is broadly defined, ranging from resident bank credit to all other sources of credit, regardless of country of origin and type of lender. It is quite surprising to put a simple report on a pedestal to evaluate such a complex and evolving concept, like the financial cycle. Activation of the cushion is based solely on this ratio. The approach is strictly univariate. It is obvious that this quotient is not able to optimally capture the financial cycle. This latter is a plural concept and difficult to model. It is clear that the credit / GDP, as defined by the Basel accords, is insufficient to reproduce the phases of the financial cycle. In addition, as already noticed, the current GDP is not sustainable. The negative impact of pollution on economies is *de facto* excluded. Finally, it is quite surprising to consider this variable as a reliable leading indicator of crisis when it does not take into account in its calculation the

5 Gross domestic product (GDP)

expected variables based on surveys (the business climate and consumer confidence). Beyond the limits linked to the variables, it is possible to highlight the problems inherent in the very choice of the filter and its calibration. Indeed, the gap is calculated using a unilateral HP filter (Hodrick-Prescott (HP) filter). This metrics is not without drawbacks in measuring the credit to GDP gap. The estimation is founded on the observed Credit-to-GDP gap and its trend, but it totally excludes credit factors. The structural approach is completely overlooked. The technical limits of the HP filter have been sufficiently described by the empirical literature (Kaiser and Maravall, 2001). There is no question here of exposing them all. We only highlight the choice of the smoothing parameter, which is not unanimous among statisticians. This constant, estimated at 400,000, is unlikely to be adaptable to all European financial cycles. The pioneering work of Hodrick and Prescott showed a coefficient of 1600 for quarterly time series. Logically, a higher value smoothes the time series more. Thus, the duration of the cycle is artificially longer and it almost impossible to detect structural changes (Detken et al., 2014; Dell'Ariccia et al. 2012 and 2019). It would therefore be more appropriate to determine the value of this parameter endogenously in order to respect the properties of the time series. In general, there is little chance of obtaining congruent results when one imposes upstream (and sometimes downstream) parametric constraints on the selected time series characterizing a phenomenon. In addition, in practice, financial cycles are not always of long (or identical) durations and imposing such assumptions may be ineffective or even dangerous for some countries. At last, the HP filter is sensitive to the number of observations. In view of all these criticisms, it is time to revisit this macro-prudential instrument flagship supposed to prevent economies from a systemic crisis (Geršl and Seidler, 2011; Bendoratyte and Kaupelyte, 2013; Wezel, 2019; Chavey et al, 2021; Gueddoudj, 2022).

Hence, it is major to rethink the foundations of the economic framework to annihilate the spectre of ecological crises and their disastrous consequences. The green tools listed below have already demonstrated a great weakness in their potential uses and efficiencies. Actually, they simply exclude ecological variables while it would be useful to back some instruments to ecological variables. In order to have a clear vision of environmental priorities, it would therefore be desirable to implicate scientists who will determine the variables to be monitored and the sectors to be favoured in order to define an imminent ecological risk by using a synthetic and/or a sectoral indicator. To date, regulators obtain information via scientific reports. Presently, it is rare for specialists in earth and in life sciences to participate in the creation of dashboards (dashboards or monitoring panels) or heat maps (maps of heat) relative to macro-prudential subjects. Anticipating natural disasters (including the emergence of viruses) is a cornerstone of financial stability policies.

One of chief tasks of CBs is to monitor the formation of imbalances, mitigate or even eliminate risks and manage crises. In principle, monitoring activity makes it possible to plan and anticipate the policies to be implemented. The European Systemic Risk Board (ESRB) is in the process of putting together a dashboard including green variables. However, its June 2020 report introduced an indicator called systemic risk linked to the COVID-19 pandemic. It highlights the probabilities of default in the productive and financial sphere and the negative effects of the virus on the economy as a whole. On the other hand, there are still no ecological variables, such as changes in temperature, the carbon footprint, the propensity for extreme climatic events, degradation of health, or even the loss of biodiversity, etc. The focus is on the health of banks, markets, insurance companies etc. and rarely on the health of the earth and its hosts as a factor of growth. Human disease is a cost for our societies and global warming is already having an international negative impact. Ecological data is essential for regulators, but it is underestimated or even ignored when it comes to determining alert thresholds that will or will not activate the CCB, for example. An ESRB report, entitled *Positively Green: Measuring the Risks of Climate Change on Financial Stability* in June 2020, outlines the main drawbacks for studying this type of issue. It underlines the difficulty of obtaining quality and harmonized green databases ("climate change reporting by banks and firms alike remains patchy"). However, it is also important to take into account the uncertainty surrounding these issues.

From the 1970's onwards, the process of undertaking the building of a dashboard was the fruit of the work of the OECD. In 1974, a set of environmental indicators was created. Currently, these variables are not sufficiently crossed with macroeconomic variables. Since 2021, the NGFS has proposed a dashboard oriented towards the impact of the climate change on the financial system, which is one of the drawbacks (NGFS, 2021).

In addition, diverse interrogations have emerged during the recent period; the most salient one is the following: are the current macro-financial variables selected by the supervisory bodies still relevant?

It may be more rational to implement macro-prudential tools, based on a heat map describing the various degrees of environmental risk. The table below summarizes the conditions for activating or not the macro-prudential tools. This is only a rudimentary illustration of considering ecological variables as a leading indicator in activating green instruments. For simplicity, we will assume that a healthy (poor) economy is characterized by high (low) GDP growth and low (high) unemployment. Several scenarios are considered since the ecological and the economic context dictates CB policies.

Table-4- climate change risks and prudential policies activation

				Synthetic ecological risks		
Financial cycle and Main macro-economic variables monitoring (GDP, inflation, unemploy-ment etc.)	Expansion Phase of the financial cycle	Healthy economy		Preventive sustainable policy	Sustainable policy	Sustainable policy
		Non-healthy economy		Policies aiming to promote growth and unemployment	Sustainable policy	Sustainable policy
	Recession Phase of the financial cycle	Healthy Economy	Without crisis	Preventive sustainable policy	Sustainable policy	Sustainable policy
		Non-healthy economy		Policies aiming to promote growth and unemployment	Sustainable policy + Policies aiming to promote growth and unemploy-ment	Sustainable policy
		Healthy economy	With crisis	Preventive sustainable policy	Sustainable policy	Sustainable policy
		Non-healthy economy		Policies aiming to promote growth and unemployment	Sustainable policy + Policies aiming to promote growth and unemploy-ment	Sustainable policy + Policies aiming to promote growth and unemployme nt

Source: Authors. Notes: Shaded boxes indicate that these situations no longer exist. The green, orange and red rectangles represent low, medium, and high risk, respectively.

The definition of ecological risks should be the result of an estimated exercise emanating from close collaboration between economists and scientists (biologists, physicists, engineering scientists etc.). Given their areas of expertise, they would be able to accurately estimate areas of environmental risk. Scientists select the variables and order them according to the imminence and dramatic consequences of the hazard. The definition of alert thresholds thus makes it possible to better gauge the intensity of the economic impacts and to select the instruments to be activated. The thresholds condition the policies to be implemented. Once reliable database available, the use of artificial

intelligence such as machine learning is highly recommended, since it deals with outstanding database, also called big data.

Regulators in cooperation with scientific experts will develop scenarios and policy actions. The assessment of the different risks (transition (TR), physical (PR) and liability (LR)) is essential. The diagram below is intended to illustrate the selection of thresholds (green, orange, red). The latter is plural. Also, we will only expose the reasoning without specifying the *n* states of nature. Only three states are introduced (E1, E2, and E3) associated with three probabilities ($p_{Ei}; i = 1,2,3.$). The risks are weighted by coefficients which may change over time. The synthetic ecological risk depends both on the state of the planet and on the three risks exposed by the governor of the BoE (whose conditional probabilities are ($p_{Rj/Ei}; i = 1,2,3\ et\ j = T,P,R$. In order not to overload the diagram, three simple cases are reported. To simplify more, we will suppose that one of the risks materialized by traditional colours (green=low danger, orange= medium, red=high) will condition synthetic ecological risk.

Table -4- Sample of risk thresholds according to States (E1, E2, and E3)[6]

		Individual risk according to Ei	Synthetic risk threshold according to Ei
$E1$	TR	$p_{TR/E1}$	
	PR	$p_{PR/E1}$	
	LR	$p_{LR/E1}$	
$E2$	TR	$p_{TR/E2}$	
	PR	$p_{PR/E2}$	
	LR	$p_{LR/E2}$	
$E3$	TR	$p_{TR/E3}$	
	PR	$p_{PR/E3}$	
	LR	$p_{LR/E3}$	

Source: Authors

The table above is a potential approach / methodology to be adopted to improve future green tools and their hypothetic implementation. The assumptions made are deliberately simple. Several more subtle scenarios and thresholds can be introduced. In addition, the rules relating to the definition of alert thresholds require special attention. It is useful to remember that the exercise is complex, as mentioned in previous developments. Besides, there is no consensus on the definitions; the methodologies for measuring them are almost embryonic (or even non-existent). Indicators are lacking and those that exist are too heterogeneous (which prevents comparisons). The very apprehension of the three risks remains thorny given their multifactorial nature and the degree of uncertainty surrounding them (Harrington, et al. 2021). One example is the transition risk, which encompasses various risks ranging from legal risk to technological risk, including reputational risk. It is therefore not easy to define an indicator reflecting such a variety of risks, especially since some variables -few in number- are qualitative. The quantitative approach is favoured to the detriment of the qualitative methodology, although the latter are complementary. This could hamper the proper assessment of risks and their impact on the economy. The risks (TR, PR and LR) are intrinsically linked and evolving, therefore difficult to predict. To date, these risks are poorly understood, although they are not new and it is impossible to obtain quality time series for these risks (BIS Report, 2021)[7].

All these constraints should not be an obstacle to the implementation of green policies, on the contrary. On the other hand, it will be necessary to implement a set of steps based on a prioritization of short-, medium and long-term objectives to deal with the climate change issues.

CBs have a significant arsenal to fight against ecological risks and their negative economic and social repercussions, as well as statistical resources whose quality could be improved as underlined earlier. However, they should not be the only ones to engage in this fight. Its interventions must be accompanied by fiscal and budgetary measures. The battle against climate change is global and it must be orderly, rational and efficient to avoid any disruption.

6 Given the climate risks data gap, it is not suitable to propose a quantitative analysis. Some probabilities calculations are under progress and confidential (Expert Group Climate Change Statistics, ECB)

[7] Climate-related financial risks – measurement methodologies, BIS, April 2021.

Furthermore, there is a huge gap between the facts in favour of the ecological transition and the actions aligned with the objectives of climate change. The final timetables for moving towards a goal of minimal or no pollution have still not been studied or even addressed. The main cause of this misalignment, which represents a systemic risk, is a lack of harmonized definition / taxonomy and a kind of lethargy due to the long-term horizon. Moreover, most European work such as that of the European Commission (EC) sets out guidelines, proposals and recommendations, but no coercive measures. Given the climate emergency, the EC should apply favourable weights to green projects by implementing Article 459 of the Capital Requirements Regulation (CRR) before including them in Articles 128 and 501 of CRR2 (Philiponnat, 2020; European Banking Authority, 2021).

Finally, we have to bear in mind that the lack of reliable data (or data gap) on climate-related financial risks represents a challenge to the application of any prudential policy (FSB, 2021; Elderson, 2021).

4. Conclusion

Climate change raises fundamental questions relative to financial and economic stabilities. This point is the roots for the justification to intervene in the climate change policy management. Starting from this scope, it is obvious that CBs should actively participate in the promotion of ecological transition (Batten, 2018; Volz 2017; D'Orazio and Popoyan, 2018-2021; Matikainen et al. 2017; Jourdon and Kalinowski, 2019; Dikau and Volz 2019, Bolton et al. 2020; Goldman and Zhang, 2021; Goldman and Marinova, 2022; D'Orazio, 2022). The global warming caused by the greenhouse gas emissions (GHS) raises the question of the planet sustainability and economic growth because all sectors are struck by the full force of unexpected and violent events with devastating and sometime irremediable consequences. As already underlined, with the climate change gravity, three risks have emerged (physical, transition and liability risks) and nowadays these risks are costly and become more and more frequent. This means that central banks actions should be both preventive and curative. However, they should not be alone in finding concrete and optimal solutions to climate emergencies. Soon or later, fiscal policies should also support the actions of monetary supervisors. Monetary and fiscal policies, which are complementary, should be coordinated to limit and/or avoid negative externalities created by pollution for instance. The COVID-19 pandemic and the brutal economic crisis that hit all economies hard, while they had not yet recovered from the last financial crisis in 2008, are signals that bear witness to the ecological emergency. Various scientific studies show that the damage inflicted on the planet has given rise to new epidemics. Researchers also warn about the risks of thawing linked to global warming or commonly called permafrost, which is a Pandora's Box. For hundreds of thousands of years, permafrost has harboured bacteria or viruses that we do not know what will look like when released into the air. This argument is debated, but it should not be ignored. The most vulnerable countries will once again be the first victims of the economic drifts linked to a frantic search for short-term profit. These apocalyptic prospects reinforce the idea of coherent and equitable international cooperation.

Lastly, it should be noted that all of the central bank's tools aimed at combating global warming could only be effective if they are optimally calibrated and timely run, thus the existence of qualitative database is an essential requirement.

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The Emergence of Digital Socio-Municipal Currencies: An institutional change perspective of the Arariboia coin's case

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Abstract

Cash transfer policies have become an important instrument for poverty alleviation and combating the effects of crises. Among many recent initiatives, digital community currencies are promising tools to operationalize these programs by municipalities. This paper investigates if there was an institutional change in cash transfer public polices with the adoption of a digital community currency issued by the municipality of Niterói, Rio de Janeiro, a recent phenomenon that we call "digital socio-municipal currency". We drew on process tracing methodology combined with a theoretical lens of the theory of gradual institutional change. Our preliminary analysis indicates a gradual change in cash transfer policies and the central role of E-Dinheiro Institute.

1. INTRODUCTION

The objective of this paper is to investigate if the emergence of Digital Socio-Municipal Currencies (DSMC) in Brazil triggered an institutional change in cash transfer public polices with, and if so, to understand the process by which this happened. For this, we studied the case of the cash transfer program carried out by the city of Niterói, in the State of Rio de Janeiro.. The municipality create their own bank and implemented the Arariboia coin, a digital community currency used to operationalized the payments of municipal cash transfer program for 30 thousand families.

Community currencies (CC) are generally designed and operated by grassroots movements and marginalized citizens without the intervention of government-based institutions (New Economics Foundation, 2015). The case of Niterói is unique for two reasons: the city created the currency, the bank and the fund that transfers income to the population through a municipal law and sought support from a grassroot organization (E-dinheiro Institute), sharing the same technological architecture with other 70 community banks, that is, financial organization(Instituto E-Dinheiro, 2021).

CC aims to strengthen local economies, create work and foster solidarity among its citizens-users. Over time, they had become an important instrument to bear big social problems and foster local resilience (Lietaer & Dunne 2015), especially during Covid-19 pandemic (Kuk et al., 2021). At the same time, the socio-economic crise caused by Covid-19 renewed the debate over public policies for addressing poverty and vulnerability (Wispeleare & Morales, 2021).

During this specific period, the Brazilian federal government implemented an Emergency Basic Income Transfers (EBI) program, which achieved more than 66 million people with

payments total of over USD 53 billion (R$ 280 billion) (Cepal, 2021). However, the EBI faced logistical challenges to reach the most need in a timely and safety way (Gonzalez et al. 2020). As a result, the EBI distribution process did not reach all those who needed the resources in time.

Against this backdrop, the case of another CC in Brazil, Mumbuca, is a successful example of EBI implemented by subnational entities. Mumbuca was the first Digital Community Currency (DCC) launched in the country and is widely studied by researchers (e.g., Faria et. al, 2020). Here, by DCC we mean complementary money that serve to specific or predefined communities and are designed, issued and used by local actors (e.g., citizens, non-profit organizations, companies) to complement the national monetary system (Meyer & Hudon, 2019) and operated through information technologies as a means to facilitatedtheir circulation in the territory (Diniz et al., 2019). Mumbuca was launched in 2013 as a tool to distribute the basic income program of the Maricá, in the State of Rio de Janeiro. In 2020, Maricá program was expanded to face pandemic effects and become an international reference for EBI implementation (Gonzalez e al. 2020).

The achievements of Mumbuca and the need for basic income during Covid-19 pandemic inspired other municipalities to create their own CC as a countercyclical policy. Currently, according to Instituto E-Dinheiro (2022), beyond Maricá, three municipalities are operating DCC public policies (Itaborai, Cabo Frio and Niterói), and three more are in implementation (Diniz & Melo, 2022).

This movement gave rise to a new phenomenon in the CC field. The DCCs operated by municipalities are hybrid currencies working in different arrangements that involve interrelations among the community, non-governmental organizations, digital payment operators, and subnational entities. Different from conventional DCCs, municipal laws establish these new types of currencies for operationalizing the payment of social benefits and basic income programs. We call this phenomenon "digital socio-municipal currencies" (DSMC).

The emergence of DSMC points to a new chapter in the history of CC and seems to indicate an institutional change in Brazil's public policies on cash transfers and basic income programs. Our research draws on a deep analysis of the Arariboia coin, one of the most prominent cases of DSMC, to answer the following question: does the emergence of DSMC represent an institutional change in Brazil's model of cash transfer and basic income public policies? If yes, how did such a change take place? We applied the process tracing methodology to answer this question and followed Mahoney and Thelen's Theory of Gradual Institutional Change (2006).

2. CASH TRANSFER PROGRAMS AND THE ROLE OF CCs

Scholars highlight that minority groups and places with vulnerable populations may benefit most from cash transfer policies (Neves et al., 2020; Palmeira et al., 2020). Different forms of cash transfer programs (CTP) have been adopted around the world as central components of social policies addressing poverty and vulnerability (Forget et al., 2013). By the end of 2000s, an estimated 190 million householders, with approximately

860 million people, was reached by social assistance programs in more than 60 countries (Barrientos & Niño-Zarazúa, 2011).

Among many modalities of cash transfer, conditional cash transfer was one of the most usual. In Brazil, it was popularized by the success of Bolsa Família (BF) (Levasseur et al., 2018; Neves et al., 2022). In the conditional cash transfer, the beneficiary needs to satisfy conditions imposed by the policy, such as the need for regular medical checkups (Levasseur et al., 2018). Another modality is the unconditional one, when there is no counterpart or conditions to receive the benefit (Levasseur et al., 2018). The last modality has received growing attention in recent years. The Universal Basic Income (UBI), a periodic cash payment to all residents in a jurisdiction without obligation (Lee, 2021) has been broadly discussed in the global political arena, and it has received a soaring endorsement from the general public (De Wispelaere & Haagh, 2019).

Most of papers drawn on the implications of the CTP (e.g., Levasseur et al., 2018; Sun et al., 2021; Neves et al., 2020; Johnson et al., 2022; Martínez Franzoni & González Hidalgo, 2021). Some investigate the public attitude towards the cash transfer implementation (Lee, 2021; Rincon, 2021; De Wispelaere & Haagh, 2019); Nevertheless, other authors the criticizes the naïve adoption of CTP as effective tool for poverty alleviation risk, which might oversimplify a complex social problem and reduce the transformative potential of cash transfer (e..g., Fouksman & Klein, 2019).

However, despite its recent popularity, little attention has been paid to the distribution channels of cash transfer. Gozalez et al. (2020) is an exception. With the expansion of CTP, governments have sought to increase the use of electronic means for CTP to improve the efficiency of distribution channels (Chiapa & Prina, 2017). The socio-economic crisis caused by the Covid-19 pandemic drove governments to implement emergency financial aid programs for individuals and companies, especially the low-income population and small and micro-enterprises. Among many initiatives, EBI was implemented by diverse governments as a tool to timely avoid financial insecurity during the pandemic (De Wispelare & Morales, 2021).

Brazil is one of the countries that have implemented EBI. By the end of 2020, Brazil's Covid-19 emergency assistance program reached 66 million people with payments total of 280 billion Brazilian reais, nearly 4% of Brazil's GDP (Cepal, 2021). Potential beneficiaries, however, faced problems registering in a mobile app created by a federal bank. This was the only way to receive the EBI for those who were not pre-registered in other social assistance services of the Brazilian government and had their name in the Cadastro Único (CadÚnico), a national database with all beneficiaries of Federal social policies (Gonzalez et al., 2020). In this context, municipalities that already had their CTP strengthened the policies, and others that did not begin to adopt them, following the CC model.

In addition to the transactional aspect of the currency, its development and use also strengthen territorial and social bonds based on mutual trust between those with a common currency (Souza, 2018). The phenomenon of CC is not something new. There have been cases recorded over the last few decades, especially in Europe, Brazil, and Argentina (Lietaer & Dunne, 2015). However, scholars have pointed out that CC

experiences remain generally small and marginal (Seyfang & Longhurst, 2013), struggling to become sustainable over time (Hudon & Meyer, 2021).

Authors who study CC point out that they can be used to face the effects of crises (Diniz et al., 2019; Gonzalez et al., 2020; Janisch & Stapleton, 2021; Martín Belmonte et al., 2021; Reppas & Muschert, 2019), as in the case of the Covid-19 (Gonzalez et al., 2020; Jacob & Boyd, 2020). However, there are differences in CC models, and there is literature that seeks to map these currencies, proposing typologies, frameworks, and classifications (Blanc, 2017; Diniz et al., 2019; Diniz et al., 2021). Finally, a considerable number of authors argue that some of these can also be seen from the perspective of post-developmental currents (Barinaga, 2020; Gómez & Prado, 2020; Huttunen & Joutsenvirta, 2019; Siqueira et al., 2020).

These works highlight the importance of involving the local community throughout the CC process (Giménez & Tamajón, 2019; Gonzalez et al., 2020; Huttunen & Joutsenvirta, 2019; Siqueira et al., 2020). There are, however, no references to the active participation of subnational entities in constructing currencies as public policies. In this scenario, this article aims to fill this gap by analyzing the case of Niterói. With this, we empirically contribute to the comprehension of the new and yet understudied DSMC phenomenon . Also, we contribute with the cash transfer public policy literature, by inquiring the institutional change triggered in such policy by the emergence of DSMC.l

3. THEORY OF GRADUAL INSTITUTIONAL CHANGE

To answer our research question, we used the Theory of Gradual Institutional Change (TGIC) (Mahoney & Thelen, 2010). From TGIC perspective, institutions can change by gradual and subtly internal intervention. Not only radical and disruptive events cause institutional changes, but ongoing incremental changes from inside also lead to transformative change in institutions (Mahoney & Thelen, 2009).

TGIC conceptualizes institutions as distributional instruments of power. In this regard, institutions are not monolithic and static blocks of social norms but represent different and divergent groups' ideas altogether (Mahoney & Thelen, 2009). Thus, the institutional change becomes the unexpected result of different desires and visions converging. Therefore, institutions would be ambiguous and formed by an intrinsic relationship between change and stability (Mahoney & Thelen, 2009). Mahoney and Thelen (2009) devise four types of institutional changes, as summarized next.

- **Displacement:** When change is achieved by removing existing rules and introducing new ones. In other words, the old institution is replaced by a new one;
- **Layering:** When change introduces new rules on top of or alongside existing ones;
- **Drift:** When environmental changes impact the existing rules;
- **Conversion:** When there is amended enactment of existing rules due to their strategic redistribution

Mahoney and Thelen (2009) argues that each type of institutional change is intertwined with the characteristics of its political context and institution aspects. The TGIC classify

the political context regarding its possibility to afford institutional actors with strong or weak veto possibilities. The institution characteristics is classified according to its capacity afford actors opportunities for exercising discretion in interpretation or enforcement. The combination of political context and institution characteristics enable the action of four type of change-actors, each one characteristic of one type of institutional change (see figure 1).

		Characteristics of the Targeted Institution	
		Low Level of Discretion in Interpretation/ Enforcement	High Level of Discretion in Interpretation/ Enforcement
Characteristics of the Political Context	Strong Veto Possibilities	Subversives (layering)	Parasitic Symbionts (drift)
	Weak Veto Possibilities	Insurrectionaries (Displacement)	Opportunists (Conversion)

(Figure 1: Types of Gradual Institutional Change, from Mahoney and Thelen (2019))

Insurrectionary can arise in any scenario but are more likely to flourish in environments characterized by low discretion and weak veto possibilities. They do not seek to preserve the institution and does not follow the institutional rules. *Symbionts* (parasites) thrive in environments characterized by strong veto possibilities and high enforcement discretion. They rely on institutions but undermine the institutional rule from inside out. *Subversives* thrive in contexts where there are strong veto possibilities and few rule interpretations. O*pportunists* tend to thrive in environments with much discretion in how institutions are enacted and few player vetoes or points to avoid real institutional change.

4. METHODOLOGY

For this work, we used process tracing, a qualitative method that enables the development or testing of propositions supported by the identification and analysis of selected evidence in processes, sequences, and conjunctures of events. Its objective is to recognize and trace the causal mechanisms, their constituent parts, and the causal chain (connection between them) that allow explaining the case studied (Befani & Stedman-Bryce, 2017; Bennett & Checkel, 2015; Hall, 2006; Schettini et al., 2018; Silva & Cunha, 2015). By enabling the identification of a process that forms a coherent whole, process tracing allowed the organization of the complex process involving CTP.

4.1 Data Collection and Analysis

Also, to get sense of the context and better understand the political relations involved in the design and implementation of Arariboia, we conducted a field immersion within Banco Preventório, a community bank in Niterói which operate a DCC through E-Dinheiro platform in the territory before the implementation of Arariboia. One of the authors participated in meetings, informal discussions and field observation about the

implementation of Arariboia with community leaders, activists, researchers, and residents.

5. RESULTS

5.1. Characteristic of the Political Context

5.1.1. Background

The first CTP experiences in Brazil came from municipal initiatives . Three pioneer CTP were created in 1995 (Soares & Sátyro, 2010) in the cities of Campinas and Ribeirão Preto (both in São Paulo state) and in Brasilia (DF). Between 1997 and 1998, 25 other cities implemented their municipal CTP (Lavinas, 1998).

CTPs emerged with the increase in the number of social policy actors (for example, subnational public bureaucrats, members of civil society and members of professional's associations) under an increasingly democratized and decentralized system, characterized by fragmentation and dispersion of authority that sought to change the country's decision-making center, a proposal adopted by the new Federal Constitution of 1988. However, the fragmentation of policies under a federal government structure made it an obstacle to an urgent response to poverty (Vale, 2021). In this context, the central government intensified its coordinating role to bring coherence to the CTPs (Arretche, 2013).

The first relevant CTP launched by the federal government occurred in 2001 and was inspired by the model implemented locally in State of Brasilia, focusing on children under 16 years of age attendance to schools (Peck & Theodore, 2010). To implement this program at the national level, the creation ofasingle register of allthe beneficiaries of social policies was an important step towards gathering information on the poor and extreme poor population, allowing the possibility to launch other social programs. Later in the same year, the federal government added two new programs and ended up with four CTP, each managed by a different administrative department (Education, Health, Energy and Social Assistance).

In 2003, a new government was elected and unified the four programs, creating and extended program called Bolsa Familia (BF), managed by the new Ministry of Social Development (Díaz Langou, 2013). The management model of BF was supposed to combine efforts between the federal and cities governments, besides the support of state governments, respecting their autonomy and interdependence (Licio et al., 2011). To overcome institutional constraints, Federal Government relied on central-local collaboration to implement BF (Fenwick, 2010).

The centralization of social policies and the adoption of clear criteria for eligibility aimed to reduce patronage policies of local governments (Fenwick, 2010) and expand social policies throughout the country (Vale, 2021). Having learned from previous experiences of CCTs, Lula government initially tried to circumvent the reluctance of potential state governors to implement the BF by giving municipalities central responsibility for implementation. States became only responsible for coordinating and training municipalities, giving them a secondary role at the CCTs (Niedzwiecki, 2016).

Programs such as BF have become the main instrument for fighting poverty in Latin America in recent decades (Leyer, 2020). However, with the impact of the pandemic, the benefits of current CCTs may be limited. In a restrictive scenario, the lack of exceptional social protection measures against the impacts of external shocks can produce an adverse scenario and increase poverty rate, reducing household savings and consumption, with the possibility of a change in consumption behavior that can delay economic recovery (Martin et al., 2020).

However, in 2021, in time of widespread socio-economic deterioration in face of the aggravation of the pandemic crise, the federal government changed the beneficiary's selection criteria, causing the interruption of EBI payment by two months (Souza, 2021). This non expected blocked in the Federal cash transfer forced local politicians to take an active stance on CTPs.

One of the major challenges of Brazilian EBI's programs was the logistic of distribution. It became extremely difficult for the federal government to correctly identify the beneficiaries. Additionally, the beneficiaries had difficulties with the application and had to take off to bank branches, forming queues and agglomerations when social distancing was required (Gonzalez et al., 2020). In this regard, the DCC Mumbuca become a successful example of EBI program implementation, and other cases, such as Arariboia, have emerged with time.

5.1.2. Arariboia

In June 2021 the mayor of Niterói, Axel Grael, presented a formal intention to create the Arariboia. The measure was adopted to mitigate in short term the effects of the economic downturn caused by the pandemic. The program's objective was to mitigate the extreme poverty in the municipality by transferring cash to citizens in regions of greater socio-economic inequality. In this setting, the Arariboia was conceived as a tool for local circulating of the public benefit, creating jobs and maintaining part of the wealth generate in the territory. The City of Niterói estimated a monthly investment of approximately USD 1.35 million (R$ 5.6 million) (Prefeitura de Niterói, 2021a), and benefiting 27,000 Niterói families (Imenes, 2021).

The work on developing the DSMC involved several secretariats and public bodies, which contemplated the creation of a municipal bank and a social fund to manage the financial resources of the Arariboia. With that actions, the municipality , intended also to expand the formal register of commercial enterprises and a reduction in regional inequalities. (Prefeitura de Niterói, 2021a)Differently from others DSMC cases, such as Mumbuca, in the city of Niterói decided to create its own bank, called Banco MunicipalA

5.2. Characteristics of Niterói cash transfer program

5.2.1 Community Currency and Community Bank

The creation of Arariboia and the Municipal Community Bank of Niterói was established in a law approved by the municipal chamber on July 7, 2021 (Plantão Enfoco, 2021). At that time, the mayor of Niterói called upon the successful experience of the neighboring city of Maricá with Mumbuca to justify the creation of Arariboia. In this regards, he

declared that banks are "spaces for dialogue, training and promotion for workers and producers who will be beneficiaries of the currency". Furthermore, the mayor added that this program will have "a space for the […] beneficiaries themselves to have the possibility of reaching exit doors, thus leaving the situation of poverty and extreme poverty" (A Tribuna, 2021).

5.2.3 Arariboia Community Bank

To manage the Arariboia and the cash transfer program, Niterói constituted a Municipal Bank, subjected to the Municipal Secretary of Social Assistance and Solidarity Economy (SMASES). The bank is responsible to transfer the necessary resources for funding, maintenance, equipment, institutional strengthening, communication, promotion, and the execution of other financial responsibilities, such as the credit fund, backing of social currencies and "other necessary actions". The budget of the Niterói Community Bank Fund is part of the Municipality's budget. In addition, the accounting of this fund will be its own (A Tribuna, 2021).

The first branch of the Niterói Municipal Bank is located in Vila Ipiranga, north of the city. The person responsible for the SMASES portfolio, Vilde Dorian, defended that the implementation of the Bank represents yet another advance for their city, both in the development and application of the Municipal Solidarity Economy Policy, sanctioned last year, and in the concern that our mayor and the government of Niterói have with economic development allied to the fight against social inequalities, especially in a moment of health crisis and deepening of poverty in the country (Apolinário, 2021).

The bank also works as a space for other public policies, such as training and guidance to citizens and small or informal business. Also, anyone can go to the Municipal Bank and open their digital account to use the Arariboia in the registered businesses around the city. Vila Ipiranga is located in the Fonseca neighborhood. It is the most populous community in Niterói, with over 15,000 inhabitants. One of the local community leaders, Tyna Marins, attended the bank's opening event and opened her account. She graduated as a makeup artist, and believes the program will be important for her professional growth. "It is very good to see investments in public policies to improve the lives of those who live in the communities. The social currency will allow me to have my business and also move the economy of the place where I live". In May, 2021 she created the Facebook page Vila Ipiranga está Desmoronando (Vila Ipiranga is Collapsing), to warn about the various risk areas that exist in the community (Apolinário, 2021).

The Arariboia is managed by the E-dinheiro Institute, a Civil Society Organization of Public Interest (OSCIP) that works as a fintech for community banks operate community currencies in their territory. The partnership between the Institute and the municipality was settled in the collaboration agreement published on September 18, 2020, in the Official Gazette of the Municipality. E-dinheiro Institute was founded by Banco Palmas, the first community bank created in the country, in 1998, and other banks that were organized in a national network of community banks. E-dinheiro Institute developed a digital payment platform that is currently used by 48 community banks in 17 Brazilian states (Apolinário, 2021). The E-Dinheiro's objective is to provide the economic and social development of neighborhoods and municipalities, training, empowering and implementing instruments of Social Finance, Creative Economy, Solidarity Economy and

sustainable development, facilitating the process of generating and distributing work, occupation and income, with local development as a strategy (Apolinário, 2021).

5.2.4 Features of the Arariboia Coin

The objective of the Arariboia is to "foster the economic and social development of communities and establish means to achieve the eradication of poverty and the generation of employment and income for the poorest strata of the municipality" (A Tribuna, 2021).

The Arariboia's user are also registered in the national database of social policies' beneficiaries (CadÚnico). Each one Arariboia unit is equivalent to one unit of the national currency. The initial value of the cash transfer benefit was $90 arariboias per person, limited to the number of six benefits granted per family. With this, each person could receive $90 arariboias, with the maximum amount established for each family being $540 arariboias (A Tribuna, 2021). The value will be corrected once a year based on the inflation of the period (Plantão Enfoco, 2021).

The Arariboia is distributed to each user through a magnetic card. This distribution is carried out through the Municipal Bank that operate in Social Assistance facilities, such as the Social Assistance Reference Center (CRAS). The Arariboia project envisaged covering the most vulnerable families, registered in CadÚnico. The currency can be used in registered local businesses, such as bakeries, small markets, vegetables and small producers, among others (Prefeitura de Niterói, 2021b).

In less than a month, Arariboia injected USD 1,74 million (R$ 9 million) into the economy of Niterói. There were 130 thousand transactions in 2.400 accredited commercial establishments. Given the initial promising results, the municipality announced that it would expand the Arariboia program to the amount of USD 26 million (R$ 135 million) per year. By the end of 2021, the municipality had already expanded the beneficiaries base as well. According to the Niterói's mayor, the main objective at that time was strengthening Niterói's economy (A Tribuna, 2021).

In February 2022, the Niterói city made the official announcement that it would expand the Arariboia program, and the idea was vote and approval in the Legislative. It was proposed that the monthly amount would be increased to $250 arariboias for the head of household and another $90 arariboias for each member, with a maximum of five additional people. With this, the beneficiary could reach $700 arariboias per month if his family has six members. In addition to the change in values, another 4 thousand families were included in the Program, reaching the total of 31 thousand families benefited (O Dia, 2022).

5.3. Agents of Institutional Change

5.3.1 Instituto E-Dinheiro

As mentioned early, E-Dinheiro is a digital platform for electronic money and mobile payments used by Ariroria and other DSMCs. The technology of E-Dinheiro was developed by the Rede Brasileira de Bancos Comunitários (Brazilian Network of

Community Banks), led by the Banco Palmas. Banco Palmas was founded by citizens moved by the public power to remote areas and without access to infrastructure.

In 1973, when the Brazil was experiencing the effects of its "economic miracle", a fishing community that had lived for years on the beachfront, north of the capital of Ceará, was relocated to another location. In the name of progress, the order was to clean up the region to establish a highly developed tourist destination. With the removal, Conjunto Palmeira emerges, in the extreme south of the municipality, in a region covered with bush, mud and native palm trees. A place without any infrastructure, after one of the largest sanitary landfills in the municipality and more than 15 kilometers from where fishermen used to live by the sea (Cernev & Diniz, 2020).

In order to try to change reality and bring a minimum structure that would guarantee the survival of the residents, the community founded the Association of Residents of Conjunto Palmeira (Asmoconp). Over time, it strengthened, starting to promote improvements in the neighborhood. However, the prosperity achieved had an unexpected effect: gentrification. With the arrival of services such as electricity and running water, the cost of living has increased, making it prohibitive for many residents to remain in the neighborhood (Cernev & Diniz, 2020).

A survey carried out by Asmoconp would change the reality of the place. The first Consumption Map of Conjunto Palmeira was carried out in 1997, which showed two relevant pieces of information: more than USD 0,23 million ((R$ 1.2 million) per month was consumed by the residents of the community. However, only 20% circulated within the neighborhood, with the remaining 80% spent on purchases in other locations. This research allowed residents to understand one of the main factors of local impoverishment: low consumption in the community led to the depletion of their savings and, consequently, their ability to generate work and income. Then came Banco Palmas, a community bank from residents to residents of the neighborhood, which aimed to offer low-cost loans, mainly focused on productive investments and poverty alleviation. From Palmas initiative also emerged, a community currency of local circulation in Conjunto Palmeira (Cernev & Diniz, 2020).

5.3.1 E-dinheiro platform

After the initiative's implementation, studies showed a complete inversion in the consumption curve of the neighborhood: between 1997 and 2009, from only 20%, the purchases of families in the locality rose to 93%. In 2011, the wealth circulating in the place was around USD 13,14 million (R$ 68 million). The data showed that Banco Palmas managed to contribute to the promotion of a sense of community and the principles of the solidarity economy, rescuing feelings of self-esteem and belonging to the neighborhood (Cernev & Diniz, 2020).

Some events have marked the recent history of the initiative: in 2007, the Brazilian Network of Community Banks was formalized, which had objectives similar to those of the institute: to promote and disseminate the solidarity economy, share knowledge and technologies and coordinate the search for financial resources for their loans, supporting local leaders in the creation and management of new community banks (Cernev & Diniz, 2020).

In 2015, the Network of Community Banks launched E-Dinheiro in partnership with a technology company. The new mobile payment service now features electronic money, or, more precisely, a hybrid service of mobile payments and mobile money. While the partner company was responsible for the development, maintenance and high-level technological support, the E-Dinheiro Institute, managed by Banco Palmas and other community banks, was responsible for the business and social model together with the community, from the dissemination and registration of participants to the financial management and expansion of the enterprise (Cernev & Diniz, 2020).

The initial objective of E-Dinheiro was to digitize Palmas - the CC of Banco Palmas - which at time circulated in paper money, as well as to improve the financial services of the community bank and promote greater financial inclusion in the region. This is because, with the adoption of a digital platform, the bank could offer services such as bill payment, electronic money transfer, consultation of balances and statements, prepaid mobile recharge, targeted communication and usage charts, useful in local financial education initiatives. Additionally, with the platform data, the bank could get to know each user better in order to assist in the loan granting process, as well as better manage the currency in circulation. More than that: for many people, the digital account opened with the E-Dinheiro application was and still is their only financial account (Cernev & Diniz, 2020).

In the first stage, E-Dinheiro was a digital platform that had two technological versions for users: an application for smartphones, using data networks from telecom operators or Wi-Fi connections; and SMS and USSD commands directly on cell phones, including the simplest (low-end), still in frequent use in the neighborhood at that time. The E-Dinheiro application for Android and iOS included payment services (including via QR-code, for offline operations), transfer, billing, extract, mobile top-ups, deposit and redemption – the latter only at the bank. This application allowed the use of services not available in the low-end version, which was limited to checking balance and transfers. In addition to being a payment instrument, E-Dinheiro was also a digital checking account, linked to the users' cell phone number (Cernev & Diniz, 2020).

There were no costs for using E-Dinheiro by users, including payments between people (P2P). When the service was used by merchants, an administration fee of 2% was charged on the value of transactions, plus 1% on cash withdrawals or transfers to a bank account. This technological model dispensed with the use of transaction capture machines (POS). In this way, there were no additional costs for renting this type of equipment, as in the case of card services. There were, however, other indirect costs and challenges for the adoption and use of E-Dinheiro by users and merchants, such as the cost of acquiring a smartphone, even though it is a simpler model, and the pricing of mobile data services (Cernev & Diniz, 2020).

To circumvent the cost of the device and encourage the use of the E-Dinheiro application, Banco Palmas began offering low-cost financing for the purchase of smartphones, with payments diluted in many installments, with low interest rates. More than a consumer dream, these devices played an important role in the digital and financial inclusion of the community. In order to also reduce the costs of using smartphones, especially mobile data services, the bank activated Wi-Fi networks in several locations in Conjunto Palmeira to offer broadband Internet access free of charge (Cernev & Diniz, 2020).

Over time, E-Dinheiro has been adopted by over 40 community development banks in order to digitize their local community currencies. It works as an electronic management system for community banks and as an application or digital wallet (e-wallet) for users. The platform allows community banks to manage their projects from end to end, from the issuance of CC to the contractual relationship with the agents involved, through a digital platform. Although it is the same platform for all community banks, with shared technology development and scale gains, user data (beneficiaries and merchants) and geographic areas of acceptance are delimited. In view of the existence of possible restrictions on the use of the E-Dinheiro application on smartphone some projects, such as the Arariboia, choose to issue, in addition to the application, cards to users (Cernev & Diniz, 2020).

6. THE ROLE OF SUBVERSIVES ACTORS AND THE LAYERING INSTITUTIONAL CHANGE

By analyzing the emergence process of Arariboia program, we see that once institutionalized, cash transfer's political context is characterized by actors with weak veto power. We see that there is no central actor who determines the design and implements CTPs. There are different actors competing and dialoguing, in national and subnational instances, to implement their vision of a cash transfer program.

In the case of Niterói, the cash transfer policy was inspired by projects in neighboring cities, such as Maricá, in the wake of the need for emergency financial protection against Covid-19 socio-economic crises. However, to implement its program, Niterói had to create a specific municipal law, creating its own rules regarding the operation of the cash transfer in the city. Nevertheless, Niterói municipal law follows the experience and knowledge of E-Dinheiro' DSMC, namely, the Mumbuca coin.

From this perspective, E-Dinheiro might be portrayed as an actor of institutional change, following a layering strategy, first acting in parallel with the existing rules until new rules were introduced through municipal banks that began to institutionalize community currencies. Over time, the rules of cash transfer were changed to include DSMC.

The DSMC was institutionalized through municipal laws and run parallel to the national currency system, establishing rules that have not yet been fully established by the Central Bank. Thus, the institutional change of the cash transfer by DSMC can be understood as a layering process when new rules are attached to existing ones. DSMC does not seek to change the entire cash transfer institution, but they run in parallel with other alternatives until it gains legitimacy to exist legally.

The E-Dinheiro seems to act as a subversive actor, as it had pursued its goal without breaking the institution's rules. Indeed, after the founders of Banco Palmas have been threatened with prison for their use of paper-based CC,, the creation of E-Dinheiro was a path to community currencies to be inserted into the current institutional rules. The Banco Palmas and other community banks became a Fintech to meet these rules. However, they have no interest in keeping the rules as they are. They seek to subvert institutional rules through their actions as a Fintech. They gain legitimacy and promote their model. As can be seen from the success they are trying with the establishment of new municipal banks

that operate social currencies. Therefore, E-Dinheiro works to subvert the system from within the system.

7. CONCLUSION AND FUTURE RESEARCH

Cash transfer policies has become an important instrument for poverty alleviation and combating the effects of crises. Among many recent initiatives, DSMC are promising tools to operationalize these programs by municipalities. This study has emphasized that the emergence of DSMC by municipalities might represent an incremental change in the cash transfer institution.

We drew on process tracing methodology combined with the theoretical lens of TGIC and conducted a preliminary documental analysis to explore this issue through the case of Arariboia Coin, in Niterói city, Brazil. Our preliminary results indicate that the recent emergence of Arariboia stemmed from the long road of community currencies experienced in Brazil and the success of the Mumbuca coin, in the neighboring city of Maricá. Despite the influence of prior success cases, the Niterói city creates its own rules through a municipal law to implement the Arariboia. This indicates that actors in the political context do not have a strong veto capacity, which opens space for the institutionalization of DSMC by municipalities. Also, our study indicates that the E-Dinheiro Institute is an important actor in the institutional change of cash transfer public policy, as they established an alternative cash transfer solution and articulated that with the municipalities.

In sum, our work contributes to the literature on cash transfer public policy by showing a potential institutional change in the design and distribution of CTP. Also, by describing the emergence of the DSMC phenomenon, we contribute to expanding the work of Gonzalez et al. (2020) on DCC for EBI.

The next phase of this research involves in-depth data collection through semi-structured interviews and the definition of the causal mechanisms that led public managers to adopt DSMCs as public policy tools, and the influence of other institutional actors, such as research institutions, the federal government and political parties. In addition, our work points to the need to understand the interrelationships between neighboring cities that adopt similar public policies, as is the case of DSMCs. Most municipalities that have implemented DSMCs as a cash transfer tool are in the same state. Future research can perform cross-case analyzes to identify relationships between different DSMCs.

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The notion of debt in mutual credit systems: some insights from the experience of Moneda PAR

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Abstract

This article explores complementary currencies (CC) that work on the basis of community credit schemes in Argentina, a country often referred to as a laboratory in terms of monetary exploration. In contrast to alternative community-based monetary systems created in the global North, CC developed in the global South usually pursue the creation of supplementary currency circulation in order to address liquidity constraints faced by the middle and low strata of the society. In particular, CC relying on community credit schemes solve two problems at once: liquidity constraints and credit scarcity. Drawing on the case of Moneda PAR, a mutual credit system originated in Argentina in 2017 upon the principles of the social and solidarity economy, we study how users understand debt.

The last quantitative data obtained from Moneda PAR show that only around 20% of the participants have a negative balance; that is, they have effectively used mutual credit. Thus, a large majority of users do only count on the liquidity obtained from their own sales. These figures seem to be in conflict with the theses on which the complementary monetary systems in peripheral countries are founded and, in particular, with CCs that work based on mutual credit systems. Given that, in these systems where money is created by granting credit, a generalized reluctance of the participants to take it could end up being self-defeating, as eventually low levels of liquidity would prevail making the whole system unattractive.

In this paper we intend to investigate the reasons why the participants of Moneda PAR tend to refrain from using the credit facility. Our working hypothesis is that the meaning of debt, both in its symbolic dimension and in the power relations in which it is embedded, may be driving Moneda PAR participants' behaviour, especially those of lower income strata, thereby limiting the capacity of the system to foster the markets where it is used. While the results of this article are useful for Moneda PAR, they can also be extended to mutual-credit complementary monetary systems built on the premise that credit scarcity constitutes an obstacle to the improvement of the material conditions of a community.

1- Introduction

The citizen trend of recent decades towards monetary plurality at the local and regional level is challenging the banking monopoly of the official currency. The communities involved have developed more than 5,000 experiences of complementary/alternative, local, community and social currencies, as estimated by Blanc (2018). These currencies, in general, are used to promote local development through the creation of liquidity and the incorporation of alternative financial instruments to those provided by the formal market, in their fight against the growing social exclusion generated by contemporary financial capitalism.

This article explores complementary currencies (CC) that work based on community credit schemes in Argentina, a country often referred to as a laboratory in terms of monetary exploration. In contrast to alternative community-based monetary systems created in the global North, CC developed in the global South usually pursue the creation of supplementary currency circulation in order to address liquidity constraints faced by the middle and low strata of the society. In particular, CC relying on community credit schemes solve two problems at once: liquidity constraints and credit scarcity. Drawing on the case of Moneda PAR, a mutual credit system originated in Argentina in 2017 upon the principles of the social and solidarity economy, we study how users understand debt.

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2- Principal concepts employed

Several of the concepts used are not univocal or homogeneous, thus we will carry out a short review of their meaning from the study of the Popular Solidarity Economy (EPS).

Solidarity markets with social currency are developed particularly within the so-called "**popular sectors**" where liquidity shortages occur more quickly and frequently at the beginning of a crisis. When we refer to the "popular sectors" we refer to workers who carry out their activities outside the formal salary relationship, and/or receive low incomes, and are object of two types of exploitation: on the one hand, a relationship of exploitation of a commercial nature, and is reflected in a process of permanent devaluation of their work. On the other hand, a relationship of "financial exploitation" that focuses on the idea that workers in the popular economy are insolvent and, therefore, must face usurious interest rates to access credit. The latter are two structural characteristics of the reproduction of this social sector that called itself popular economy (Gago and Roig, 2016).

Considering the "**financialization**" of the popular sectors, this is generally made invisible by the dominant thought, for which they do not go into debt, do not save, do not have a financial life. However, this is not true, since the network of debts that financial capital weaves extends to all social sectors, including the popular sectors, to which financial exploitation fully

reaches through financial instruments that assign them a place of submission through “**debt**”. Then, the creditor-debtor relationship becomes a "power device" that acts on the intimacy of people and their conscience, trying to eliminate any initiative that means an autonomic claim of the subject (Lordon, 1999, Chena, 2017).

The strategy of generating “popular economy debtors” is built on the premise of creating new liabilities that allow the capitalist block to convert access to liquid money into a form of control over that sector, a situation that is verified by the lack of liquidity, faced by the popular sectors at the mere beginning of a crisis, or in the beginning of an orthodox anti-inflationary policy. It is a control over subjectivity, through the morality of “guilt for having debts”.

In this sense, as the material dimension that can be reflected in a usurious interest rate it’s consolidated by a "**subjective dimension**" on money, credit and debt that stigmatizes the worker in these sectors, and conditions them in their behaviour against the possibility of becoming autonomous from that relationship.

We believe that this "**subjective dimension**" may be the cause of the low use of mutual credit in the case of the PAR Currency, as we stated in the introduction and will develop further on.

This "**mutual credit**", granted from a social currency, must be distinguished from those community currencies backed by official currency in a bank, which create confidence in the currency by that backing. In a mutual credit system, the currency that is used in a transaction is created while it is carried out. These systems function as interest-free credit in which the debt becomes credit for the other members of the community and constitutes an alternative for those communities that are excluded from the legal financial system, or as Gago and Roig (2016) suggest, in a situation of “financial exploitation”.

The currencies that are created under a mutual credit system are consistent with the ideas of the German Argentine economist Silvio Gesell (1907), according to whom money should allow communities to make the most of their productive capacities, facilitating the exchange of goods and promoting circulation versus hoarding, mutual credit systems work in that sense. John Maynard Keynes, in the General Theory (1936) values the ideas of free competition socialism proposed by Gesell, and the idea of negative interest -which arises from his thought- in his development of the euthanasia of the rentier.

From this conceptualization, we seek to analyse these basically transactional submarkets (Schroeder, 2015), as a remedy to the fall of popular sectors in the inclusion based on exploitation, or directly in exclusion from the financial market.

The PAR currency is one of these mutual credit systems, which also offers an overdraft as a way to ensure and expand the circulation of the goods and services offered. Based on it and on data obtained from the Blockchain, as well as surveys and interviews, we will analyse mutual credit as a form of financing that would allow access to credit exempt from interests and freed from exploitative relationships.

3- Our experience in study: Moneda PAR

Moneda PAR is a Blockchain-based complementary currency launched in Argentina in 2017, built upon the principles of the popular solidarity economy (EPS). Its goal is twofold: to stimulate the economy of communities with unsatisfied needs due to the lack of liquidity, and to promote more sustainable, cooperative, and friendly interactions between the people. In terms of Polanyi’s classification of the forms of economic integration, Moneda PAR aims at fostering relationships based on the principle of reciprocity.

Moneda PAR is designed as a mutual credit system (along the lines of local exchange trading systems (LETS)), where participants are granted interest-free loans based on their productive capacity. Sales are recorded as positive balances and purchases are registered as negative ones, the sum of all individual balances always adding up to zero. Every time a user makes use of the overdraft facility granted by the community, he is in fact receiving

credit from the rest of the network. Similarly, when a user holds a positive balance, he is granting credit to the rest of the network because the positive balance implies that he has delivered goods or services of his own while not having yet acquired anything for his own consumption. Thus, positive balances are interpreted as a right to claim products from the network (for a value equal to the balance) while negative balances should be interpreted as an obligation to deliver products to the network (for a value equal to the balance).

In order to facilitate adoption, a one-to-one relationship between the Moneda PAR and the Argentine peso was adopted, keeping the peso as the unit of account and giving PAR the role of the medium of exchange. PAR units are not backed up with fiat - otherwise, the money creation process would be tied to the liquidity conditions of the market, which is exactly from what Moneda PAR tried to decouple in its origins. Thus, there is no institutionally guaranteed conversion between Moneda PAR tokens and the Argentine peso.

As a project based on the values of the social and solidarity economy, Moneda PAR promotes the practice of participatory democracy. The project is governed as a Federation of nodes, each of them having its elected representative at the national assembly where all the relevant decisions are made. The nodes, in turn, have their own government structures where all members are encouraged to participate.

4- Methodology

Social research provokes explicit political intervention not only on the field of study but also on us as researchers, constituting the very own reality it is studying at the same time that contributes to making visible initiatives that do not respond to hegemonic values (Gibson-Graham et al., 2013; Burke and Shear, 2014). Relying on forms of direct engagement in organizational practices, this research relies on an engaged ethnographic approach (Lyon-Callo and Hyatt, 2003). As acknowledged by Barinaga (2017), requirements for engaged scholarship in the construction of a fairer society are threefold. It is first situated, as we recognise the effects of our methods and reality as dynamic. Second, it is reflexive as we (researchers) should be constantly aware of the impact of our research practices in the context we study. And finally, it is deliberatively political as it seeks to create a more just and fairer reality, chiming with the goals of Moneda Par.

All the authors are involved in the management and use of Moneda PAR, in line with what is proposed by Alvesson (2003), so we characterize our approach as ‘self- ethnography’, due that our participation in the currency enabled us to gather information from a wide range of sources over the years, contributing to a comprehensive analysis of the different indebtedness patterns in this currency.

According to its interdisciplinary nature, the data sources are multifaceted. We do not only rely on “ethnographic” information or questionnaires, or descriptive statistics but articulate these three types of data.

First, the transaction database freely available using a Bitshares block explorer such as bts.ai allowed us to compute exhaustive statistics about the network’s dynamics.

Second, we rely on ethnographic data, collected through participatory observation and semi-directed interviews with Moneda PAR users. Articulating this knowledge with the transaction database helped us to construct node-based statistics, as we could assign each user to a specific node, an input that could not be found in the blockchain witnessing only the seller’s and buyer’s pseudo as well as the date of the transactions and the nominal amount that passed hands. Ethnographic work provided us with invaluable socio-demographic inputs on the users, along with the symbolic and social networks within which the commodities estimated in Moneda PAR could circulate.

Third, we passed three different questionnaires to the user’s community. Two took place in the second and the third quarters of 2021 respectively. The first one was largely preliminary, focusing on how the members got in touch with the Moneda PAR, and how they would behave in the community, 54 people participate. Between the first and the second quarters of

2021, Moneda PAR had about 314 monthly active users on average. The 54 participants figure amounts to a 17,2% participation rate. The second survey focalized on the relationship that Moneda PAR users had with the financial sector and what kind of monetary and financial practices they could exhibit, both in offline and online sales and shopping. 112 persons participated, which, compared to the about 361 monthly active users on average between the second and the third quarters of 2021, amounts to a 31,0% participation rate. Finally, a last questionnaire was passed between the second and the third quarters of 2022, aimed at understanding better the way Moneda PAR would relate to traditional indebtedness and mutual credit, and how both would be considered by the community. 71 persons participated, which compared to the about 256 monthly active users on average in the second quarter of 2022, amounts to a 27,7% participation rate. Responses for this survey will be further explained below.

Information at a node level relies on participants' responses. Whereas some nodes account with a solid representativity of their populations, others are only represented by a few users in the survey. Thus, nodes with less than 5% of weight in the survey were categorized as 'other'.

5- The results of the survey developed for this paper

The survey was compound of 34 semi-structured questions, whereby 11 had an open field that enabled respondents to go in depth in their meanings and understanding of the phenomenon. The different areas we explored in the survey were the relation that Moneda PAR users stablish with traditional debt, and their relation with mutual credit within Moneda PAR. It was also accompanied by questions in relation to how users became involved in Moneda PAR, and demographic information of themselves and their households. The survey was self-administered online and the link was distributed to all the community of Moneda PAR. We first shared the link and a brief explanation of the study to all the representatives of the different nodes via a group chat, and sent a reminder a couple of days later. After 2 weeks of having the survey alive, we screened the first results, and sent a general reminder through the same group chat, along with specific messages to nodes coordinators with a lower response rate than the node's participation in the currency. Finally, a few days before closing the survey, we sent similar reminders.

a. General results of the present survey combined with qualified informant interviews and participant observation

Regarding the results of the survey, a feature that stood out in the beginning of the analysis was that 3 out of 4 responses received were from women. The larger participation of women in Moneda Par resonates with previous studies on complementary currencies in Argentina (Gomez, 2010) and in other contexts (Fare and Ahmed, 2017). Whereas it is acknowledged in previous studies that participation of women in the labour market is generally more precarious than men, the large majority is self-employed, either in the formal sector or in the informal sector. Moreover, 90% of respondents self-perceive themselves as middle-class, whereas 20% stated to receive benefits in different forms. All in all, we can suggest that respondents of the survey were middle-age educated women who self-perceive themselves as middle-class, however their incomes are not considerably far from the poverty line during at the time of the study.

A first element explaining the subtilization of the credit facilities provided by Moneda PAR is that despite its foundation -the creation of credit rather than money-, most active users in our sample claim that they do not need credit at all (68%). Of those that declare a need for some type of credit, 70% claim to have no access to financing through the traditional financial system. Interestingly, the remaining 30% is given by those who, while admitting a need for credit and the possibility of taking debt, choose not to do it (presumably with the

consequence of suffering from a higher level of unsatisfied needs). The explanations they give for this behaviour are mostly concentrated on economic factors, such as the high interest payments and the uncertainty regarding the capacity of their entrepreneurship to produce the cash-flow required to pay back the debt. Some also point out ideological motives for refraining from taking debts, but they represent a minority in our sample. When asked to identify their feelings toward debt, the “loss of freedom” and “fear of the consequences of not paying back” were the descriptions most widely chosen.

This group, the 30% who need to take formal credit but decide not to, represents, the moment in which the creditor-debtor relationship becomes a "power device" that operates by controlling subjectivity from of "guilt for having debts", Lordon (1999). In turn, they express this limitation on two levels: the material (high interest rates that end up configuring a new form of exploitation, "financial exploitation") and the subjective (through the fear of being excluded from access to symbolic goods, necessary to maintain a certain social hierarchy),

If we analyse by income level, it is also worth noting that 46% of the participants in the group claiming no need for credit had an income level below the poverty line (they earned less than 85,000 ARS) in June 2022, when the survey was conducted. The members of this group, belonging to the popular sectors, exclude themselves from the possibility of taking credit. This would be due, in most of the observed cases, to an installed conception of debt and formal credit, from which they have been systematically excluded for decades and that would have shaped a particular "habitus"[1] on their consideration.

The picture changes when the questions about their attitude towards credit and debt are framed in the specific context of Moneda PAR. While the quantitative analysis, based on the entire population, shows that by May 2022 30,5% of the active users did not have credit, the results from our survey show that 37% of the users in the sample declared not to use the credit facilities of the mutual credit system. This group can be broken down according to the reasons for not using the supposedly most standard element generated by the community, at least seen from the lenses of alternative monetary systems: 38% claims to have access to the credit facility but simply chooses not to use it, 27% admits having rejected the credit granted by the community, 19% states not having been given credit at all, and 15% were not aware that they could have credit in Moneda PAR.

It is worth digging into the reasons that lead the first two categories of users (which make up 24% of those who decided not to use the mutual credit facility) to decide not to take debt in the mutual credit system. Based on the insights obtained from the survey there are, in principle, two factors driving this decision. First, the reluctance to engage in a debtor-creditor relationship may be by the reason they transpose the “habitus” towards formal debt and credit to mutual credit from Moneda PAR, even when they know that in Moneda PAR no-one would threaten them if they cannot pay back a loan, and they don’t have to pay interests. Second, some prosumers seem to not use the credit facility because they do not find anything in the market that they consider worth purchasing, or that given their position in the “economic structure” of the community these users tend to be in a surplus position, thereby not requiring to take debt at all.

Another noteworthy, result of the survey is that the majority of the active participants seem to have a good understanding of the values upon which Moneda PAR has been built, the way the system works and, therefore, its difference from the traditional financial system. Compared to the perceptions declared when reflecting about the latter, users of Moneda PAR hardly ever relate debts in the mutual credit system to a “reduction of my autonomy”, a feeling of guilt, difficulty to face the debt service or fear of the consequences of eventually not being able to pay the debt back. But still, 49% of the respondents prefer not to be in a deficit position, with a relevant number of them (38%) claiming that they feel more comfortable

[1] " The habitus is defined as a system of durable and transferable dispositions -structured structures predisposed to function as structuring structures- that integrate all past experiences and function at all times as a structuring matrix of the perceptions, appreciations and actions of the agents in face of a conjuncture or event and that they contribute to producing" (Bourdieu, 1972).

limiting their expenditures to the positive balances obtained through the (prior) sales of goods and services. This latter result coincides with those who voluntarily choose not to use the credit facility pointed out in the previous paragraph, signalling that despite the fact that a project is built upon the principles of popular solidarity economy in a bottom-up fashion and with a strong participatory imprint, again there can be some notions learned in the traditional market system that are deeply anchored in the subjectivity of the individuals, conforming their "habitus", consciously or not, and are replicated in their attitude and behaviour in Moneda PAR.

Analysing the use of the overdraft facility by the network, it shows wide variations across nodes. Still, no patterns in terms of geographical regions or features of the type rural/urban were identified. Río Ceballos registers 29% of the respondents declaring the use of the credit system, followed by Traslasierra (13%), and Boedo and Gran San Miguel de Tucumán (both with 11%). The results differ when the figures are compared to the size of each node, as defined by the number of survey respondents that identified themselves as members of those nodes. Río Ceballos and Villa Gesell were the nodes that exhibit a higher use of the credit system compared to their sizes (4.6 and 2.8 percentage points, respectively, above their share in the sample), while Boedo and La Plata registered the lowest figures (4.0 and 4.6 percentage points below their share in the sample).

By gender, women exhibit a higher use of the credit facility in absolute and relative terms. Of the 45 participants that declared the use of the overdraft, 36 were women and only 9 were men. This implies that while women represented 73% of the sample, 80% of users claiming to use the credit system belonged to that gender. Finally, no specific patterns related to age were found in using the credit system.

b. Discussion of the results

The two aforementioned drivers that explain the reluctance to use the credit system can be used to build a typology of the scenarios that can arise when a social currency built along the lines of a mutual credit system is implemented. First, there is a "symbolic dimension" that refers to the users' understanding of debt and money, and the extent to which their attitude towards these concepts is aligned with the notions of debt and money that underlie the mutual credit system. This dimension is intrinsically symbolic because the individual's notions of (immaterial) objects like credit and money, and relationships of the type of debtor-creditor, are necessarily mediated through a series of symbolic devices (hegemonic discourses, beliefs, individual and collective experience, etc.) that condition its particular perception about these concepts - it is through the mediation of the symbolic order that the individual becomes a subject.

Second, there is a purely "material dimension" consisting of the size and variety of the market where users participate and the capacity of those markets to satisfy their basic needs in a sustained way. These two dimensions are orthogonal in that they describe two clearly distinct aspects of a mutual credit system, both of which are crucial to its success.

Based on the survey results, two cases (ideal types) can be defined for each of these two dimensions. In the case of the symbolic dimension, there is a first case where participants understand debt, money, and the relationships between them as dominated by the logic of the free market, competition and of the "homo economicus", reproducing the current "habitus" in the formal market to the mutual credit. In those cases, debt is most likely associated with the "fear of losing freedom and autonomy" or the "consequences of not being able to pay back". Hence, people try to avoid being indebted, and the use of the mutual credit system tends to be low. A second case is where participants have acquired (or already had) a sufficient understanding of the use of money and debt in mutual credit systems and the type of relationships cultivated in them. As the results showed, these people are more prone to use the credit facility in the social currency network while they are not willing to do so in the traditional banking system.

In the case of the material dimension, the first case is that of users that participate in markets where they can satisfy their (basic) needs, thereby laying the foundations for broader use of the credit system. A second (and more generalized) case is that of users that participate in markets that have not reached a depth that enables them to satisfy people's needs through the social currency. In these cases, the use of the overdraft facility is expected to be low.

The combination of these two dimensions and their ideal types gives four possible scenarios, each with a specific likelihood of a generalized usage of the mutual credit system. Table X illustrates these cases. The most desirable scenario is the one where users' understanding of debt and money is aligned with the system and the market is attractive enough to encourage them to participate (bottom left quadrant). In this case a generalized and sustained use of overdrafts is expected. On the contrary, the worst-case scenario occurs when users' notions of debt and money are not aligned with the system. Simultaneously, they participate in a market that does not allow them to acquire what they need (top right quadrant). In this case, the most likely outcome is very low or even null use of overdrafts.

Table X: A typology of scenarios that mutual credit systems face

		Material dimension: size of the market where the social currency works	
		Basic needs satisfying	Not basic needs satisfying
Symbolic dimension: understanding of debt and money	Aligned with the conventional system	Intermediate use of the credit system	Scarce use of the credit system
	Aligned with mutual credit systems	Generalized and sustained use of the credit system	Intermediate use of the credit system

It is not easy to state *a priori* which of the two remaining scenarios, where the usage of the credit system is intermediate, will show a higher rate of utilization. This is because the drivers could be different in each case. When users are reluctant to take debt even when they are operating in a mutual credit system with markets where basic needs can be satisfied (top left quadrant) it is still possible that they end up using their overdraft facilities if required to satisfy a material need - even if they would prefer to rely only on their positive balances, there are situations where they might find themselves in the need to take debt.

Even when the material dimension can overcome the symbolic dimension in some cases, the hypothesis about the "habitus" about money and the financial world must still be considered in all the cases where the symbolic dimension remains aligned with the conventional system.

In these cases, we believe it is important to point out the importance of incorporating the time variable, which is necessary to achieve the appropriation of the values that the EPS promotes.

Therefore, we must consider the maturation time of any experience that goes against the "common sense" of the market society. It is necessary to highlight the importance of the comprehension of process of creating and managing these markets with social currency, which is based on the active participation of the community in its management and in the solidarity market on which it operates (Orzi, 2019).

> *The economic sustainability of an economic system based on self-managed work is a medium-term objective and is not defined at the micro level, it*

depends on the variable behaviour of a multi-actor and multi-institutional group. It justifies a subsidized incubation period (Coraggio, 2005).

On the other hand, users whose understanding of debt and money is aligned with those of mutual credit systems but that belong to markets where basic needs cannot be satisfied (bottom right quadrant) might still exhibit some use of the overdraft facility, mainly because their alignment with system's values and goals encourage them to participate and keep on trying to make the best out of the market they are faced with. In this case, the prosumers understand the need to create, in a continuous and extended way, a market to work with the proposed social currency. This might seem obvious at first, but in our conversations with many of the entrepreneurs who want to operate a social currency, we have come across the belief that the very creation of the currency creates the market, or that the market is waiting for a new medium of exchange. This is not the case when we work with solidarity markets, which operate under horizontal social control and have distinctive characteristics contrary to the dominant logic (Orzi, 2019), configuring one of the problems faced by social currencies in general, and those that work on mutual credit in particular.

c. Operationalizing the typology

The proposed typology can be operationalized by placing each respondent in a quadrant according to its own understanding of money and debt within the mutual credit system, and the depth of the market where it participates. To assess each user's understanding of money and debt, their answers to some of the related questions were used, requiring them to respond to at least 70% of the questions in line with the principles of Moneda PAR to consider their attitude towards debt is aligned with the system. The depth of the market where each participant operates was assessed by asking the coordinators of each Moneda PAR node what percentage of the basic needs can be satisfied by means of the social currency. The results are shown in Table Y, where the ratio of participants using the credit system as a share of the total of the respective category is presented.

Table Y: The situation of Moneda PAR

		Material dimension: size of the market where the social currency works	
		Basic needs satisfying	Not basic needs satisfying
Symbolic dimension: understanding of debt and money	Aligned with the conventional system	Intermediate use of the credit system **10/13 (77%)**	Scarce use of the credit system **6/14 (43%)**
	Aligned with mutual credit systems	Generalized and sustained use of the credit system **5/7 (71%)**	Intermediate use of the credit system **21/34 (62%)**

The first result that arises from the application of the typology to Moneda PAR is that the best-case scenario is highly unusual, as only seven users fall in this category. Surprisingly, two of them do not use the credit system, but this obeys the fact that the community did not grant her credit in one case and to a technical problem with the mobile wallet in the other

one. If it was not for this, it is expected that the rate of usage of the mutual credit system would have been 100% (instead of 71%).

A second noteworthy issue is that, according to the coordinators' perception, in most markets it is impossible to satisfy the participants' basic needs, thereby undermining the potential of the mutual credit system, as we explained above. Still, the credit system usage rate is not low, especially in the case where users' understanding of money and debt is aligned with Moneda PAR (62% of these participants use the overdraft facility). Here, in addition to an active participation in the market, there is an overcoming of the dominant thought about money, debt, credit and the market, showing -in general- an ideology in accordance with the experience.

The rate of usage of the credit system is reasonably lower in the worst-case scenario (43%), but still decent considering the adverse conditions found for the development of the social currency. The (lower number of) cases where the overdraft is used there where the market is not deep enough and there is not an accurate understanding of the mutual credit system can be explained by cases where, as users claimed, people "prefer not to have debts" but end up using the credit to purchase a good that they might be needing, even if they belong to a market where it is not possible to satisfy a relevant share of the basic needs, which continues in line with what was developed on Table X.

The third result that is derived from the analysis of the survey read through the lenses of the typology is that when the depth of the market is sufficient to cover an important part of the basic needs, an incomplete understanding of the underlying concepts of debt and money is not an obstacle to the usage of the credit system, as the 77% rate in the top left quadrant shows. In this case, usage of the overdraft facility could be given by a lack of reluctance to take debt (even in the traditional meaning of it) and/or due to a situation of urgency, where individuals prioritize their material needs over their beliefs concerning debt and money. The analysis of the ten users that without understanding debt and money as they are understood in Moneda PAR but still use the overdraft in markets where basic needs can be satisfied to a large extent shows that all of them exhibit a negative attitude towards debt in general (as they claim to avoid taking debts in the traditional system as long as they can do it). However, 7 out of 10 of these users had an income in pesos that left them below the poverty line, thereby giving room to the hypothesis stating that in contexts of unsatisfied needs, the material dimension might overdetermine people's behaviour, leaving the symbolic (or ideological) aspects on a second place. Once again, the importance of the continuous construction of the market arises in order, through constant material benefit, to pierce the "habitus" of our total market society.

The opposite way of approaching this hypothesis is to check the socioeconomic status of the users that, understanding debt and money that is aligned with Moneda PAR and operating in incomplete markets (bottom right quadrant), use the overdraft facility. What we are interested in testing is whether people whose needs can be satisfied in pesos (most likely through a formal employment relationship) can prioritize the ethical dimension, meaning that even in a context where it might not be easy to find attractive goods and services in the market of Moneda PAR, they still manage to participate in the fairs and use the credit system. The results show that 13 out of the 21 users (62%) that fall in this category were above the poverty line, suggesting again that the typology describing the fertility to develop a mutual credit system can be enriched by considering the socioeconomic status of the users.[2]

[2] An important caveat that needs to be made when reading the results is that the dichotomic nature of the ideal types, where we distinguish between markets where basic needs can be satisfied or not, necessarily loses the nuances that are found in the markets - for instance, users participating in markets where basic needs cannot be even partially satisfied might still use the credit system if there are just a few essential goods that can be acquired by means of the social currency.

6- Some preliminary conclusions

From the analysis of the results of the survey and the typology presented in the above section, we can conclude that in order to be sustainably adopted (and grow) over time, a mutual credit system needs to tackle two dimensions successfully: one of them symbolic, referred to the participants' understanding of money and debt and their alignment with the principles that the system aims to promote; the other one purely material, related to the capacity of the markets where the system works to fulfil the participants' needs. Failure to develop strategies that favour the creation of deep, diversified markets and a series of training and communication devices that help promote the underlying principles regarding debt and money and considering the period of time needed for the experience to do it, will jeopardize the whole project.

These two dimensions cannot be taken in isolation, as the socioeconomic status of the users has also proved to be relevant in explaining their behaviour - our evidence seems to suggest that while the behaviour of users living in tighter economic conditions, and -in general- the "popular sectors", are more driven by their material needs than their ideology, using mutual credit even they have not changed their "habitus", those living in better conditions are more likely to shape their behaviour according to ethical considerations.

It is worth noting that, taking the case of Moneda PAR, while the likelihood of the best-case scenario occurring is only 10%, the probability of the worst-case scenario is 21%. This implies that the most likely scenario, for a young experience, is one where usage of the system is intermediate and mostly conditioned by material conditions related to both the markets where the social currency works and participants' living conditions.

The experience of the Moneda PAR reaffirms the need to work on both the "habitus" and the construction and recreation of the market where the currency works: after 4 years of operation, the system still requires a greater appropriation by the community and -in some nodes- the market might be promoted more dynamically.

Practitioners that are willing to create mutual credit system aiming at establishing an alternative to the conventional monetary and financial system need to keep an eye on the dimensions analysed, to prevent the system from becoming obsolete before even having been launched.

Finally, these awareness about the symbolic and material spheres, which must run together in the development of social currencies that use mutual credit, would pave the way for the popular sectors to escape from the "exclusion and financial exploitation" to which they are exposed, by joining a credit system under the values of the Popular and Solidarity Economy.

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Social currencies as public policy instruments: The case of municipal social currencies in Brazil

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ABSTRACT

In Brazil, some local governments are creating their own social currencies for paying social benefits to poor families. These governments were inspired by the experiences of community development banks (BCDs) that use social currencies, which comprise a network of 148 initiatives in the country (Pupo, 2021). In addition, the digitalization of social currencies, which began in 2015 with the experience of the Mumbuca social currency, in the city of Maricá (Rio de Janeiro), and later consolidated through the acquisition of the E-Dinheiro platform by the Brazilian Network of Community Banks (RBBC), has contributed to municipalities' process of reapplication the BCD methodology. This reapplication process has taken place with the support and guidance of RBBC. Today, there are eleven cases of the so-called Municipal Social Currency (MSC) in Brazil. The purpose of this article was to understand how these social currencies have been assimilated by some local governments. However, the recent dynamics of the process made it difficult to get primary and secondary data. Therefore, this research was exploratory, and we present only two cases: the Livre (Free) currency, adopted in the city of Limoeiro de Anadia, Alagoas, and the Araribóia currency, used in the city of Niterói, Rio de Janeiro. We sought to understand the cases by associating them with the concept of public policy instruments (Lascoumes & Le Galès, 2004; 2007; 2012), and the Mirada ao Revés notion (viewing in reverse) in public policy studies (Amorim & Boullosa, 2013; Boullosa, 2013). In addition, we contextualize the relationship between the use of social currencies and public policy through some studies published in the International Journal of Community Currencies Research (IJCCR). We believe that the discussion we start here can provide the theoretical and practical foundations to guide the use of social currencies in municipal public policies. Our intention is to support RBBC in finding the appropriate institutional design for a democratic governance, without losing the potential of partnerships with public authorities, much desired throughout the network's development process.

1. Introduction

In Brazil, some local governments are creating their own currencies for paying social benefits to impoverished families. These governments were inspired by the experiences of community development banks (BCDs) with social currencies, whose use has become popular from the notorious experience of Palmas Bank, in Fortaleza, and due to the social changes they promote in the territories where they circulate.

Most BCDs are located in impoverished communities, mainly in small cities of the Northeast region of Brazil, and in poor neighborhoods of large cities. Each BCD, as part of its methodology of action, creates and manages its own currency that circulates only within that territory, building a local economic circuit between traders, producers, and consumers. Therefore, as social currencies and BCDs are seen as mechanisms for territorial development, they can also be understood as public policy instruments. This potential called the attention of governments since 2003, through the action of Senaes (National Secretariat for Solidarity Economy), linked to the Ministry of Labor and Employment at the time, and the federal public policies it created.

In September 2004, Senaes's support resulted in the first reapplication of the BCD methodology, and the PAR Bank was established in the western coast of the State of Ceará, in the city of Paracuru. In 2005, the idea of reapplicating the CDB methodology was consolidated, and several partnerships were built for setting up BCDs throughout Brazil. A relevant step was the creation, in 2006, of the Brazilian Network of Community Banks (RBBC), aiming to contribute for exchanging experiences and knowledge, gather resources, and strengthen partnerships between the network and support and promotion entities, in addition to partnerships with the public power itself. Another turning point was the National Solidarity Finance Program, also created by Senaes in 2010 (Neiva *et al*., 2013). According to the last survey, in December 2021, there were 148 BCDs affiliated to RBBC, of which about 50% were created between 2010 and 2015, strongly influenced by Senaes' programs and policies (Pupo, 2022).

As of 2015, with the near disappearance of Senaes from the national scene, the implementation of new BCDs became more directly linked to state and municipal government actions, especially those oriented to social protection, income transfer, territorial development, and access to microcredit. It was in this scenario that one experience stood out among the new BCDs. In the city of Maricá, state of Rio de Janeiro, the Mumbuca social currency was implemented by the local administration, ending a process that had begun in 2013. Mumbuca was the first digital social currency in Brazil (Cernev & Proença, 2016).

Following Municipal Act 2,448, of June 2013, BCD Mumbuca became the financial operator of municipal socioeconomic allocation and aid programs. The most important, Maricá's Basic Citizenship Income program, established BCD's debit-credit card and the digital social currency, the Mumbuca, as tools for transferring income to the poorest population of the city. Between 2013 and 2017, the network established between card users and local merchants benefited 14,000 families with BRL 100 per month (Faria *et al*., 2020). Actually, the municipality allocates annually an average of BRL 86.7 million (approximately USD 17.3 million) to 42,500 citizens of Maricá (26% of the local population). The Mumbuca is seen as an enhancement of payment logistics for low-income people, as digital social currencies, by incorporating information technology, expand their circulation in the territory (Alves *et al*., 2014; Gonzalez *et al*., 2020).

In the same period, in 2015, RBBC launched the E-Dinheiro digital platform, a prepaid payment arrangement that allows purchases and transfers through a digital social currency. The use of such currency by BCDs was only possible by Act 12,865, of 2013, that regulated digital payment arrangements in Brazil. The E-Dinheiro Brazil Institute was created to manage this platform, and operates together with the Palmas Bank Institute, which led the creation of RBBC. According to RBBC representatives, the E- Dinheiro platform, developed to operate on mobile phones, allows expanding financial inclusion to low-income people (although not excluding people from other classes). Hence, with the successful experience of Mumbuca and with the E-Dinheiro platform, the reapplication of the BCD methodology in other territories, with the leadership of local governments, has become a reality in the country.

This is the context of our study, whose goal was to better understand how social currencies are assimilated by local governments in some Brazilian cities. What we present here is part of a larger research project that began this year, under the coordination of one of the authors. It is entitled "Social currency and community banks in Brazil: Potentials and limits as public policy instruments for the development of territories", and foresees, among other stages, a new mapping of the entire RBBC, including BCDs and municipal social currencies, the focus of this study. At this stage of the research, still exploratory, we have identified the experiences of banks and municipal currencies created so far, and present two cases: the Livre currency, at Limoeiro de Anadia, Alagoas, and the Araribóia currency, in the city of Niterói, Rio de Janeiro.

We sought to understand the cases by associating them with the concept of public policy instruments (Lascoumes & Le Galès, 2004; 2007; 2012), and the Mirada ao Revés notion in public policy studies (Amorim & Boullosa, 2013; Boullosa, 2013). In addition, we reflected on the use of social currencies as public policies, through studies published in the International Journal of Community Currencies Research (IJCCR). Regarding the method, in addition to a bibliographic survey related to the topics of this study, we carried out interviews with four key actors: two representatives of the Municipal Secretariat of Social Assistance and Solidarity Economy of Niterói, responsible for implementing the Araribóia social currency; the district attorney for the city of Limoeiro de Anadia at the time of the Livre currency implementation; and Joaquim de Melo Neto, president of the Palmas Bank Institute and the E-Dinheiro Brazil Institute, the main protagonist of RBBC since its inception.

Although exploratory, the discussion we engage in this article is relevant for several reasons, of which we highlight two. First, there is no precise information on the cases of municipal banks and currencies in Brazil, since this is a recent movement. Second, our discussion can bring insights to guide the use of social currencies in local public policies, especially because we do not know the directions these initiatives will follow, and what will be their relationship with RBBC community banks that already operate in several territories.

2. Public policy instruments and the “View in Reverse”

Lascoumes and Le Galès (2004; 2007; 2012) provide a notion of public policy instruments that seems appropriate for understanding social technologies, such as social currencies (Rigo & Ventura, 2019). For the Lascoumes and Le Galès (2007), public policy is often analyzed as a result of the interaction of interests or of institutional structure, but they should also be considered a sociopolitical space built either through techniques and instruments or by goals or content.

> A Public Policy instrument is a device that is both technical and social, which organizes specific social relations between the state and society (those to whom the

> instrument is addressed), according to the representations and meanings that it (the instrument) carries. It is a particular type of Institution, a technical device with a generic purpose of establishing a concrete concept of political/society relations, supported by a concept of regulation (Lascoumes & Le Galès, 2007, p.4).

For these authors, the instrumentation of public policies means the set of problems posed by the choice and use of instruments (techniques, methods of operation, devices) that allow state public policies to take place. Therefore, instrumentation is a way of guiding the relationships between political society (through the administrative executive) and civil society (through managed matters), by means of intermediaries in the form of devices that blend technical components (measurement, calculation, the Rule of Law, procedure) and social components (representation, symbol) (Lascoumes & Le Galès, 2004). Hence, instruments enable forms of collective action to stabilize and make actors' behavior more predictable and probably more visible (Lascoumes & Le Galès, 2007).

Currently, multicentric approaches for public policies have gained relevance. They go beyond the state-centered approach, and consider public policies as "a complex, multifactor action to address a public problem, through instruments activated by different people in a policy arena" (Amorim & Boullosa, 2013, p. 59).

Boullosa's (2013) understanding reverses the logic of how public policy should be perceived and analyzed. The author suggests that the focus should be on the "problem of public relevance", rather than on the quality and attributes of actors, whether public or private. This leads the analyst to invert the expression "public problems" to "problems that are public", since, under this perspective, the attribution of "actions from one government" are understood as "government actions," that is, the ones that rule are those who are authorized, in the ongoing processes and flows of public policy. Hence, inverting the view, public policies are like

> [...] flows of instruments, practices, and arguments, activated by a multiplicity of actors and intended to solve a problem perceived as publicly relevant. Thus, if the problem of public relevance is the element that defines the public character of a policy, the quality of the actor that activates it is no longer determinant. Flows become multidirectional, non-linear, and the decision-making process becomes plural (Amorim & Boullosa, 2013, p. 20).

In this sense, public policies result from the contributions and interaction of various actors that establish rules and develop their own dynamics (Amorim & Boullosa, 2013). Thus, these actors govern the flows of actions, according to their powers of governance in certain circumstances. Moreover, the very definition of what is a public problem is left up to the actors who put not only their governance powers in motion, but also activate their intentions in the field and in making public policy. According to Boullosa (2013, p. 77-78), the government of certain actors takes place through "their powers of governability, of mobilizing resources, and influencing other actors that form that specific public arena".

That is, the policy is "public" because the problem that brings together the actors and their actions to define and address the problem are "public." Thus, "public" qualifies the problem (Boullosa, 2013). From this perspective, the actors grant themselves some degree of governance over the public policy process, and build their spaces within the arena around the problem. Boullosa (2013) understands public policies "viewing in reverse", which means going beyond laws, norms, procedures, objective phenomena, and ordered programs. Thus, it seems that, by "looking in reverse," a public policy is constantly under construction, starting from a problem (or several) that is socially recognized as public. Under this perspective, it is always possible to

~~interpret public policy as a complex, multifactor, and multicentric process, oriented to solving~~ a problem of public relevance.

3. The public authority and the interest in systems of social currencies

Blanc (2018) shows how, in recent years, public powers have acted and reacted in the face of the development of social currencies in the world. Some social currency systems by moving closer, others by deliberately moving away from potential state interference (even if to support them).

In a brief survey in IJCCR, searching for studies that directly address the discussion of the relationship between the use of social currencies (also called community or complementary) and public policies, we found those related to: (a) how social currencies can be influenced, to a greater or lesser degree, by the public sector (Honzawa, 2009); (b) how they can be legally accepted by the Central Bank and become public policy instruments within the national monetary system (Freire, 2009); (c) as a policy instrument for behavior change towards sustainability (Joachain & Klopfert, 2012); and (d) governments interested in research on the functioning and potential use of social currencies for supporting experiments or creating their own (Van Kuik, 2009; Freire, 2009).

In Honzawa's analysis (2009, p. 21), social currency systems undergo different degrees of public intervention, showing how public-private partnerships or, more commonly, public-community partnerships result in hybrid monetary systems. The author reminds us that "there are local social currencies that have developed exclusively in the public sector, as in 2014, when France began to regulate them (article 16 of the Act 2014-856, on the social and solidarity economy)". The specific legal framework facilitated the support of local governments for creating social currencies, as in Toulouse, Lyon, and Grenoble. In another example, in Bristol, UK, sometime between 2012 and 2020, the user could pay the municipal tax in Bristol Pounds, which were automatically exchanged for British Pounds (Honzawa, 2009).

Thus, local public authorities can promote the use of social currencies actively. In the case of Trueque systems in Argentina, between 2001 and 2003, the complementary currencies were widely accepted, including by the federal government. For exemple, the Patacón, the complementary currency in Buenos Aires region, was used to pay public debts (up to 80% of pension and salary payments) (Colliac, 2005).

According to Honzawa (2009, p. 27), "each project should design its own model based on its objectives, context, available resources, and the capabilities of the promoting organization". The fact is that, either to regulate (by supporting or prohibiting), governments have shown interest in exchange and payment systems through social currencies. Some require prior studies to understand the functionality and potential of local monetary systems to be adopted as instruments of public intervention (Van Kuik, 2009); others, to understand what it's all about, and if they harm the public authority for issuing currency (Freire, 2009).

Concerning the demand from the government of Landgraaf, Netherlands, in 2007, which requested an investigation to know if a community currency could support its anti-poverty policies, Van Kuik's (2009) literature review concluded that the general idea was that currencies still had to prove themselves regarding their effects. In this respect, although they advocate the use of social currencies, many scholars agree that their effects cannot be easily checked, and there is a real need for employing more appropriate evaluation methodologies (Lopes, Rigo, & Silva Júnior, 2018; Silva Júnior, 2016; Silva Júnior, Rigo, & Vasconcelos, 2015; Ruddick, 2011), mainly qualitatives evaluation methodologies (Rigo, 2020).

Freire (2009, p. 91), investigating the legality of social currencies in Brazil as instruments of public policy compatible with the monetary policy under the responsibility of the Central Bank, concluded that they were compatible and beneficial, because "the wealth produced in the local economy mainly benefits the people who participate in the social currency system, and each system builds what could be called an optimal monetary area". However, the author already warned that, from a legal point of view, it was important to investigate the cases of digital currencies, due to the volume of transactions they could reach and the absence of a specific legal framework in the country, at that time.

4. The E-Dinheiro platform and the potential for using social currencies as public policy instruments in Brazil

The debate about the legality of social currencies in Brazil has revealed two poles of understanding. On one side, less significant, is the argument that the Central Bank is being complicit and tolerant with the use of such currencies, assuming that they promote development. Thus, the Central Bank would not be fulfilling its function as "guardian of the national currency, preventing the emergence of others" (Caminha & Figueiredo, 2011, p. 118). In this sense, if not even financial institutions can create a currency, neither could the community banks, since they would be assuming the role of the Central Bank and interfering in the national monetary policy. On the other side, more expressive and supporting the development of the idea and practice of the use of social currencies in Brazil, is the argument that these currencies, beyond legality, do not pose any threat to the role of the Central Bank regarding national payment systems, much less to the stability of the financial system, since they do not represent a significant macroeconomic impact (Freire, 2009; 2011).

From this perspective, social currencies establish social monetary systems, based on available local resources, and directed to "meet needs not yet served by the official currency in such locations" (Freire, 2009, p. 91). Thus, in practice and legally, social currencies can indeed be public policy instruments.

In Brazil, some laws have contributed to sustaining and developing the field of solidarity finance, in general, and the use of social currencies, in particular. Act 12,865 of October 9, 2013, of Brazil Central Bank, which defines payment arrangements and payment institutions that are members of the Brazilian Payment System (SPB), was crucial for the digitalization of social currencies by BCDs through the E-Dinheiro platform. The legislation states that payment institutions, among other functions, can "convert physical or scriptural currency into electronic currency, or vice versa, accredit the acceptance, or manage the use of electronic currency".

According to this national legislation, electronic currencies are resources stored in an electronic device or system that allows end users to make a payment transaction. In addition to the principles provided for payment arrangements and institutions, such as soundness, efficiency, quality and transparency of services, and protection of data and of users' economic interests, this legislation stipulates financial inclusion, innovation and diversity of models of payment institutions and arrangements (Brazil, 2013, art. 7). That is, it foresees the process of financial inclusion through the use of mobile devices.

> Brazil Central Bank, the National Monetary Council, the Ministry of Communications, and the National Telecommunications Agency (Anatel) will stimulate, within the scope of their competencies, financial inclusion through the participation of the telecommunications sector in the provision of payment services, and may, based on periodic evaluations, adopt measures to encourage the development of payment

arrangements that use costumer-owned terminals for access to telecommunications services (Brazil, 2013, art.8).

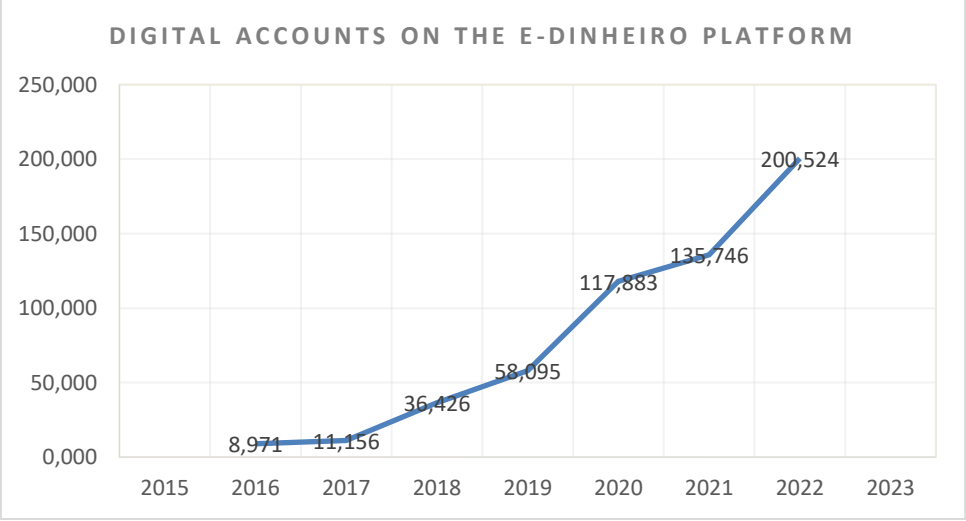
Other important and subsequent legislations were the Regulatory Framework for Civil Society Organizations, known as MROSC (Act 13,019 of July 2014), which provides the basis for "partnerships between the public administration and civil society organizations, for the achievement of purposes of public and reciprocal interest" (Brazil, 2014), and Act 13, 636 of 2018, in its article 3, which authorizes Civil Society Organizations of Public Interest (OSCIP) to operate or participate in the National Program of Productive and Oriented Microcredit (PNMPO). These regulatory marks strengthened the legitimacy of BCD methodology and the use of social currencies, and opened space for their digitalization.

Starting with the Palmas social currency, the E-Dinheiro platform has replaced paper currencies in several territories where BCDs operate. The purpose is to improve and increase the supply of financial services and, consequently, promote greater financial inclusion in the communities. With the platform, it is possible to pay bills, make transfers, buy credit for a cell phone, etc. It is also possible to have a more focused communication with users and gather information, to better manage the supply of credit and currency circulation.

In addition, according to Joaquim de Melo Neto, president of the E-Dinheiro Institute and Palmas Bank Institute, the 10 years of using the Palmas paper currency allowed building a sense of community among the neighborhood residents, and its replacement does not change this feeling in the territory. For Cernev and Diniz (2020, p. 490), "for many low-income people, this digital account through a smartphone application was probably their first and only experience of having and using a financial account".

These authors also mention (2020, p. 491) that "between 2015 and December 2016, when the expansion of E-Dinheiro platform to other locations began (including Maricá and the insertion of part of Mumbucas on the platform), 2,477 people were already using the platform in 166 accredited stores, with a transaction volume of BRL 10.5 million". However, the platform still has a large potential for growth, since only about half of the BCDs in the network have implemented it in their territories. Figure 1 shows the growth in the use of social currencies in RBBC through the E-Dinheiro platform.

Figure 1: Evolution of the number of open digital accounts on the E-Dinheiro platform (2016-2022)



Source: E-Dinheiro Institute (2022)

More agile and instantaneous, the digital social currency has the advantage of allowing immediate liquidity for the dealer, which increases the speed of exchanges and the circulation of local wealth. BCDs' digital social currencies strengthen the local market by stimulating demand, through the increase of local purchasing power, favoring the flow of production and distribution at the neighborhood, territory, or city levels. Although not immediately, traders and service providers have gradually accepted the digital social currency. A percentage of these transactions is set aside by BCDs for a credit fund to be offered to merchants at low interest rates. About the range of total BCDs operations, 57% carry out credit operations and 60% operate with the E-Dinheiro platform, using the digital social currency for consumption, bill payment, cell phone recharging, access to credit, and basic income transfers and social benefits. There were more than 135,000 E-Dinheiro users, mobilizing BRL 1.1 billion (about USD 220 million) in operations in 2021 (Pupo, 2022).

5. From support to government leading role: municipal social currencies as instruments of local public policy in Brazil

As we have seen, between 2005 and 2015, Senaes played a predominant role in the creation of new BCDs that formed RBBC, and in building the idea that they could be considered public policy instruments. At that time, although on a one-off basis, some BCDs received direct and constant support from city authorities, and the case of São João do Arraial, in the interior of Piauí, stands out. When realizing the potential of BCDs as a public policy instrument, the city government copied the experience of Palmas Bank and created the Community Bank of Cocais, in 2007, in articulation with the organized civil society. The goal was to mitigate the effects of the lack of a bank branch in the territory, and population's financial exclusion. To this end, the authorities enacted Municipal Act 112, in 2007, and made an agreement with the Community Bank of Cocais. Therefore, it was authorized to hire the bank to pay civil servants and collect municipal taxes with the Cocais social currency.

Unlike the process of constitution of Cocais Bank, as we saw in the introduction of this article, Mumbuca Bank, located in the city of Maricá, RJ, was created by the municipal government, through Act 2,448, of June 26, 2013, which established the Municipal Program of Solidarity Economy, Fighting Poverty, and Economic and Social Development of Maricá. This act allowed the use of a social currency, the Mumbuca, as an instrument of income transfer from the city to the poor families. Initially, this process took place through the use of a magnetic card, provided by a company. With the acquisition of the E-Dinheiro platform by RBBC, the Mumbuca could also be used in the platform, expanding the possibilities of social programs' payments. After that, the Bank and the Mumbuca currency became a recent example for municipal public managers to implement public policies of income transfer through their own social currencies, limiting their use within the cities.

We highlight that this process of reapplication of social currencies by local governments has taken place with RBBC's direct guidance, and each municipality establishes its own legislation for the operation of the social currency. Today there are 11 cases of the so-called municipal social currencies (MSC), and only a few cities, like Maricá, have set up a community bank to operate with microcredit.

Table 1: **Municipal Social Currencies (by legislation date)**

City/ State	Currency Name	BRL Value/month	No. of families	Municipal Legislation	Circulation period	Pop. *
Silva Jardim/RJ	Capivari	_	_	Act 1,502 /May 2010	Ongoing	21,775
Maricá/RJ	Mumbuca	100.00	42,000	Act 2,448/ June 2013	2015-today	167,668
Limoeiro de Anadia/AL	Livre (Free)	70.00	1,000-4,500	Act 173/ April 2019	Nov. 2019 to Dec. 2020	28,904
Porciúncula/RJ	Elefantina**	Digital accoun	E-dinheiro plataform	Act 2,378/June 2021	Ongoing, waiting for the cards and active on the platform	19,068
Itaboraí/RJ	Pedra Bonita	150.00	5,000	Act 2,867/April 2021	May 2022-today	244,416
Cabo Frio/RJ	Itajuru	200.00	1,000	Act 3,286/July 2021	March 2022	234,077
Niterói/RJ	Araribóia	Between 250.00 and 500.00	31,000	Act 3,621/July 2021	Dec. 2021-today	516,981
Saquarema/RJ	Saqua	_	_	Act 2,189/ January 2022	Ongoing	91,938
Indiaroba/SE	Aratu	450.00	100	Act 645/February 2022	August 2022-today	18,337
Iguaba Grande/RJ	Caboclinho	120.00	2,083	Act 1,403/ March 2022	March 2022-today	29,344
Itanhandu/MG	Tonites	-	-	Act 1,494/April 2022	Ongoing	15,511

Source: data from E-Dinheiro Institute, IBGE*, and Specific Legislations** (2022).

According to data from the E-Money Brazil Institute, the most common services paid in social currency are: a) basic income; b) food aid; c) social rent; d) bonus for civil servants; e) emergency programs for catastrophes; f) payment of servants; g) credit programs; and h) environmental projects (E-Money Brazil Institute, 2022).

5.1 Exploring two cases of municipal social currencies: Livre (Free) and Araribóia[1]

Between November 2019 and December 2020, in the city of Limoeiro de Anadia, interior of the state of Alagoas, Northeast Brazil, the Livre (Free) social currency circulated to pay social benefits to the poorest families. It was the first experience of using digital social currency after the Maricá experience in Rio de Janeiro. Its implementation process took place between 2017 and 2019, when the city mayor at the time started it, after learning about the social currency Terra, from the BCD at Igaci city, also in Alagoas. Next, the administration sought partners to implement the project, and two of them were crucial: a) the Technological Incubator of Solidarity Economy (ITES), of the Federal University of Alagoas (UFAL), which developed the methodology of implementing BCD and social currencies; and b) RBBC and E-Dinheiro

[1] **Araribóia** refers to an Indian chief that lived in the Guanabara Bay region and helped the Portuguese to conquer the territory against the French and the Tamoios, in 1567. The Portuguese rewarded him with a region at the bay entrance, which originated the city of Niterói, of which he is considered the founder. (Wikipedia, 2022). It is also the name of a snake species in the Tupi language.

~~Institute (which already provided the service of social currencies' digitalization through the~~ platform). Hence, the process of implementing the municipal social currency took place together with the BCD at Limoeiro de Anadia, which was born already connected to RBBC.

The city of Limoeiro de Anadia is peculiar. It is near Arapiraca, a city with an estimated population of 234 thousand inhabitants (IBGE, 2021), with high consumption power and a Gross Domestic Product (GDP) growth rate that exceeds that of the country and of the state of Alagoas[2]. Therefore, the population of Limoeiro de Anadia and of the towns near both cities prefer consuming in Arapiraca, either by the variety of stores or the ease of transportation,which results in the population's income flowing to Arapiraca; even the salaries are withdrawn in the bank branches of this neighboring city, and quickly spent there.

Based on this reality, the government of Limoeiro de Anadia and the partners in the process of implementing the currency raised awareness of the town's legislative chamber on the role of social currency in keeping part of the income in the city, since it could only be used there. Visiting Maricá, in Rio de Janeiro, contributed for convincing the City Council and the City Hall to enact Act 173, of April 3, 2019, which created the "Solidarity Economy Program, Fighting Poverty, and Economic and Social Development of the Municipality of Limoeiro de Anadia, as a way to fight social inequalities" [...]. According to the interviewee, the legislation of the city was designed to be wider, including social programs compatible with the whole field of solidarity economy. In practice, the legislation allowed the City Hall to sign an agreement with BCD to manage the Better Income Program, which pays social benefits to local vulnerable families.

Next, the Secretary of Assistance registered the beneficiaries and, between December 2019 and December 2020, the city transferred BRL 70 per month to each beneficiary. The funds were paid by BCD in the social currency Livre, through a magnetic card. Initially, the benefits were transferred to 1,004 persons, but with the outbreak of the Covid 19 pandemic, it increased the number of beneficiaries throughout 2020, reaching about 4,500 thousand people (Interview with former district attorney, August 2022).

Regarding the technology used, the card proved to be more suitable to the local reality than the E-Dinheiro platform. When queues became a problem, because of the crowds, in a region where much of the population lives in rural areas, with difficult access to the internet and using old cell phones, it was easier to educate them for using the card than the platform. Moreover, the interviewee highlighted that the payment of social benefits with physical currency, in this case paper social currencies, would face a legal obstacle, and digital means (card or digital platform) would be more consistent with the national legislation.

The benefits paid through the Livre social currency were interrupted by the new city administration in December 2020, two months after the municipal elections. Although the legislation defines the program as legal and legitimate, it does not guarantee its continuity, especially when there are government changes, since each public manager allocates resources to the actions he/she considers a priority. Because the income transfer program, the BCD, and the currency were directly linked to the previous government and its reelection campaign, we assume that they influenced the new government's decision not to continue allocating resources to them. The name of the social currency – Livre (Free) - was given by the previous mayor, relating to the notion of "freedom of speech", an issue that was part of his campaign.

[2] Between 2006 and 2009 (last data from IBGE), Arapiraca's GDP grew in nominal terms and on average 16.1%, reaching 1.7 billion, a growth higher than that of the state of Alagoas (10.5%), the Northeast (12.1%) and Brazil (11%). (https://www.fecomercio-al.com.br/2012/08/estudo-aponta-arapiraca-como-a-7a-cidade-com-maior-poder-de-consumo/)

More recently, and directly inspired by the Mumbuca, the administration of Niterói, also in the state of Rio de Janeiro, created the Araribóia currency, which, in the first five months of operation (December 2021 to April 2022), brought to the local economy BRL 134.4 million (equivalent to USD 26.88 million), through the payment of basic income to about 20% of its citizens. However, unlike Maricá, which started in one neighborhood and then expanded throughout the city, the Araribóia covered the whole city of Niterói. The authorities were in a hurry to use the social currency for replacing the Temporary Basic Income (RBT) program, implemented during the first year of the Covid 19 pandemic, which was about to end. Although the volume of income transfer and the number of people served by the Araribóia currency were smaller than in the previous program, the city kept a significant amount of resources in the territory, transferring BRL 500 per month to 50,000 families, from March 2020 to December 2021 (considering RBT program and Arariboia currency).

According to the interviewees, which represented the Municipal Secretariat of Social Assistance and Solidarity Economy, the process of implementing the Araribóia social currency occurred in two moments. The first comprised discussions and planning, and lasted from the first half of 2020 until the sanctioning of Act 3,621, in July 2021, which created the Solidarity Economy, Fighting Poverty, and Economic and Social Development Program of the Municipality of Niterói, as a way to combat social inequalities and foster the economic and social development of communities. Among other general provisions, the law established the Araribóia Social Currency Program, which provides a benefit value of 90.00 arariboias per person, limited to 6 (six) benefits per family.

The second moment was the implementation itself, starting with the bid of a Civil Society Organization (CSO) to manage the currency, which ended in October 2021. At this point, the CSO also started issuing cards and registering users, that is, traders and service providers in the municipality (formal and informal). Between September and December 2021, about 4,000 merchants and service providers were registered; there was a concern that when resources were available to the beneficiaries, they would find where to spend it. To give an idea of this task, the Cielo brand for food, Lelo, used by the RBT program that would end, covered 3,800 accredited merchants in the city.

According to interviewees, it took a specific task force and a great effort to explain and make people aware, before the currency was implemented. According to the Secretariat's estimate, more than 100 meetings took place in the city's poor communities to mobilize people. The team believes to have involved about 10,000 people, with crowded meetings, 200 to 300 participants, with the whole secretariat team working on this process.

They also mentioned that partnerships were fundamental, and highlighted the partnership with the Federation of Community Associations of Niterói (Fanit). They report that "Niterói has a very strong, very powerful community movement", including a direct and active relationship with the local public power. It seems that the role of associations in the city gains more legitimacy when they support community organization processes to make up public and social policies.

Regarding the initial criterion for registration of traders or service providers, they should be located in the city’s poor communities, in order to favor the low-income population in another way. However, after the first payment, the beneficiaries themselves started to pressure for the accreditation of some large supermarket chains. This was because, as an income transfer program, people typically used the resource to buy food. Therefore, the Secretariat decided to register some large supermarket chains, as long as they were located in popular areas of the

~~city. The supermarket chains welcomed the proposal, because they were already present in the~~ city of Maricá and knew how it worked.

6. Final remarks

This article is part of an ongoing research project, which began in May 2022 and is scheduled to end in March 2024. Therefore, the information and discussions we present here are still exploratory. The recent dynamics of the processes of creating municipal social currencies makes it difficult to obtain primary data, and based on some open interviews, documents, and websites we were able to present, although briefly, the cases of the Livre (Free) currency, in Limoeiro de Anadia, Alagoas, and Araribóia currency, in Niterói, Rio de Janeiro. Our goal was to understand how local governments assimilate these currencies. While both were created directly by the municipal authorities in each city with the same purpose - to transfer income to the poorest people - their implementation processes are much different, especially regarding the local context.

Both experiences have important similarities with the notions of public policy instruments and public policies "in reverse", proposed as a key reading in this article. Based on this understanding, an instrument such as the social currency (or even the entire BCD), is capable of structuring public policies from its own operating logics and through the relationship between actors, even producing governmental decisions. An instrument-focused approach is significant because it can complement the classical perspective that focuses on an organization or on the interaction between actors and representations, which has historically been central in public policy studies. It became clear that public policy instruments can be created by civil society actors, until they become government mechanisms for a more direct implementation, including building specific legal frameworks.

However, the greater participation of public authorities in systems that use social currencies raises important questions. One is about the autonomy of civil society in managing social currencies. Another question is on ensuring the continuity of the experience, with or without the participation of public authorities. In other words, what would be the appropriate institutional design to ensure civil society governance and the active participation of the public power in these systems?

The history of RBBC and municipal social currencies began with the complete absence of the public power, when the poorest families of Fortaleza, Ceará, were transferred to a distant neighborhood, Conjunto Palmeiras. In 1981, the residents created an association that, in turn, created the Palmas Bank in 1998. It was a period when the community organized itself and acted, while demanding unsuccessfully the attention and action of the local government. In 2003, as we have seen, Senaes was created and, as its head, Professor Paul Singer (1932-2018), a researcher and activist in the field of solidarity economy, undertook a series of policies for generating work and income, among them reapplicating the methodology used in the territory of Palmas Bank throughout Brazil. The partnerships between the Palmas Bank Institute, support and promotion entities (such as university incubators), and the federal public power ensured the constitution of RBBC and the consolidation of the practices of community development banks and the use of social currencies, especially between 2010 and 2015.

The continuous weakening of Senaes in the national scenario, since 2015, has led to reducing public policies for solidarity finance at the national level, but the visibility of BCDs and social currencies as potential public policy instruments was already consolidated. It seems that the legal framework, RBBC actions, the innovations of the Palmas Bank Institute, and research on BCD methodology have, to a large extent, ensured the legitimacy of these

~~community organizations. As a result, state and municipal governments began to support~~ directly some of these experiences, although not continuously.

However, cases like São João do Arraial (PI) and Maricá (RJ) show that the cities themselves can design projects to implement community banks and social currencies, without taking on the governance of the institutional arrangement built, that is, keeping the solidarity and democratic logic of BCDs' methodology, and not its technocratic and managerial logic. Currently, one of the most important challenges of RBBC is to support the use of social currencies through the direct leading role of city authorities, towards income transfer policies that aim to minimize local socio-economic difficulties, reduce social inequalities, and promote territorial development (goals compatible with the RBBC purposes). At the same time, it needs to ensure the permanence of one of its principles: participation and democracy in the bank's management and in the circulation of social currencies.

We believe that the discussion we have started here can provide the theoretical and practical bases to guide, at least academically, the use of social currencies in municipal public policies. It seems to us that by "viewing in reverse" at a public policy, we see it more clearly, in constant building. From now on, our intention is to support RBBC in finding the appropriate institutional design for democratic governance, without losing the potential of partnerships with public authorities, which have been so desired throughout the network's development process.

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Solving crises

Re-making money for an inclusive economy: Universal Basic Income in complementary monies

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> Taking into account that the administration of household goods requires its rules, its laws: what could be those laws that put the economy at the service of fragility? What should the relationship between economics and politics be like to ensure that everyone has what is necessary to live a fulfilling life?
>
> – His Holiness Pope Francis, 2021, the second of three of New Economic Questions asked to the Young Scholars Initiative YSI, here

Universal Basic Income (UBI) is an idea which time has come. Or so it would seem from the multitude of voices clamouring for it. Major tech-industry figures are converging with popular movement activists in demanding this particular form of progressive politics. From the likes of Silicon Valley entrepreneurs Jack Dorsey, Mark Zuckerberg and Elon Musk to more anarchist crusaders Yiannis Varoufakis and David Graeber, from politicians of the establishment such as Richard Nixon to political reformers such as Martin Luther King, from economists on the right such as Milton Friedman to those on the left such as Guy Standing, Universal Basic Income (UBI) is increasingly heralded as a form of welfare that is to project us into a more economically, socially and politically sustainable future. Their arguments differ along with their ideological inclinations: To address the rise in unemployment brought about by enlarged automation contend the techies; to take aim at the politically dangerous levels of inequality reason the moderates; to democratise the economy advance the activists. The common mantra, to give everyone the possibility to live a fulfilling life.

The general idea of a UBI – that the government should make a regular payment to every citizen sufficient to guarantee her material existence as a right with no strings attached – directly addresses some of the most pressing aspects of precarity and inequality that so trouble many observers today. The regularity and un-conditionality of payments take immediate aim at the uncertainty that so limits the precariat. The level of payment – high enough to cover basic needs – is meant to guarantee the right to subsistence so as to grant a dignified life. For scholars and activists, like for an increasing

number of renown supporters,[1] the certainty of having one's material needs covered is a fundamental requirement for deepening democracy. The Greeks realised this already, when they instituted rewards to citizens to enable their participation in political and cultural life.[2] A basic income detaches income from employment and thus enables people to have more control over their time so that, if they so wish, they can engage in work that is not remunerated but that nonetheless builds the polity: from participating in political debate to caring for family, friends, and neighbours; from volunteering for one's community to enrolling in education and retraining. In liberating the individual of the need to endure excruciating labour conditions and to perform jobs that go against one's ethical principles to be able to barely survive, and in freeing citizens from the constraints that determine reception of welfare benefits, a universal basic income becomes an essential component in efforts to build societies where people enjoy the moral freedom to act as they think is right, and the republican freedom to speak back to power. A more egalitarian, democratic and emancipatory system, it is argued, requires everyone has its subsistence secured.[3]

While pilot studies show the promises a UBI in national currency offers for recipients,[4] and while UBI ideas are slowly infiltrating the programs of political candidates in several national and local elections,[5] the objections to move from pilot studies to institutionalised UBI programs are still many. One set of concerns refers to its financing. A regular basic income paid to everyone in a country would simply be unaffordable, this objection goes. The second set of concerns relates to cultural and ideological assumptions of worth and human nature. Providing "something for nothing," basic income is said to promote laziness, reducing the supply of labour; scarcity is needed to make people work. The gigantic stimulus packages governments put together to confront the pandemic has proven the first set of objections is a matter of political will, not of lack of funding. The second set of objections has been proven wrong in many UBI pilot studies, which show recipients resolve to keep jobs that give them an occupational identity or to retrain for future participation in the labour market.[6] That is, both

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[1] Supporters of UBI include Nobel laureates James Buchanan, Herbert Simon, Angus Deaton, Christopher Pissarides and Joseph Stiglitz; academics Tony Atkinson, Robert Skidelsky, Robert Reich, Clauss Offe or Philippe Van Paris; economic journalists Martin Wolf and Martin Sandbu. The idea has gathered other supporters who, however, defend the need for a UBI not from the perspective of deepened democracy, but from the risk increased automation puts to profit due to the overall decline in purchasing power. Among these supporters we find Silicon Valley investors and tech entrepreneurs Sam Altman, Chris Hughes, Elon Musk or Eric Schmidt to name but a few. For an updated and more detailed list of supporters, visit the website of the Basic Income Earth Network (BIEN).

[2] In Standing, G. 2017. *Basic Income: A Guide for the Open-Minded*.

[3] For a thorough exposition of the main arguments for basic income – justice, security, and freedom –, as well as for an overview of the objections to it – mainly those concerning affordability and its impact on the supply of labour – and how to address them, I recommend reading Standing, G. 2017. *Basic Income: A Guide for the Open-Minded* as well as Bregman, R. 2017. *Utopia for Realists: How We Can Build the Ideal World.* For a discussion of UBI in relation to a re-organisation of national money along the ideas of Modern Monetary Theory (MMT) see Crocker, G. 2020. *Basic Income and Sovereign Money: The Alternative to Economic Crisis and Austerity Policy*. Palgrave Macmillan.

[4] Initial studies of various UBI-type programs in low-and middle-income countries show not only a positive impact of these programs on the local economy (Jones & Marinescu 2018), but also large improvements in psychological well-being (Haushofer & Shapiro 2016) and health (Robertson et al. 2013), as well as a significant reduction in domestic violence (Haushofer et al. 2019). These positive impacts were observable beyond those individuals and households receiving the unconditional payments, in the form of increased consumption for non-recipient households and on larger revenue for local firms (Egger et al. 2019). Importantly, positive impacts were sustained over time with recipients able to build higher levels of asset holdings, and maintain food security, consumption levels, and psychological well-being relative to non-recipients (Haushofer & Shapiro 2018). Improved impacts are proving to be resilient to dramatic shocks such as the Covid-19 pandemic (Banerjee et al. 2020). Positive impacts have also been documented in high-income countries such as Canada (Forget 2011; Simpson et al. 2017) and Finland (Kangas et al. 2020), with a reduction in hospitalisations, improved mental strain, and increased school attendance. For an overview of impact studies of various UBI-type programs, see Hasdell 2020.

[5] To name just a few: 2020 Democratic presidential candidate Andrew Yang, Indian member of parliament Varun Gandhi, co-founder of the Workers Party of Brazil Eduardo Matarazzo Suplicy, Germany's minister for foreign affairs Annalena Baerbock, and almost half of the politicians in the Welsh and Scottish parliaments.

[6] For an overview of these pilot studies results, see Standing, G. 2017, chapter 11.

objections have more to do with politics and our assumptions about human nature than with the technical and economic merits of the proposals. And so, while UBI is increasingly defended as a necessary element to change the politico-economic system and bring about a more inclusive future, because its approval requires of the established institutions, UBI advocates are rendered powerless by the very system they ambition to transform.

Instead of waiting for change to come from established institutions, a variety of actors are taking the lead by creating complementary currencies through which to implement their UBI vision. From grassroots groups anchored in local communities to digital entrepreneurs with global ambitions and regional public authorities in partnership with civil society organisations, UBI has become a policy ideal mobilising shifting interest groups in what Polanyi may have called a countermovement. United by a recognition of the need to protect themselves and others from the destructive socio-political effects of intense inequality, and infused with the sense of real possibility new technologies have awaken, these groups varyingly call on the commons, the state, or the market to design, organise and realise a different socio-economic order. Each following its own organising principle, grassroots groups, local public authorities, and the private sector are, independently of each other, assembling their own monetary arrangement to put their UBI utopias into practice.

The actors behind Demos, Mumbuca and GoodDollar all share a dream for a different economy, for an economy more equal caring fair, an economy inclusive of the most fragile. They all conceive UBI as the policy tool that would allow society to realise that dream. They all take a hands-on learning-by-doing approach to the concrete realisation of the UBI utopia. Yet they advance different practical answers to the twin questions of monetary design and governance. Informed by distinct cultural and ideological imaginaries and standing on distinct power structures, Demos, Mumbuca and GoodDollar follow distinct organising principles to re-make money. The paper unpacks the three currencies and shows that though these monetary experiments may be presented under the same UBI story-line, though they may cater to the most fragile in our societies, the different set of relations they assemble into the new monies has far-reaching consequences for the form of the economy and the depth of democracy these monies enact in the communities using them. This lesson holds beyond the particular experiments studied. Attending to how the relationship between money creation, economic interests, and socio-political groups is designed and organised can help us appreciate the extent to which an economy truly has a chance to align individual interests to the service of the common good.

Demos

> We have constructed our economic system along different rules which radically change how the economy works.
>
> – Miguel Ángel Figueroa, member of Demos[7]

"Este sistema no nos representa" / "This system does not represent us." On May 15, 2011, tens of thousands of young citizens took to the streets all over Spain to denounce a political system that, they felt, did not represent their economic realities. The economic crisis that followed the financial crash of 2007-2008 had left many in unstable, insecure jobs with declining real wages and no clear occupational narrative. The austerity policies governments were implementing worsened the situation, leaving this "new dangerous class" with little or no benefits, with poor public welfare services, and in a

[7] Own translation from the original: "Hemos hecho nuestro sistema económico con unas normas distintas que cambian radicalmente cómo funciona la economía." Interview published in the local newspaper *Diario de Lanzarote*, on December 23, 2013, here. See also, Delisau Suárez, S. 2018. *Demos, moneda social virtual con renta basica*. Universidad Oberta de Catalunya. Accessed on May 9, 2022, here.

situation of chronic debt.[8] A generation better educated than any previous in history, they faced however a future of precarious badly-paid jobs for which they were overqualified. A few days previous to regional elections, the manifestations quickly grew into a movement – known ad "the Spanish revolution" or the "movement of the outraged"[9] – demanding "real democracy now!" Thousands of "youth without future, no home, no job, no pension, no fear" camped in the squares of cities across the country, resisting official calls to empty those public spaces and enduring police violence. Under cries such as "we are not merchandise of politicians or bankers," and "traitor politicians, culpable bankers," the outraged voiced their discontent with the traditional political powers seen by the many as supportive of an economic system – global capitalism – that took their future away from them. They condemned a financial system of "economic terrorism," in which established political parties promulgated the interests of capital – "State = Capital" –, condemning citizens to "give [their] souls for a mortgage" and to "become slaves for a roof and a job."[10] The Spanish Revolution had been inspired by the Arab Spring and would soon inspire similar outraged movements in various countries of the North Atlantic in what became known as the Occupy movement.[11]

Campsites on city squares developed into small urban laboratories for the kind of direct democracy and economy of solidarity and mutual care the young activists were clamouring for. They self-organised in groups that attended the children, collected, cooked and distributed food, gathered books and lent them freely, educated for non-violent struggle, informed new arrivals, continuously updated media communication, and organised shifts to guarantee sanitation and security in the camp. For all the febrile activity, for all the lack of sleep, they lavished time and energy in various forms of horizontal decision-making processes. They held daily general assemblies to discuss technical issues of organising the camps, developed hand-signals to conduct consensus-based direct democracy, and collectively studied the latest labour market reform. The intense months of experimentation with direct participatory democracy and horizontal social coordination created both a community organised without market or state, and an enraptured sense of boundless possibility. The experience opened the horizons to a more exciting world. It catalysed a "transformative outbreak of imagination"[12] that not only projected a vision of another organisation of society but that had also realised that vision in the relatively small heterogeneous and inclusive communities that coalesced in the squares.

Aware that "nobody is going to come to save us," tired of "feeling like the donkey forever chasing the carrot," yet armed with a new sense of possibility, activists from La Isleta, a mixed neighbourhood of the capital city of the island of Gran Canaria, went on to try to realise their collective utopia. "Trapped

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[8] Guy Standing speaks of the precariat as a the new dangerous class that has emerged from the demise of the traditional proletariat. The process of globalisation that unfolded with the neoliberal turn of the 1980s led to the erosion of labour rights and the weakening of trade unions. This has resulted in a change on the relations of production, a change that has been the most dramatic for the lowest income group. This group has seen its labour contracts become "flexible", casual, part-time or intermittent; precarious. The constant change of jobs and the need to take whatever is on offer leaves the precariat with no occupational identity, forced to work for little pay in jobs that carry no pension or holiday benefits. Such structural conditions have led the precariat to feelings of anxiety, anomie, alienation and anger, turning them into a "dangerous class," some of them united in their struggle for a progressive agenda. See Standing, G. *The Precariat: A New Dangerous Class*, and *A Precariat Charter: From Denizens to Citizens*.

[9] The Spanish name of the movement ("Los Indignados") came from the French booklet that inspired it, Stéphane Hessel's *Indignez-vous!* from 2010. A second booklet that greatly inspired the non-violent tactics followed by the Spanish movement was Gene Sharp's *From Dictatorship to Democracy: A Guide to Nonviolent Resistance* from 2012/2002.

[10] For some pictures of the many manifestations where these slogans can be read in placards, see here.

[11] Much has been written about the long-term impact of the Spanish Revolution and Occupy movements in the societies that held them. While some dismiss them as simple outbursts that left nothing but disillusion when they wore out, others argue that they transformed the political landscape, with the formation of new political parties that have changed the parliamentary game – as in Spain –, the organisation of civil society to support the most vulnerable – as to stop evictions –, or the re-appropriation of the urban space for conviviality use – as in the creation of urban gardens on abandoned plots. For an ethnographic account from one prominent participant in the Occupy movement, see Graeber, D. 2013. *The Democracy Project: A History, A Crisis, A Movement.* New York: Spiegel & Grau.

[12] Graeber's formulation.

[as they were] in the official monetary system" which "made [them] dependent" and "prevented [them] from changing it for the better," they reasoned, if they were to "reduce their dependency on the system," "it [was] necessary to build an external support."[13] They took their demands for a caring economy and dreams of deepen democracy forward into action by designing an "economic system along different rules which radically change how the economy works." At the heart of the economic system they were engineering they put a new monetary system; and at the core of that new money they put UBI. They aimed to organise an alternative monetary arrangement that not only implemented a universal basic income but which rules for the creation and governance of money also followed the values of mutual care, equality and direct democracy they had experienced in the square.

The form and reason of their community currency was made clear from its very name. "Demos" was chosen for its triple signification. First, it makes direct reference to the Greek *demos* – the common people, plebeians with civic status and rights, commoners –, to foreground those "who give money its value" and "who money should really serve." The double reference to the *demos* as both the basis of value and the purpose of money encapsulated some of the lessons the outraged of La Isleta had learnt as they contributed to organise the camp on the square: one, the extent to which *individual contributions* constituted the communities shaping up on the square and two, the centrality of the *relationship between rights and obligations* for a community to work. Thereof the second signification, a collective exhortation to give explicit through the collective imperative form of the verb "dar" – Spanish for "to give" –, "demos" – literally "let us give" – as in "let us give a monthly payment in complementary currency [so as to] guarantee everyone can satisfy one's most basic needs," as well as in "the need for every one to give" if the community economy is to work.[14] Finally, "Demos" made for the acronym of what the grassroots group stood for, "Democracia Económica en MOneda Social" or "Economic Democracy in Community Currency."[15] Two pillars of Demos were, from its very start, key to the sort of deep economic democracy the group was intent to realise: the universality of a basic income in the local currency and the governance of the monetary arrangement through a general assembly.

The initial features of Demos' internal design: 1, the quantity of money issued is proportional to the number of users; 2, released at a monthly rhythm through the payment of a UBI to all active individual members; and 3, a fixed proportion of each member's account balance is automatically withdrawn monthly and transferred to the Common Fund.

First, the issuance of demos. Every time a new member registers, an amount equal ten times the basic income is created and placed in the Common Fund. The purpose is to "mirror the human value of participants in the monetary system by making this human value equivalent to the existing quantity of money."[16] There is a direct relationship between the amount of demos and the size of the community, an implementation of the designers' twin premises that money is to serve the community and that money derives its value from the community. In a second step, demos is automatically introduced into the community at the beginning of every month through the transfer of basic income from the Common Fund to each member account. Concerned about the "sustainability of the basic income over time," the third step consists in automatically charging to every member at the end of the month a "cooperative tax" equal 10% of the member's account balance. In the words of one of demos co-designers, "the basic formula of incomes and taxes is really simple. In the end, you have money circling around. It feels like the easy trick of a street magician but it results in many positive effects. It allows you to distribute money [as well as] to discourage its accumulation in individual accounts for, why would you contribute [sell] too much? You would end up paying more taxes than the income given to you. So you end up being more interested not in contributing yourself but in teaching someone else

[13] From Demos Manual, *Funcionamiento de Moneda Demos*.

[14] From Demos website, here.

[15] In Spanish, the term used to speak of local or community currencies is "social currency" (*moneda social*).

[16] In Demos Manual, p.5. Own translation.

to do what you contribute with."[17] From the outset, it seems, demos was engineered so as to encourage individual users to balance their economic activity with their level of consumption; to provoke a behaviour in line with the collective vision of a caring and more equal economy. The call to align individual behaviour to the requirements of the real utopia they were building was condensed in the maxim "Give as much as you can receive," a direct call for individual members to balance their contributions to and appropriations from the community, their obligation to give with their right to take.

———- insert figure 3 from demos manual ———

Demos demurrage tax mechanism soon proved inadequate to induce reciprocate giving to the community. The first basic incomes in demos were paid on June of 2012. Though a small amount, initially fixed to 50đ per month (equal 50 euros), Demos' commoners soon observed some users – "ninja users" – were taking from the community without contributing to it. Come Demos basic income at the beginning of the month, they would go to the Demos markets – "mercademos" –, spend it all in products commoners readily offered in the local currency, and leave with an untroubled "I don't have any more demos left, so I'll come next month once I've received my basic income." For an economy that was being organised from scratch by the grassroots, the monetary arrangement needed to incite members to contribute with their goods and services, to provide for the community-in-the-making, to produce for there to be a real economy outside of the established euro. Yet dependent as individual members were on euros, some of them were producing in the conventional economy alone and consuming in the emerging complementary economy; they were taking from the local community without giving back to it. The tragedy of the commons was playing out from the very start of the local currency. True, a cooperative tax was withdrawn from the accounts of ninja users, but this made no productive contribution to the community economy. For monetary tokens alone do not make an economy – an insight ignored by many a crypto-entrepreneur and that we will see happen again in GoodDollar's UBI. The *pendulum mobile* of the tax mechanism that had been built into Demos was not triggering the obligation to reciprocate with real goods and services that so builds community and economy.

By January 2013 the general assembly was discussing changes to the rules that governed the monetary arrangement. And they decided to deal with their own version of the tragedy of the commons the same way communities around the world have dealt with similar tragedies for centuries: with a graduated system of sanctions and rewards.[18] The basic income was to remain universal, yet the level of payment was conditioned in two ways. First, the basic income to be paid each month was to

[17] Miguel Ángel Figueroa, interview on April 12, 2022.

[18] Mainstream economics and political science had for long argued that the only way to deal with the tragedy of the commons is through giving property of the common resource to either private owners (in whose interests it would be to manage the resource) or public authorities (who could regulate its use). That is, it was either through the market or the State that the commons could be managed. In her Nobel prize winning research, Elinor Ostrom argued there was a third way to manage the commons, one that had proven resilient to changes in the conditions of the common resource and to the pass of centuries. Her empirical research took her to communities that had managed water and land resources sustainably for years all over the world. She identified 8 principles shared by communities that had successfully managed the commons sustainably. Summarily, well defined communities developed governance rules fit to the local circumstances of the resource and the community, monitored the following of those rules, and developed a graded system of sanctions for those that broke the rules. Both the development and implementation of rules and sanctions worked best if it carried in an inclusive participatory manner by members of the community. As we see, these are all principles Demos followed intuitively, from their very premise to realise economic democracy. Ostrom, E. 1991. *Governing the Commons: The Evolution of Institutions for Collective Action.*

vary with the total volume of trade in the community two months previous – a monetary design that strengthened the relationship between the amount of demos in circulation and the size and activity of the community. The more members in a community, and the more active these members were, the higher the monthly basic income. Second, the basic income paid to each individual member was to vary with the degree that member had contributed to, relative to taken from the community. Those members that had taken more than they had contributed received a basic income somewhat lower than the average. Those members that had contributed more than taken received a basic income somewhat higher than the average. A universal basic income which level is conditioned to one's contribution to the community, they hoped, would remind users of the importance of giving for both building community and developing the economy. The two design features aimed at aligning individual interests to the interests of the collective.

———- insert figure 4 from demos manual ———

Once such system of sanctions and rewards was decided in the general assembly, the calculations were automated through the code, whereupon individual behaviour adjusted swiftly, promptly strengthening the community economy. Members who had not found interest in the products they offered quickly set to learn about other members' interests and adapted their offerings accordingly. Goods most on demand – mainly local food, lodging and transportation – were readily offered. "We started to see ourselves under the key of 'what can I give'." As they gave, earned, spent and took, members became aware of the value others granted to skills and competencies they had themselves been blind towards. The middle-aged unemployed woman whose bakery unfailingly sold out as did the elder woman's marmalades. In realising the value of their offerings, some members found a springboard to imagine their lives differently and to start up their own small businesses. Today, the middle-aged woman sells home-made cakes to local cafés who pay her in euros, the elder woman runs a marmalades business that sells, in euros, to groceries on the island, and Lali has dared to realise the dream of her youth, "earn a living as a herbalist." As one member proudly assessed, "it is the dream outcome of any labour-market program."

Most notably, the experience taught the community the enormous infrastructural capacity well-arranged money can have – even such a local and young money as Demos was. As a Demos user phrased it, "it started as a response to government inaction but that soon was forgotten in favour of what we were observing. Demos was organising us!" Or, "the rules you implement change behaviour." Among those rules, Demos Assembly identifies those related to taxes, rewards and sanctions as the most determinant. Connecting taxes to the level of one's wealth – one's account balance in the Demos economy – "makes selfishness unprofitable." As for rewards and sanctions, they concede, they help educate members about the reciprocal obligation to take and give back, about the relationality of this money; it teaches members to move away from an imaginary of money as property – a commodity to dispose at will – and onto an imaginary of money as a relation of credit and debt towards one's community; it teaches them to relate back, to give forward, thus contributing to co-develop commoners and commons in the process.

As the pandemic wanes down, demos markets are being spontaneously organised. "We have missed each other" – an indication of the enduring sense of community and of individual responsibility towards each other Demos-money has contributed to develop.

> The new currency will not be mandatory, but an option to increase the city's commerce. […] Civil society, through a council, will have an active participation in the project.
>
> – Miguel Moraes, Maricá's municipal secretary of human rights, in Neumann, D.M. 2021

Located some 40 km North of Rio de Janeiro, along the Brazilian Atlantic coast, Maricá is home to over 160,000 inhabitants. A satellite city to Rio, a mere 23% of Maricá's working-age population work in the municipality. With no industrial or productive capacity within its territory, the largest majority of Maricá's working population commutes to Rio and other neighbouring cities to earn a living. Maricá's economy is further characterised by a large number of families living under the poverty line, an extensive informal economy, and a youth with little hope in the future.[19]

Though industrially underdeveloped, the City of Maricá receives a large sum of royalties from the oil fields in Bacia de Santos. In an effort to support the most vulnerable families, in 2011, the mayor of the city decided to distribute part of these royalties as a social benefit added to the federal government's welfare program "Bolsa Família" – a national income transfer program conditioned on keeping children vaccinated and in school. The mayor was however aware that the royalties transferred as welfare to citizens in the form of Brazilian reals soon leaked out of Maricá as residents and merchants used it to buy from outside the city or to pay debts owed elsewhere. That is, paid in Brazilian reals, the extended welfare program was strengthening Maricá's economy and its families only to a very limited extent.

Intent "to develop the city's economy […], trade in particular,"[20] in December 2013, Maricá introduced a local currency, Mumbuca, through the Mumbuca Community Bank.[21] Oil royalties backed the new currency on a one-to-one basis. Mumbucas were injected into the city's economy as welfare benefits – again, on top of the regular benefits in the national currency – to the city's low-income families. Introduced as a strategy for local development, merchants had no obligation to accept the currency in payment of their goods. To attract them to the city currency network, however, merchants were given the possibility to convert their earned mumbucas into Brazilian reals, these coming from the royalties backing the currency. To keep it local and constrain money leaking out of the municipality, convertibility was restricted to merchants that were registered in the municipality. Conversion was also charged 2%, which went to fund the operations of the Mumbuca Community Bank.

——— insert drawing of Mumbucas monetary arrangement here (see R€22/6) ———

From its inception, the Mumbuca monetary arrangement developed organically, following a trial-and-error process of sorts through which the local public authority and the community bank learnt together. Started small at first, the city gradually increased the size of the welfare benefits paid in mumbucas, enlarged the range of beneficiaries, and developed the underlying technology. In late 2014, one year after its inception, 14,000 families received a complementary family benefit of 85 mumbucas/

[19] I would like to thank Professor Eduardo Diniz from Fundação Getulio Vargas for his patience and detail in explaining the context, development and functioning of Mumbuca and its tech payment platform e-Dinheiro.

[20] Neumann, D.M. 2021. Mumbuca: Moeda Social e/ou Renda Básica de Cidadania? As narrativas sobre a moeda social de Maricá. Master thesis. *Fundação Getulio Vargas*. Accessed on April 25, 2022, here. I have Professor Mario Aquino Alves to thank for this reference.

[21] Cernev, A. & Proença, B. 2016. Mumbuca: a primeira moeda social digital do Brasil. *Revista Brasileira de Casos – Gvcasos*, 6(2). Cernev, A. 2019. Mumbuca e-Dinheiro. *Revista Brasileira de Casos – Gvcasos*, 9(2).

month – equal 85 reals – which eventually grew to 130 mumbucas per family and month, and later transformed into 130 mumbucas per family member and month – a family of four thus seeing its total allowance increased from 130 to 520 mumbucas. New welfare programs, catering to other precarious citizens, were added in 2015: a "youth solidarity minimum income" – 100 mumbucas monthly for young persons aged 14 to 29 –, and a "pregnancy minimum income" – 85 mumbucas per month paid to mothers during pregnancy up to the child's first birthday.

Distrusting yet "another political initiative," merchants were initially reticent to accept mumbucas, the number of merchants in the mumbuca network barely growing beyond the 100+ that first registered in 2014. To promote acceptance, the city cancelled the 2% redemption fee for those merchants converting mumbucas into Brazilian reals before the 5th of the month. Another key development during these initial years was the city's decision to support the digitalisation of the infrastructure. In 2018, mumbuca went from a paper- and card-based currency onto a digital currency supported by the e-Dinheiro payment platform alongside a Mumbuca plastic card.[22] The e-Dinheiro platform allowed beneficiaries not only to receive and spend their mumbucas, it also gave them access to regular banking services, such as a savings account, a checking account, or the possibility to get a smaller credit. A previously unbanked and vulnerable population could now pay their bills, make P2P transfers, or buy a phone on credit. In this way, the expansion enabled by a monetary technology driven by a community bank embedded mumbuca deeper into Maricá's economy.

The continuous tinkering with mumbuca's monetary arrangement – from its rules and beneficiaries to its technology and partners – meant that by the time the Covid-19 pandemic hit Maricá, the city was well prepared to quickly roll out an encompassing UBI program.[23] First, it enlarged, simplified, and unified its various welfare benefits under two programs: a "renda básica e cidadania," literally "citizen's basic income", handing 300 mumbucas per person and month to all registered citizens unconditional of their means, and a "renda minima" or "minimum income" of about 1,000 mumbucas handed to precarious micro-entrepreneurs in the gig economy as well as to employees companies retained despite the economic downturn brought by the lockdowns. Second, the fact that the technology was already in place and citizens were versed in its use enabled the immediate implementation of the UBI-like emergency benefit programs.

Indeed, while implementation of the emergency basic income approved by the Brazilian Congress on the onset of the pandemic was riddled with challenges to reach out, in April 2022, the Mumbuca-based UBI successfully reached out to 42%[24] of Maricá's population. With a large informal economy, many Brazilian citizens are not registered in the Federal Government's registry, and even if registered, many of them do not have a bank account. During a time of increased health risk, agglomerations formed at the entries of government agencies and bank offices across the country as citizens queued to register, renew their national identity cards, and start a bank account through which to receive the emergency basic income they were eligible to. In Maricá, instead, registered citizens eagerly

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[22] The payment platform e-Dinheiro was developed by Instituto e-Dinheiro – formerly Instituto Palmas – a non-profit organisation that supports the development of community development banks across Brazil. See Cernev, A. & Diniz, E. 2019. Palmas para o e-Dinheiro! A evolução digital de uma moeda social local. *Revista de Administração Contemporânea*, 24(5):487-506. Ansonera, A., Diniz, E.H., Siqueira, E.S. & Pozzebon, M. 2021. From Community Bank to Solidarity Fintech: The Case of Palmas e-Dinheiro in Brazil. In Walker, T., McGaughey, J., Goubran, S., & Wagdy, N. (eds.) *Innovations in Social Finance*, pp.251-268 (here). For the history of Instituto Palmas itself, see Meyer, C. 2012. *Les finances solidaires comme biens communs durables: étude de cas de la Banque communautaire de développement Palmas (Brésil)*. Bruxelles: Université libre de Bruxelles. Other???

[23] Other cities took the step to roll out a UBI when the pandemic hit. The most known are probably those of Barcelona (Spain) and Seoul (South Korea). See Seung-Yoon Lee, S., Lee, J. and Kyo-seong, K. 2020. Evaluating Basic Income, Basic Service, and Basic Voucher for Social and Ecological Sustainability. *Sustainability*, 12; Martín Belmonte, S., Puig, J. and Roca, M. 2021. Crisis Mitigation through Cash Assistance to Increase Local Consumption Levels: A Case Study of a Bimonetary System in Barcelona, Spain. *Journal of Risk and Financial Management*, 14(9):1-17.

[24] Freitas, F. 2022. Transferência de renda com moeda social em Cabo Frio, Itaboraí, Niterói e Maricá: alívio da pobreza ou renda básica? *Gestão, Política e Sociedade*, here.

downloaded the Mumbuca app to claim their rightful basic income, the city easily transferring the Mumbuca basic income to its citizens.[25] The number of Mumbuca bank accounts grew from 37,550 in December 2019 to 65,374 in September 2021 – a 74% increase. Most tellingly, the volume of trade in mumbucas in local businesses grew from 36.172.646,47 in 2019 to 254.403.346,66 in 2021 – a 603% growth in local trade, guaranteeing money served the local economy.[26] The results of the last elections in November 2020 are telling of the satisfaction of Maricá's population with the outreach of municipal welfare programs: 94% of citizens renewed their confidence in the Workers' Party that governs the city.

If you think about it, it is not at all surprising. A monetary system anchored in local government brings the infrastructural capacities of money to empower public development policies at the city level. And conversely, anchoring the monetary architecture on a centralised, if local, authority, enhances the infrastructural capacity of money by amplifying its reach and speeding up the rate at which city-dwellers embrace it. A welfare policy that benefits the population at large directly addresses the concerns for inequality and precarity that dominate the day. When delivered in a currency organised to work for the region a little longer – by constraining its use to the local territory –, the public welfare policy not only supports low-income citizens but has the potential to further strengthen local businesses and the local economy. As money remains circulating in the territory, it remains working for the territory. The local nature of the monetary architecture and its articulation through local public policies are both key features to understand the rapid change both currencies effected on the economic dynamics of the local communities.

Mumbuca's monetary architecture includes however a design feature that weakens its ability to work for the territory, its economy and its people. The possibility for local businesses to redeem mumbucas into Brazil's national currency opens up a gate for money to leak out of Maricá. What's more, convertibility risks the long-term sustainability of any local currency. Such dynamics were readily observable in the complementary-currency-based UBI-like program implemented in Barcelona between 2018 and 2019. After 13 months, once the backing in euros was exhausted, the program necessarily ceased.[27] In Maricá, 85,5% of the mumbucas injected into the economy in 2018 were redeemed. Had Maricá not had a stable and secured source of national money in oil royalties, the possibility to redeem would have consumed the backing of the local currency and, with it, mumbucas would have ceased to exist. Such a high conversion rate was a sign of the, then, limited trust – or use, or both – local businesses had for the local currency.

Yet, as local businesses gained trust in the commitment of public authorities and as the mumbuca economy developed, conversion ratios went down. 67,88% of mumbucas were converted into Brazilian reals in 2019; 60% in 2021.[28] Over 12,600 businesses accept the local currency in payment for their goods and services, 67% of which trade at least once a month in the local currency, and 26% of which pay for all their supplies exclusively in mumbucas.[29] With mumbucas not being accepted for payment of taxes and with mumbucas distributed as a right with no required counter-obligation, there is no clear mechanism built into Maricá's local monetary arrangement. As the number of merchants not converting mumbucas into reals grows, the answer to the question 'how does mumbuca work' – or 'why would merchants accept mumbucas in payment of their goods and services' – necessarily hinges on the size and variety of the real economy that gradually articulates into the monetary

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[25] See Gonzalez, L., Cernev A.K., de Araujo, M.H. & Diniz, E.H. 2021. Digital complementary currencies and public policies during the COVID-19 pandemic. *Brazilian Journal of Public Administration*, 54(4):1146-1160.

[26] From "Métrica e Volumetria dos Programas Sociais da Prefeitura de Marica: RBC, PAT, PAE e Aluguel Social. Balanço 2018-2021." *Instituto E-dinheiro Brasil*. Accessed on April 25, 2022, here.

[27] Martín Belmonte, S., Puig, J. and Roca, M. 2021. Crisis Mitigation through Cash Assistance to Increase Local Consumption Levels: A Case Study of a Bimonetary System in Barcelona, Spain. *Journal of Risk and Financial Management*, 14(9):430-447.

[28] Up till September of 2021.

[29] Gama and Costa, 2021, cited in Freitas, F. 2022.

arrangement. The larger and more varied, the more possibilities merchants have to spend their mumbucas and thus, the more willing they are to accept them in payment for their goods. The so-called "network effect" as it plays out in monetary arrangements – the more and more varied the merchants and users, the more valuable the monetary tokens. Or, in a formulation more attuned to the commons perspective of the book, the value of a currency for an economy rests on the community of users behind it. Mumbuca is evidence of the key role local governments play in catalysing the network effect.

GoodDollar

Open UBI is controlled by its own ecosystem
and does not depend on politics or changing governments.

– Yosi Assia, CEO and Founder of eToro, at the OECD Forum, 2019[30]

The "flagship CSR [Corporate Social Responsibility] of eToro"[31] – a multi-asset investment platform –, GoodDollar is a cryptocurrency designed to channel impact investment into a UBI of global reach. The premise of the GoodDollar UBI experiment is uncontested: wealth inequality is "one of the biggest problems in the world today," leading to "populist movements, instability and violence,"[32]-a problem the founders of GoodDollar argue is bound to get worse as artificial intelligence, machine learning and automation result in the further disappearance of jobs. GoodDollar team's discontent with the mainstream solution to inequality is widely shared: "trickle-down economics has proved a failure. The wealthiest 10% of the globe's population now earns 52% of its income, whereas the poorest 50% takes home just 8% of that total. The gap is even more pronounced when it comes to wealth. Of the world's total assets, the poorest half of the population owns just 2%, while the top 10% hold three-quarters."[33] GoodDollar's suggested solution, a growing clamour across the board: "[UBI as a] new approach to capital and liquidity distribution;" "get one GoodDollar a day and keep the banker away."[34] GoodDollar's drive for change is inserted within the seemingly attractive trend to incentivise investors to put private money to work for people and planet: "we have a fundamental belief that there are enough people who care not just about doing well for themselves, but also about doing good for others; […] there is a large and growing appetite to invest in impact-driven initiatives that seek human and/or environmental wins alongside financial gains."[35] An appeal "to do well while doing good" that underscores a form of reasoning that juxtaposes finance with the common good. GoodDollar's technical infrastructure and organisational arrangement is professedly apolitical: "take blockchain technology and create a non-profit," dodge the "political discussion" that comes with UBI when conceived at a national scale and when implemented through "government-led currencies," and write UBI scheme into "computer code that cannot be manipulated or changed" thus making it "independent of one's specific politics or government."[36]

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[30] Yosi Assia, CEO and Founder of eToro, presenting the non-profit GoodDollar at the OECD Forum in 2019. A recording from the presentation can be found in YouTube; accessed on April 29, here. The quote appears on the slide shown in minute 8 of the video.

[31] As stated in GoodDollar's website, here. Quotes in this section come from Yosi Assia's intervention at the OECD Forum, GoodDollar's White Paper, and GoodDollar's website. See also Assia, Y. & Ross, O. 2018. Good Dollar Experiment: Wealth Distribution Position Paper.

[32] Yosi Assia's address to the OECD Forum, 2019. Minute 2.

[33] Assia, Y. Barrack, T., Iron, T. & Stone, A. The GoodDollar White Paper, p.2. Here.
For a brief, entertaining, and well-informed critique of trickle-down economics, see Quiggin, J. 2010. Trickle-down economics. *Zombie economics: How dead ideas still walk among us*, chapter 4, pp.137-176.

[34] Yosi Assia, 2019, at the OECD Forum.

[35] Assia, Y., Bariach, T., Oron, T. & Stone, A. The GoodDollar White Paper, p.11.

[36] Yosi Assia, 2019, OECD Forum. About minute 7.

Fundamentally, GoodDollar's ambition to "righting the balance of economic equality"[37] through a global UBI distributed by means of the GoodDollar cryptocurrency builds simultaneously on the logics of financial rewards and social good. These otherwise contradictory forms of reasoning[38] are brought together through a perceived apolitical arrangement that is "much a part of laissez-faire, of market structure. […] It's really about just changing mechanics to create something that's fairer but could be as free and as open."[39] In short, GoodDollar's efforts to build a UBI utopia are simultaneously grounded on the profit motive that drives actors in financial markets and the notion of monetary automation enabled by the code.

In the supposedly apolitical mechanics of GoodDollar – I apologise for the barrage of crypto-jargon – investors *stake* – hold – their assets in the GoodDollar Trust. These yield interests which are deposited – ~~*yield farming*~~ – in the form of DAI – a decentralised *stablecoin*[40] – into the GoodReserve to back the *minting* – issuance – of GoodDollar tokens (G$). Users can further back the minting of GoodDollar by depositing cryptocurrency in the GoodReserve in exchange for new G$s. Finally, G$s are also minted daily as the reserve ratio – the ratio between the assets staked in the GoodReserve and the G$s in circulation – is set to reduce gradually. Once minted, G$s are distributed partly to investors – "supporters" in the GoodDollar ecosystem – as return for their investment, and partly to UBI recipients – "claimers" – as a basic income they receive when they log into their GoodDollar *wallet* and actively request the payment, a request they can claim daily. Though "no one guarantees the liquidity or market price of the G$ to any extent at any time,"[41] in theory, anyone holding G$s can convert them into any of the cryptocurrencies held in the GoodReserve. The conversion rate varies according to a *bonding curve* – an *automated market maker* mechanism that facilitates the liquidity of GoodDollar or, in lay-language, a computer program that automatically prices cryptocurrencies against each other thus removing mediators when buying and selling G$s. This results in the total supply of G$s varying alongside the assets staked in or removed from the GoodReserve: "when a user buys G$s, the tokens are minted, when they sell, the tokens are *burned*."[42] If not through the GoodReserve,

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[37] GoodDollar White-paper, p.3.

[38] The blending of a financial logic with a logic of social good is not new. Micro-finance and social impact bonds are typically designed along both logics. On the one hand, these financial instruments attend the interests of investors so as to mobilise their resources and put them to work to achieve a social or development goal. On the other hand, there is an avowed intention to focus on satisfying the needs of more or less vulnerable groups. These are, as it were, instruments that cater to two distinct interest groups which may have conflicting interests – returns and liquidity the investors, economic development the target groups –, and timeframes – the short-term dominates investors' preoccupations, while a long-term approach is central for achieving sustained socio-economic development. As investors and financial actors ultimately hold the upper hand, the interests of investors tend to be prioritised over those of the vulnerable groups which these hybrid instruments are supposed to serve. For a critique of financial instruments that follow a hybrid logic, see Roy, M.J., McHugh, N. & Sinclair, S. 2018. A Critical Reflection on Social Impact Bonds. *Stanford Social Innovation Review*. Yan, S., Ferraro, F. & Almandoz, J. 2018. The Rise of Socially Responsible Investment Funds: The Paradoxical Role of the Financial Logic. *Administrative Science Quarterly*. Kent & Dacin. 2013. Bankers at the gate: Microfinance and the high-cost of borrowed logics. *Journal of Business Venturing*, 28(6):759-773.

[39] Yosi Assia, 2019, OECD Forum. About minute 4.

[40] Stablecoins emerged as a response to the volatility that characterises first generation cryptocurrencies such as bitcoin. By pegging and backing their value to an official currency, to a basket of currencies, or to an external asset (such as gold), the teams behind stablecoins aim to overcome the instability of the currency's price and thus provide a safe digital asset. Dai is a well-known stablecoin on the Ethereum blockchain backed by Ethereum-based assets deposited in the MakerDAO ecosystem. Those involved in governing DAI aim to maintain its value equal to 1,00 USD. Initially, much hope had been placed in the stability stablecoins promised. See, for instance, Fantacci, L. & Gobbi, L. 2021. Stablecoins, Central Bank Digital Currencies and US dollar Hegemony. *Accounting, Economics, and Law.*

The crypto-crash of 2022 has however thrown much doubt upon the reality of the backing that is to stabilise this second generation of cryptocurrencies. The implosion of TerraUSD – an stablecoin which 1-to-1 peg to the USD was meant to be held by its backing in the crypto-token LUNA – was the particular event that threw the crypto world into turmoil: when LUNA succumbed to extreme selling, its value collapsed bringing the value of TerraUSD down with it, and raising general mistrust on other stablecoins.

[41] GoodDollar Whitepaper.

[42] GoodDollar Whitepaper.

G$ holders can always try to exchange their G$s for other cryptocurrencies at *decentralised exchanges* (DEX) – peer-to-peer marketplaces enabling crypto-traders to exchange their crypto-holdings without the mediation of banks, brokers or any other financial intermediary.

——— insert drawing of G$ monetary arrangement here (see R€22/6) ———

Already here, in the rules that govern the creation and distribution of G$s, we can observe the political nature of the GoodDollar monetary arrangement. How many G$s are created and at which rhythm they are created is contingent on investors and investors alone: on their willingness to put their assets to work for the GoodDollar global utopia, on how long they are willing to hold their assets in the GoodDollar Trust, and on the degree of returns they demand from their investment in GoodDollar. There is a direct relationship between the amount of G$s issued and the financial disposition of investors; the supply of G$s completely detached from the number of UBI claimers GoodDollar is supposed to serve. The level of UBI paid daily is similarly dissociated from the economic needs of recipients. Instead, daily UBIs vary alongside the interests generated by the assets of the investors and the degree of distribution of these interests back to investors relative to UBI claimers. That is to say, the rules for the creation and distribution of GoodDollar money are designed along a financial market principle that prioritises the moneyed interests of investors. Whatever trickles down to UBI claimers – in September 2022, around 105 G$/day, at a price of 0,000176 USD/G$ equivalent to 0,0185 USD/day or less than two cents a day[43] – depends on the benevolence of investors to stake their assets and forgo financial returns. It is difficult to see how a monetary system that puts the profit calculations of the wealthy at the heart of its monetary rules is to free money from politics. The sanctity of financial returns gives space to a denial of responsibility on the part of the well-off for the condition of the world's poor. In the case of GoodDollar, it reproduces wealth and power disparities at the heart of money creation. Instead of a money free of "changing governments," we got a money and accompanying social welfare scheme organised around the whims and changing bets of investors, leaving the poor GoodDollar is supposed to serve exposed to the uncertainty and instability of financial market forces.

Another important component articulates into the GoodDollar monetary assemblage: markets where users can spend their G$s, thus conferring use value on G$s. To this end, GoodDollar has set up its own dedicated online marketplace in which users can advertise the goods and services they want to sell and find the goods and services they want to buy. As for the development of on-the-ground markets in G$s, the assumption of the GoodDollar team is that, as users accumulate the complementary currency, "local vendors and merchants will face growing pressure to accept it in exchange for goods and services."[44] The ease with which G$s can be converted into other currencies – or, as phrased in the White-paper, "as G$ will be liquid from day one" –, it is hoped, would also attract merchants to accepting the cryptocurrency in payment for their goods. In other words, two cultural assumptions guide the articulation of the new money with the productive economy where the poor ~~GoodDollar aims to serve~~ live and work: pressure from users holding commodity money (or demand exerted in G$s) and ease of conversion (or locating the value of money in money itself). Building on these assumptions, the GoodDollar team expects the free introduction of G$s into the economy will lead to the spontaneous emergence of online and on-the-ground trade relationships.

[43] For updated figures, visit GoodDollars dashboard here.

[44] GoodDollar White Paper, p.13.

Such cultural beliefs are in line with the economic orthodoxy of the barter myth, that conceives markets develop spontaneously and money as a neutral intermediary that eases relationships of trade.

With barely two years in existence, it may be too early to deem whether markets do end up developing spontaneously in the GoodDollar economy. So far, transaction figures seem to point in a different direction. Twenty-two months after its inception, in June 2022, with the total number of active UBI claimers 75,800 and the total number of unique claimers 444,358, only 4,540 transactions were conducted.[45] If we assume unique active claimers carried those transactions – an assumption that results in the largest possible percentage of users actually conducting trade – we obtain 6% of them did so – down to 1% if we take the total number of claimers. G$ UBI claimers, the figures show, are holding (oops! hodling) to their G$s. And lively markets have therefore little chance to emerge spontaneously.

As we learnt through the monetary experiments in the book, the effectiveness of a currency for trade hinges not on its ease of conversion (liquidity), nor on its presumed intrinsic value. For a currency to actually serve as a medium of exchange and means of payment, it needs of a mechanism that provokes its holders to be willing to part from it, to spend it, to put it into circulation. In the crypto-space, dominated as it is by an approach to money as a commodity which market value development brings dreams of easy capital earnings, it is however unclear what would break the preference of investors and claimers to hold their G$s. A money imaginary that prompts users to relate to it as property to hold on to and eventually sell for a financial gain inhibits the movement of G$s into real markets. It is a money disembedded from relationships of trade in the productive economy. When, as it is the case with the GoodDollar initiative, markets for real goods and services do not exist previous to the launch of the complementary currency, the question that monetary designers need to ask is "why would participants in the monetary system be willing to spend the currency?" The ease of conversion – thanks to the "automated market maker" – alongside a cultural expectation in the crypto-space of increases in currency values, risks inclining G$ users to hold their crypto-money forward. And with no, or little spending, no emergence of a market for real goods and services where the poor receivers of UBI could put their G$ to use. A money designed to incite its users to hold it forward serves the speculative drive of investors and crypto-claimers without the possibility to satisfy the economic needs of the poor.

The final component in the GoodDollar monetary assemblage is its governance institution: the GoodDAO. A DAO, acronym for *decentralised autonomous organisation*, codes the crypto-fantasy of a money free of politics into a set of *smart contracts* – computer programs that execute automatically when predetermined conditions are met. Man-made as they are, those programs can be updated, re-coded and continuously adjusted to the evolving needs of GoodDollar users. Monetary variables such as the reserve ratio or the expansion rate of the GoodDollar supply, the conversion rate between G$ and the collateral in the GoodReserve, the minting rate of G$s when interests are deposited in the GoodReserve, UBI spending plans or the number of G$s rewarded for marketing referrals, can be re-programmed if the team maintaining the GoodDAO so decides. Decisions are taken through participation and vote by members in the GoodDAO community. Membership in the GoodDAO governance institution and individual voting rights are determined by one's holdings of GOOD – "a non-transferable token [that] therefore has no market value"[46] – at the equivalence of 1 GOOD = 1 vote. GOOD governance tokens are distributed regularly to investors and UBI recipients as these "interact with the protocol."[47] In short, the purpose of embedding the GoodDAO into the GoodDollar arrangement is to democratise decision-making concerning the management of money.

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[45] Figures for the months of February, April and May 2022 are similar. Accessed on September 9, 2022. For February, see here; for April, see here; for May, see here; for June, see here.

[46] GoodDollar White-paper.

[47] Gustavo Segovia, January 20, 2022, *GoodDAO Community Call 01: Main features of GoodDollar V2 & our first governance proposal. GoodDollar Discord Voice Channel*, here.

"DAOs are governed by the community, for the community."[48] The GoodDAO is an effort to transfer the control of money from the GoodDollar Foundation to the overall community and thus "safeguard against the wealthiest in the community capturing the lion's share of power."[49] A commendable ambition if the governance of money is to attend the common interest.

Now, two aspects bear a central import on GoodDollar's version of monetary democracy. One, how GOODs are distributed across the GoodDollar community. Two, the conditions and point of time at which the voices of the many are given entry into the decision-making process. Concerning the first dimension, the distribution of voting power across the community. The 1-GOOD-1-vote rule springs from the Proof-of-Stake reasoning that dominates the crypto-space, where voting rights hinge on the individual proving genuine interest in the particular cryptocurrency. The more cryptocurrency an individual holds, the stronger the commitment in the currency that individual is taken to have. The larger one's stake in the specific cryptocurrency, the more sincere the individual's interests on the good functioning of the currency is supposed to be. Proof-of-stake democracy – one-cryptotoken-one-vote rule – is based on individual wealth; the more you own, the more voting possibilities you have. It is the amount of crypto-possessions that grant you voting power – a form of democracy that is far from the liberal democratic ideal of one-person-one-vote. In grounding the strength of individual voting rights on individual holdings of the governance token, one-GOOD-one-vote fails to recognise the equal worth of each and every community member. An Athenian democracy of sorts, where non-proprietors – slaves, freed slaves, foreigners, women and children then, the have-nots in GoodDollar – are prevented from voting.

Such form of democracy begs the question of how unequally GOODs are distributed across members. It also raises the question of whether UBI claimers that do succeed in spending their G$s to satisfy their economic needs do retain the GOODs that may have been granted to them. Central as they are to assess the depth of the GoodDollar democracy, those two questions remain however unclear in the White-paper. From a blogpost by GoodDollar HQ, we learn that "beyond the initial and ongoing annual distributions of the token" – unclear to whom and in what proportions – there are two ways to earn more GOOD. "One is by *staking* G$ claimed through the app to the GoodDollar Trust. The other is by *staking* to the protocol (currently, in DAI), which will earn rewards in both G$ and GOOD."[50] That is to say, GOODs, and with them voting rights, are handed out to stakers, investors in the GoodDollar economy, putting staker-investors at the pinnacle of decision-making. This skews decision making towards the wealthy, risking further bending the monetary arrangement towards the investors which interests the G$ architecture already prioritises. It is all but certain that the interests of investors align to the interests of the poor the global UBI initiative aims to serve.

Let's imagine that GOODs are distributed evenly, and that poor UBI claimers are therefore given a fair chance to voice their interests and shape the future of GoodDollar. A second vector relevant in the design of real inclusive democracy concerns the conditions and point of time at which one is allowed to raise one's voice. Members who want to submit a proposal for change to the GoodDAO are required to have a minimum of 240,000 G$s in their wallets,[51] about 42USD at the time of writing. Though the figure may seem low for today's UBI claimers, it is a sizeable amount for those GoodDollar intends to serve, "populations [who] currently live on less than US$10 a day."[52] At any rate, conditioning the suggestion of ideas to one's savings is yet another wealth constraint perverting the GoodDollar democracy.

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[48] GoodDollar HQ. 2021. Introducing the GoodDAO: GoodDollar Governance. Accessed on May 7, 2022, here.

[49] GoodDollar White-paper.

[50] GoodDollar HQ. 2021. Introducing the GoodDAO: GoodDollar Governance. Italics are mine. Accessed on May 7, 2022, here.

[51] Gustavo Segovia, January 20, 2022, *GoodDAO Community Call 01: Main features of GoodDollar V2 & our first governance proposal. GoodDollar Discord Voice Channel*, here, minute 28.

[52] GoodDollar White-paper, p. 9.

It is also about timing. Imagine, again, that the G$s savings requirement was to be voted away, and that no other form of wealth – whether in GOODs, G$s, or stakes – was to condition the strength of one's voting rights. Inviting the community to participate in the governance of money *after* the monetary arrangement has been designed, organised, and implemented weakens the extent to which the community can effectually influence the monetary architecture. Investors have already been placed as the anchor of money creation, their interests at the center of money distribution. Poor members of the community are only invited ex post. Other monetary architectures, architectures that would have placed the poor at the core of money creation, are left out of the decision process opened up with the transfer of control to the GoodDAO. Designs that anchor money creation in the economic needs of users – like those of mutual credit systems or in Demos earlier in this paper – are not possible any more. Those decisions have already been taken, coded, and executed. And yet, those are the primary decisions affecting the level of UBI payment and thus the extent to which the poor will be able to cover their basic needs. Ex-post democracy is but a chimera of democracy.

Crypto-dreams of autopilot money free from politics, governments and bankers are rooted in a laissez-faire market principle that re-embeds money in a different set of political and cultural arrangements. Given money's capacity to infrastructure economic and social life, we cannot escape the need to arrange and continuously manage money. As GoodDollar shows, efforts to end politics in money are likely to end up shifting money's constituencies and displacing politics to spheres where fewer have the possibility to effectively raise their voice.[53]

Re-articulating money, markets and democracy

"What should the relationship between economics and politics be like to ensure that everyone has what is necessary to live a fulfilling life?" Pope Francis' question to young progressive scholars resonates with those raised by UBI advocates. Independently of background and ideological inclination – from the right and the left, from tech entrepreneurs and political candidates, from activists and scholars – UBI demands are re-focusing the discussion of the economy on reaching the most fragile, on including those living under 10USD a day, on providing stability to present and future precarious workers. Not for the sake of charity; not because of a suddenly woke philanthropic generosity. But because of a profound insight that the future of all, later generations included, hangs on the future of the weakest. Recent political and social instability has obviated that a sustainable future requires an economy oriented towards the common good, an economy that ensures "everyone has what is necessary to live a fulfilling life." UBI demands conjure up a diverse Polanyian countermovement calling for an economy that provides for the welfare of all.

Driven by a sense of urgency and an action-oriented attitude, some dreamers-doers have taken digital technologies into their hands to start experimenting with monies to build new inclusive economies. A UBI that reaches all is ultimately their collective goal. The understanding of "inclusive economy" they code into their monetary rules is however differently framed depending on the social, economic and political position they act from. For the community grassroots group, an inclusive economy is about economic democracy; for the local public authority, it is about regional economic development; for the fintech entrepreneur, it is about doing well while doing good. Different framings lead to different monetary designs, to different organisation of economic relations, and to different governance arrangements. They result in monetary assemblages that piece together the economy-society twosome differently. Such difference manifests most obviously in the role given to markets and the depth granted to democracy.

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[53] In *Woke Capitalism: How Corporate Morality is Sabotaging Democracy,* 2022, Carl Rhodes makes a parallel argument. He discusses the extent to which major corporations set the democratic agenda through what are popularly seen as good-faith gestures. Including progressive social critique – such as denouncing racism or calling for LGBT+ rights – in their marketing campaigns, corporations shape debates without the need to act on changing the very practices and structures at the root of what they may campaign for.

Markets play a pivotal role in all three complementary monies. They are however differently embedded into the monetary architecture. In Demos, the market is the place where members give and take, where participants exercise their right to appropriate and execute their obligation to give. It is a place of reciprocity, a place where debts and credits are cleared out, a place where to give, take and reciprocate and thus make community. Markets are simultaneously economy *and* community. Recognising the intense work required to set up markets that work effectively, Demos' monetary rules anchor the creation and distribution of money into the activity members carry to develop community markets. In Mumbuca, markets are equal to the economy. The state is the institutional setting within which markets function. Traders, markets, economy are made synonymous; local state policies to strengthen the economy thus directed to traders and the markets they work in. Markets are the object of local government's economic development policies. Rules concerning the creation and distribution of money are contingent on local government, its budget, and its assessment of citizens' economic need. In GoodDollar, markets of a particular type constitute the very rules coded into algorithmic money. Through the interests they generate, financial markets determine the rhythm at which money is created; through the price they accord, financial markets determine the value of the new money. Neither a community, nor an object of policy, in GoodDollar financial markets are the very principle organising money. The other markets, markets where the poor can attend their real needs, are assumed to emerge spontaneously; no need to embed the monetary arrangement into them.

The three complementary-currency-based-universal-basic-income schemes epitomise, as it were, three distinct principles for the design and organisation of economic and social relations – community-centred, state-centred, market-centred. Decision-making in monetary governance similarly follows the distinct principles. In Demos, the monthly General Assembly, open to all community members, makes monetary decisions through direct vote. In Mumbuca, the local government, elected every fifth year, makes those decisions in association with the local community bank. In GoodDollar, monetary decisions have been made by the developers and automated through smart contracts. The rules of Demos democracy and of its money are co-designed with users from before its implementation – ex-ante direct participatory democracy. In Mumbuca, citizens elect those that decide and re-elect them, or not, every five years – representative democracy as we know it. In GoodDollar, developers decide, code, and launch before users are invited to any decision-making process. Having put the interests of one group at the core of the money creation and distribution rules, the possibility to make decisions that radically change the system are limited for the other group – ex-post democracy skewed towards the moneyed interests. In both Demos and Mumbuca, money and the economy are subordinated to democratic politics, direct and continuous democracy the first, indirect and intermittent democracy the later. In GoodDollar, democracy and the economy are subordinated to the financial market principle coded into the monetary algorithm.

Apart from eliciting the wide range of designs and governance welfare programs under the same scheme may follow, Demos, Mumbuca and GoodDollar offer lessons that go beyond themselves. One, money is necessarily political in at least two senses: Whose interests it serves and, how social groups with varying economic interests are included into its design and governance. Two, if money is to reach to the most fragile, it needs to be articulated into state institutions that confer it legitimacy, scale, and trustworthiness. Three, if it is to put the economy at the service of society, money needs to be embedded in communal relations of reciprocal rights and obligations. In other words, we need to make sure the design and governance of money is done together, subsumed to democratic control, and directed to meet our individual and collective needs.

Money is a phenomenon with the capacity to infrastructure the economy and the polity. If we aim beyond giving the poor a means of subsistence, if we aim towards everybody having the means to live a free and fulfilling life, if we aim towards building an inclusive, just and equitable future, then we need to make sure the relationships we articulate into the money assemblage are just, inclusive and impartial. We need to subsume money and the economy under a renewed vision of democratic

politics. Markets are to be embedded as forums where community is made, the state as the partner that leverages community, investors as yet another component on equal footing to the have-nots. From the recognition that real value is created together follows the need to include, on equal terms, the voices of the many into the making of money. As we re-imagine, re-claim, and re-organise money to build an inclusive and sustainable future, we can take the opportunity to insert its constitutive relations in a deepened form of democracy.

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Solidarity and territorial resilience: local currency experiments during the Covid-19 pandemic

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Résumé

Dans cet article, nous questionnons les initiatives monétaires développées comme réponses à la situation socio-économique engendrée par la crise sanitaire, soit par des associations déjà gestionnaires de monnaies locales, soit par des municipalités. Celles-ci ont pu soit s'appuyer sur une monnaie locale déjà présente, soit émettre leur propre monnaie. Ce recours à des monnaies locales est interrogé sous les deux angles combinés des formes de solidarité promues et de leur contribution à la résilience des territoires concernés. Après avoir distingué les formes absorbative, adaptative et transformative de la résilience, et présenté en quoi les projets de monnaies locales portent ordinairement un projet de résilience territoriale dans une perspective transformatrice, on montre l'originalité de ces initiatives par rapport aux pratiques plus courantes de distribution d'argent liquide et de bons d'achat. On étudie 18 initiatives monétaires covid dans des espaces francophones (France, Belgique, Suisse, Québec). Dans la variété de ces initiatives, il apparaît que la coopération des collectivités locales (mobilisant des ressources redistributives) avec les associations monétaires permet à la fois de mieux répondre au choc à court terme et d'établir des liens aptes à soutenir les formes adaptative et transformative de la résilience territoriale.

Abstract

This paper looks at the monetary initiatives developed in response to the socio-economic situation brought about by the health crisis whether by non-profit organizations that already managed local currencies or by municipalities. Municipalities could either turn to existing local currencies or issue their own. This resort to local currencies is investigated from the combined angles of forms of solidarity that were promoted and of the contributions local currencies make to the resilience of the localities concerned. After distinguishing among the absorptive, adaptive, and transformative forms of resilience and after presenting the ways in which local currency schemes ordinarily support territorial resilience projects from a transformative perspective, we show how these initiatives were innovative compared with the more commonplace practices of distributing cash and vouchers. We review 18 monetary initiatives undertaken during the Covid-19 pandemic in French-speaking areas (France, Belgium, Switzerland, and Quebec). Among the range of these initiatives, it seems that cooperation between local authorities (mobilizing redistributive resources) and monetary non-profits provides a better response to the short-term shock and establishes ties capable of supporting the adaptive and transformative forms of territorial resilience.

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Key words

Territorial resilience, local currencies, Covid crisis, solidarity, transformation

JEL codes

R49, H12, L38

1 Introduction

In March 2020, when confronted with the Covid-19 crisis and the socio-economic repercussions of lockdown, public authorities across Europe stepped in swiftly to avert mass redundancies, sustain production capacities, and maintain the incomes of most of the population. This intervention often came in the form of state-backed business loans and support for partial unemployment. However, these national or federal measures did not settle everything and the underpinnings of daily life were shaken even so. Needs were felt in places of routine economic activity by the local population and especially by small and very small businesses with scant resources to fall back on and few if any employees. Two main types of actor stepped in to support these activities and communities' everyday lives: local municipalities, as the elected institutions closest to their inhabitants, and a series of already established non-profit organizations (NPOs), networks, or collectives. All endeavoured by trial-and-error to provide quick answers where help was needed in connection with the sudden drying-up of income flows, with difficulties in securing foodstuffs and other basic supplies, and with the provision of care for dependent persons or people in need. In this context, the concept of resilience was used by a host of actors, especially in the way it applied to local areas. This episode has generated a wealth of academic work investigating resilience in various domains of the social sciences.

This paper looks at the mobilization of local monetary arrangements under these circumstances in France and French-speaking areas of Belgium, Switzerland, and Canada. We deal here with convertible local currencies (LCs in what follows). These are currencies generally issued by NPOs and designed to circulate via user networks of individuals and professionals within a limited geographical area. They are issued by converting an equivalent amount of national currency (modulus sometimes with a premium), which sets them apart from the "trueque" experiments in Argentina and "HOURS" experiments in the United States in the 1990–2000s. The amounts converted are paid into a reserve fund that is used to convert back into the national currency any monies that might be presented by professionals having received the LC by way of payment. This particular type of currency first appeared in Canada in the late 1990s and then spread in two main waves (only the most salient features are presented here): first in the early 2000s in Brazil (França Filho et al., 2012; Ansorena et al., 2021), Germany (Degens, 2018; Gelleri and Stodder, 2021), and the UK (Ryan-Collins, 2011); then in the 2010s in France (Blanc and Fare, 2018), Belgium, Switzerland (Stamm, 2021), and Spain (Martín Belmonte et al., 2021). In Europe, existing LCs are generally meant to support ordinary local economies while re-aligning them with social and ecological objectives.

What, for the sake of simplicity, we shall refer to here as Covid monetary initiatives were started either by non-profits already managing LCs or alternatively by municipalities. The

latter could either take avail of any existing LC or else issue their own currency. In this paper, this resort to LCs is addressed from the two combined angles of forms of solidarity and of the LC's contribution to territorial resilience. What are the main features of these initiatives? What are the respective roles in these arrangements of local authorities, LC NPOs, and local businesses? How is solidarity apparent in these cases? What is their scope? To what extent do these initiatives promote territorial resilience? The aim will be more specifically to understand in what way the forms of solidarity set in motion by these initiatives act upon the type of territorial resilience at work and on their efficacy. Far from being a contingent view, it shall be shown in what way LC initiatives are generally a vehicle for resilience and what meaning this term takes on. These LC initiatives in times of Covid-19 shall be contemplated among a series of monetary interventions so as to identify what it is that makes them innovative. A taxonomy of the arrangements studied shall be established.

This contribution is based on work undertaken as part of the TerMos – *Territoires des monnaies locales* (2020-22) – research programme on experiments in the French-speaking world where LCs were already in use (France, Quebec, Belgium, Switzerland) (March 2020 – June 2021).[3] The scope of the study was restricted to monetary initiatives arising from the Covid-19 crisis, that is, initiatives to support local actors during the first lockdown and to kick-start the economy thereafter. Initiatives decided on ahead of the crisis were omitted. Also left aside was the study of the issuing of vouchers in national currency (such as gift certificates, meal tickets, and tickets for other services) so as to focus exclusively on initiatives involving the issuing of – generally re-usable – means of payment in some other unit of account than the official currency. The corpus is made up of 18 initiatives identified from information collected online (social networks, websites, news sites, etc.) (Table 1). Although it is likely that the main initiatives have been identified, the study lays no claim to being exhaustive. We obtained usable quantitative data for 17 of the initiatives and we conducted 14 semi-directed interviews remotely with the leaders of the LC non-profits and/or public actors (elected officials or technical staff).

Table 1 – Covid monetary initiatives under study[4]

Country	Covid monetary initiatives studied
France	*Bulle* (Angoulème), *doume* (Puy-de-Dôme), *gonette* (Lyon), *méreau* (Montargis), *pive* (Besançon), *polopolo* (Saint-Pol-sur-Ternoise), *roue* (Grand Avignon), *SEL* ("*solidarité économie locale*", Capestang), *sol-violette* (Toulouse)
Belgium	*Ardoise* (Wellin), *carol'or* (Charleroi), *épi* (Meix-devant-Virton), *lumsou* (Namur), *orno* (Gembloux), *solatoi* (Ath), *yar* (Tournai)
Switzerland	*Léman* (Geneva)[5]
Canada	*Dollar solidaire* (Quebec)

[3] The initial data collection and survey work was done by Félix Urban during a research internship as part of the TerMos programme in 2021. Early results were presented at the *Forum International de l'ESS* (Carthage/Mulhouse, 25–27 October 2021) and then at the *XXIe rencontres du Réseau interuniversitaire de l'ESS* (Bordeaux, 1–3 June 2022).

[4] The locations named are the main places where Covid monetary initiatives were implemented: they are unrelated to the scope of the area of circulation of LCs.

[5] The *léman* is unusual in being a cross-border LC. As the Covid monetary initiative associated with the *léman* was conducted by the city of Geneva, we consider it here from the Swiss side of the border.

The following section explains the relationship between LCs and resilience and puts forward a working definition of territorial resilience (section 2). We begin by showing how, even before the health crisis, LCs were designed to achieve objectives of territorial resilience (section 2.1). We then roll out our analytical framework for territorial resilience drawing in particular on the work by Manca et al. (2017) to distinguish among different forms of resilience and timespans ranging from the short to long term (section 2.2). The presentation of the diversity of monetary interventions with communities both in times of emergency and in other contexts shows the first-time use of LCs in emergency situations (section 3). We then present the corpus of initiatives studied on the basis of a taxonomy differentiating among resources used, actors behind the monetary initiative, and forms of solidarity promoted (section 4). Lastly we compare and contrast the operations rolled out in respect of the purposes of territorial resilience by differentiating among short-term actions as part of absorptive resilience and longer-term actions that may fit in with forms of transformative resilience (section 5). Section 6 concludes the paper.

2 Local currencies and territorial resilience: providing a framework

We begin by showing how, even before the health crisis, LCs were designed to meet objectives of territorial resilience (2.1). Then, drawing on the work of Manca et al. (2017) in particular, we set out our analytical framework for territorial resilience to distinguish among different forms of resilience and timespans ranging from the short to long run (2.2).

2.1 Resilience as a constituent part of local currency projects

It is noteworthy that the NPOs managing convertible LCs that have developed in Europe from the early 2000s spoke of resilience before the shock of 2020. Two shocks more specifically brought about the emergence of these systems (although they are not sufficient to explain it) and each is associated with a future projection aimed at transforming the future: a futurity within the meaning of Commons (1931, 1934).

The first was an energy and climate shock that was endorsed by the network of transition towns or territories in the mid-2000s (Semal and Szuba, 2010). This movement was embodied especially in the militant experiments in the small town of Totnes in SW England and the figure of the militant and social activist and thinker Rob Hopkins (2009).[6] It was built on the idea of necessary civil-society initiatives to combat climate change and on the expectation of a future break in energy supplies because resources will run out. The prospect of "peak oil", which gained in visibility in the late 2000s when energy prices were very high, was drowned in the non-conventional hydrocarbon boom in the 2010s. It was superseded by awareness of a glut of fossil fuel resources given the warming process underway. The outcome was the same: ways of life needed to be invented to enable the "energy descent", that is, reduced consumption of fossil fuels. In this context, LC projects have been viewed as tools for supporting the territorialization of certain activities so as to limit pointless and hazardous energy consumption.

[6] For an interpretation of the role of LCs in the context of transition towns and from a perspective of resilience, see Ryan-Collins (2011).

Apart from just energy issues, this transition matrix that citizens have brought to bear on local areas was central in LC dynamics in the 2000s and 2010s.

The second shock was financial. It was the 2008 crisis and its repercussions. It incontrovertibly gave the impetus for the LC projects that ensued, by providing an additional argument that was quite crucial at the time for the militants behind those projects. The aim was to build monetary arrangements that would notably provide a framework in which, if or when the current ailing monetary and financial system collapsed, neighbourhood economic activity could continue despite the collapse. This financial critique is to be found in the writings of many militant authors. It is made more specifically in Lietaer et al. (2012).

These two grounds are not mutually exclusive but on the contrary mutually reinforcing. They lead to talk about the necessary (re)location of a number of activities and the need to make arrangements so as to be in a favourable position when the anticipated shocks actually occur. They do not rule out a positive approach to the transitions sought, or even the need for complementary currencies to build a convivial society that respects the pluralistic character of economic acts beyond the market alone (Viveret, 2012; Bosqué, 2014). The point is, then, all told, to construct forms of resilience.

Having imagined resilience as a solution in the event of a shock, it is understandable, then, that the non-profits managing LCs were able to mobilize their infrastructure when the health crisis broke out, even though the particular nature of the shock had not been foreseen by their initiators.

2.2 A framework of analysis of territorial resilience

Because LCs were associated with resilience as an objective well before the 2020 crisis, their action at the time of the shock can be contemplated. In framing the analysis, it should be made clear that we shall not reason in terms of organizational resilience (Weick, 1993). We shall not, then, be addressing questions of the resilience of NPOs issuing LCs when confronted with the shock of 2020 (Didier, 2022). Nor shall we address the resilience of the ecosystem of LCs in the context of a progressive changeover to digital forms of currencies opening up the project to new actors (Lung and Montalban, 2020). Our paper focuses on territorial resilience. The territory in question is that where the local currencies are meant to circulate. It is defined by the issuing NPO. According to the 2019–2020 national survey on French LCs, the spaces they refer to are for 34.9% of them *départements* or larger territories, up to the scale of the *région*. The remaining 65.1% are more limited spaces: *intercommunalités* and *municipalités* (together making up 23.8% of the total), or, for the remaining 41.3%, "*bassins de vie*", *pays*, *provinces d'Ancien régime*, or again ad-hoc combinations (Blanc, Fare, and Lafuente-Sampietro, 2020).

Resilience was gradually taken on as a concept in the social sciences at the turn of the 2000s. One of the pathways for this transfer was the transition from a reflection on ecological systems (Holling, 1973) to socio-ecological systems (Walker et al., 2004), opening up the way to approaches to resilience in reflections on sustainability (Folke et al., 2002), with this being possibly envisioned on the scale of local areas (Hamdouch et al., 2012; Talandier, 2020). A positive economic variant of the concept is to study the change in quantitative indicators relating to economic indicators at the regional or local level (Martin, 2012; Talandier and

Calixte, 2021). A normative and political variant associates resilience with political intentions in the face of a catastrophe that has been announced (Semal and Szuba, 2010; Semal, 2013).

Here we propose to construct a framework of interpretation of territorial resilience including several of these directions, arranging them on the basis of two criteria: the time horizon of resilience; the relative size of needs engendered by a shock and of aspirations to change. We propose to follow and tweak the presentation taken up by Manca et al. (2017). That presentation identifies three resilience capacities. For absorptive capacity, which relies on the system's strength, the repercussions of a shock are absorbed without the system being changed. For adaptive capacity, which relies on flexibility, the system must adapt incrementally. For transformative capacity, the system must evolve in a more far-reaching way. Each of these capacities has a different time horizon that is increasingly distant as we move from absorption to adaptation to transformation.

A presentation of the kind requires a few adjustments for three main reasons. The first reason relates to the fundamentally shifting character of socio-economic systems, meaning that the idea of straightforward absorption without any change does not stand up. Since there can be no permanent state of equilibrium from a dynamic perspective, absorption cannot lead to a return to some hypothetical equilibrium that prevailed before the shock. Furthermore, however limited a shock may be, it necessarily gives rise to change – in the consumption structure, in the activity of some of the actors, in the location of activities, and so on – with the result that absorptive resilience must be associated with some change, even if that change may be invisible on aggregate and only perceivable at micro or meso levels (such as the return to a pre-shock level of employment but with a changed distribution by sector).

Secondly, whereas the actors of territorial resilience and change are, in some instances, located within the area and geared to it, others are external to it: firms taking decisions about the location of their activities from headquarters outside the area, higher tiers of government, etc. The driving forces of resilience (or conversely of lack of resilience) are therefore not to be found exclusively within the endogenous interplay of components of the system under consideration, because the system is not a closed one.

The third reason is that the monetary NPOs, which are actors within the territory under consideration, are out to promote transformation. They showcase an aspiration to transform the territorial socio-economic system to align it with a set of values and objectives expounded in documents such as charters (Blanc and Fare, 2016a). Their stated objectives are more often than not those of territorial resilience through the development of short circuits and the strengthening of citizens' power and local democracy (Blanc, Fare, and Lafuente-Sampietro, 2020). In principle, the transformative dimension of resilience must therefore play an important role here, but contrary to what Manca et al. (2017) suggest, this transformation is not guided by what would be an objectifiable necessity: it is guided by the political choices of transforming agents, mitigated or redirected by social interplay and its confrontation with political projects. This is a key feature of the concept of resilience as employed in this paper: resilience does not come down to safeguarding what is already there in the face of a shock, even at the price of a few adaptations, because resilience is also forward-looking and transformative, meaning it can take onboard the political rationales of local actors and the reactions they elicit. In this light, we take in the question of purposiveness (of a wealth of actors), of the simultaneous presence of initiatives designed to achieve different forms of resilience and of transformation in a longer-

run perspective. This is why we shall try to identify the extent to which this purposiveness can give rise to territorialized cooperation mechanisms as local vehicles for resilience.

By characterizing territorial resilience in this way, it is possible to come up with a question about the positioning of Covid monetary initiatives. These initiatives, reacting to the emergency of everyday life (and in some cases of day-to-day survival), are positioned from the outset with an objective of absorptive resilience: it is a matter of coping with matters here and now. However, the continuation of some arrangements set up in March–April 2020 suggests that other rationales are also at work, and besides some Covid initiatives were set up under pre-existing arrangements that asserted their transformative purpose from the off. There is a need, then, to understand why these experiments were extended: was it always with an objective of absorptive resilience, which could be explained by the continuation of the health crisis beyond the first lockdown? Was it on the contrary in reference to other objectives of resilience? Examination of the various Covid monetary initiatives should provide an answer to this question.

3 Money and social emergencies: a new role for local currencies

In order to clarify the potential role of LCs in the context of the 2020 shock, these arrangements have to be viewed among the range of interventions involving forms of access to basic goods or income for emergency situations. The literature on emergency aid or aid in the context of humanitarian interventions generally deals with distribution in kind (especially foodstuffs) or the distribution of income (for buying foodstuffs). Such aid may be provided in cash (i.e. in the currency serving as legal tender, generally as cash payments) or in the form of vouchers (i.e. in the form of purchasing power allocated to certain goods supplied by distributors accepting the vouchers). Both are given increasing consideration in the specialized literature under the term of CVA ("cash and voucher assistance"), and their use surged in humanitarian aid circles in the second half of the 2010s. Doocy and Tappis (2017) explain this expansion by the fall in the cost of aid with the shift from direct food aid to the provision of food vouchers and then to the distribution of cash. Vogel, Tschunkert, and Schläpfer (2022) draw no specific distinction between cash and vouchers but they study the contrasting effects of introducing liquidity in the form of cash or vouchers compared with aid in kind: the freeing-up (to a greater or lesser extent) of choice through the use of aid in form of liquidity is offset by new tensions surrounding this form of aid.

This paper sets aside immediately the hypothesis of aid in kind since the 2020 health crisis did not have the same effects on day-to-day logistics as natural disasters or wars do. Beyond a few interruptions in the supply of goods because of production difficulties in some countries, local distribution channels were operational and one of the challenges was to maintain them in that condition.

Turning to the provision of income, three situations can be made out: (1) distribution of currency having legal tender (generally referred to as *cash*, although scriptural or digital forms may be used); (2) distribution of liquidity in the form of *vouchers*; (3) distribution in the form of *local currencies*.

Technically, and so beyond the availability of the amounts required, the distribution of cash is the most straightforward because it requires nothing more than laying down rules and

arrangements for its distribution. The supply of vouchers is more complex, because it involves identifying a range of accredited providers to receive such payments and constructing the infrastructure for issuing and withdrawing vouchers while abiding by the rules associated with them (assignment to certain uses, deadlines for use, conversion into money reserved for shopkeepers, etc.). In this way, assigned purchasing power – a form of special-purpose money – is supplied that is not designed for general circulation but that must ensure the proper use of the resources supplied. These vouchers bring moral or even moralizing issues into the distribution of aid (Zelizer 2005; Vogel, Tschunkert, and Schläpfer, 2022). Lastly, LCs require in addition to all the foregoing a network of takers that is not a set of reception points for vouchers prior to their conversion into cash but a space for circulation among professionals. This means there must be an array of takers that does not appear in the voucher solution, because vouchers may be used with a very small number of professionals. LC is therefore the least common form, because it entails the participation of a wider range of actors and thought must be given to the ways to dynamize those actors, a process that is not necessarily compatible with emergency action. While such arrangements may be set up in places of extreme poverty (underprivileged districts and communities in Brazil or even slums in Kenya), it is exceptional for them to be set up in times of extreme emergency.

In point of fact, these three means of payment whereby substitute income can be supplied are associated with arrangements for securing access to money that are not just about the unconditional distribution of income. Distribution can be made conditional (e.g. on activities as part of workfare) and, besides, microcredit is a very commonplace way of accessing money in some communities.

Light can be shed on this initial distinction by a second one, this time a distinction among the objectives pursued by the use of transfers or loans in the form of cash, vouchers, or LCs. (a) *Action to ensure survival or the continuation of living conditions in the event of a shock* is just one of those objectives. In the case of the 2020 shock, the aim was more specifically to maintain the income of populations and businesses and to get ready for recovery. To simplify things, two other major objectives can be identified: (b) *the fight against poverty* as a structural situation and (c) *building sustainable lifestyles.*[7] The 2020 shock goes into the first category, even if the urgency was not the same across all social settings. The use of LCs ordinarily relates instead to the fight against poverty (Brazil, Kenya) or the quest for sustainable lifestyles (Europe).

Table 2 cross categorizes these two three-way distinctions. It resituates the variety of existing monetary intervention mechanisms and illustrates in what way Covid monetary initiatives (box 3a) are doubly original, while including similar initiatives in the shape of vouchers (box 2a).

It is novel primarily in that emergency situations are seldom dealt with by resort to LCs. The standard practices are CVA, cash and voucher assistance. Accordingly, few works have looked at LCs in situations of this kind. Martín Belmonte, Puig, Roca, and Segura (2021) examined the impacts of the REC set-up in Barcelona on the basis of a 2018–19 survey. Although they resituated their thinking in the context of the health crisis, their study is

[7] While this may resemble the absorption/adaptation/transformation sequence identified above to characterize resilience, it is not the same, especially because the fight against poverty is not entirely a question of adaptation but also a matter of transformation.

associated more with box 3b in Table 2: LCs to combat poverty. However, they do discuss the South Korean experience in the province of Gyeonggi, where the government introduced a basic income for young adults in 2019 in the form of purchasing power in an LC that could be used in just the city or county of residence and that was stepped up in 2020 in the context of the health crisis (Martín Belmonte et al., 2021; Seong Yoo and Yun, 2021). Ussher, Ebert, Gómez, and Ruddick (2021) studied arrangements in Kenya by the *Grassroots Economics* foundation. Although those arrangements ordinarily relate to a structural situation of extreme poverty in the slums of southern Kenya, they were used early in 2020 as emergency support tools on the basis of a partnership with the Red Cross. For Brazil, Gonzalez et al. (2021) show how the pre-existing infrastructure of a digital municipal currency (the Mumbuca, in Maricá, State of Rio de Janeiro) and prior knowledge of the socio-economic characteristics of the local population were helpful in extending the scheme when the pandemic caused a collapse of income of the vulnerable categories of the population, including small shopkeepers and casual workers. There was therefore in these cases an extension of LC arrangements intended to combat poverty (box 3b) to emergency management of the pandemic (box 3a), a context in which most monetary interventions consisted in distributing cash (box 1a) or vouchers (box 2a).

Table 2– Forms of money-based social intervention (whether by unconditional transfers, conditional transfers, or loans)

	(a) Survival and maintaining living conditions in the event of a shock	(b) Fight against poverty	(c) Building sustainable lifestyles
(1) Legal tender (notably cash)	(1a) Cash transfers (including as part of basic income)	(1b) Microcredit, cash transfers (including as part of basic income)	(1c) Ecological transition income
(2) Vouchers	**(2a)** **Vouchers for specific uses (from essential foodstuffs to a variety of goods)**	(2b) Vouchers for purchasing various types of goods	(2c) Compensation for good deeds by distribution of allocated purchasing power
(3) Local currencies	**(3a)** **Emergency monetary initiatives**	(3b) Local currencies in impoverished communities	(3c) Local currencies in Europe

This leads on to the second original feature of Covid monetary initiatives: LCs are not generally designed for emergency situations. Very little work has been done along these lines. Ranalli (2014) admittedly proposed an application directed at refugee camps, but in a situation in which the camps were permanent and not emergency facilities. Ussher, Ebert, Gómez, and Ruddick (2021) are among the very few to discuss the value of "complementary currency" arrangements for humanitarian aid. Both these papers discuss the importance of constructing the mechanisms with the relevant populations, which is indeed a central feature of alternative currencies known since the 1980s. Both also discuss different types of mechanism wherein convertible LCs in question here are just one possibility. Even so, it remains to be shown under what circumstances the participatory construction of mechanisms can fit in with emergency situations. The French national survey of LCs before the health crisis shows that on average 29.4 months elapsed between the start of a project and the actual launch of the currency. When

the local authority is the driving force, the average falls to 14.5 months; the shortest time recorded is 3.9 months (Blanc, Fare, and Lafuente-Sampietro, 2020). In all cases, the process is too protracted to serve as an emergency response. In several cases, municipalities that set up what were referred to as "local currencies" were actually vouchers, plans for which are less demanding and can be set up more quickly (box 2a). In discussing the Brazilian case of Maricá, Gonzalez et al. (2021) discuss the importance of there being a pre-existing LC infrastructure for dealing with emergencies. This, then, is in principle where LCs can step in: as pre-existing arrangements that can be used in unexpected situations.

4 Monetary initiatives rolled out: actors and resources

In order to characterize Covid monetary initiatives, we develop a framework of analysis transposing Polanyi's contributions to the study of organizational resources and highlighting their hybridization. As concerns monetary NPOs, the framework developed more specifically by Gardin (2006) is discussed and the interpenetration of the forms of organization of interdependencies leads to a different terminology being used here. A distinction is drawn between market resources, redistributive resources, gift resources, and membership resources (section 4.1). This makes it possible to address the diversity of Covid monetary initiatives at a higher resolution. The corpus examined for this study brings out two rather different types and a mixed situation (section 4.2). The dividing lines are essentially between the actors behind the initiatives (pre-existing monetary NPOs and municipalities), the resources used to roll out the monetary initiative, and the target for those resources. In this sense, the intensity of cooperation relates to the diversity of actors and resources.

4.1 The resources used in implementing monetary initiatives

Inspired by Laville (1994) and Evers (1995), and adapting Polanyi's differentiation between exchange, redistribution and reciprocity (Polanyi, 1957), Gardin (2006) establishes a distinction between the market economy, non-market economy, and non-monetary economy, in order to conceptualize hybridization of resources. This framework can be challenged by observations from LCs (Blanc and Fare, 2016b). This distinction hierarchizes the components by subjecting them to the market. Despite the central role played by reciprocity in the pluralistic socio-economic framework defined and affirmed by Gardin, the conceptualization used does prioritize the market: the "non-market economy" is defined by reference to the "market economy", and the "non-monetary economy" is then defined by reference to the preceding two. Moreover, the "non-market economy" may include non-monetary forms (such as free access to schooling or health care). Lastly the "non-monetary economy" as conceptualized is just as much "non-market" as the "non-market economy", since it relates to gift-giving and reciprocity. So these categories pose problems of theory; and when applied to the matter of resources, these problems are duplicated.

For this reason, the approach has to be reconfigured by distinguishing between four types of resources. First are **market resources**, which in the context of LC management are primarily made up of reserve funds built up from the conversion of national currency into LC means of payment, those reserves being isolated from other resources due to full backing requirements. Market resources also include the fees levied on members' monetary activity (fees for converting LCs back into the national currency by members authorized to do so, but

also demurrage fees[8]) and ancillary market activities such as training and education. Then come **redistributive resources** which, being part of the redistributive logic, may stem from public actors but also private actors (including foundations) providing support such as project financing or sponsorship. **Gift resources** are dependent on volunteering and on donations in cash or in kind from members, public authorities and private actors. Lastly, **membership resources**, composed of membership fees, relate to the membership principle that makes a number of organizations in the social and solidarity economy so specific and whereby users are also members and therefore participate in the governance of organizations. Contemplating this membership resource separately from the other three categories has the advantage of separating all of the activities based on membership from all the others that do not involve it.

This typology can be used to characterize forms of solidarity and cooperation with regard to actors providing the resources with which the monetary initiatives under study can be rolled out.

4.2 The actors behind Covid monetary initiatives and the forms of solidarity elicited

The actors behind these initiatives are either NPOs already managing LCs or municipalities. In some cases, local businesses also play a leading part. Municipalities managed either to rely on an existing LC or to issue their own currency. Three configurations are presented below. This leads to the initiatives being characterized in terms of the forms of territory-based solidarity they seek to elicit through the collection of resources marshalled to support consumers or producers (Table 3).

- **T1 – Initiatives by pre-existing LCs, independently of municipalities**. This first type of initiative was launched by NPOs whose LCs were already in circulation (*doume*, *gonette*, *sol-violette*, *méreau* – in France). As the infrastructure was already in place, they were able to step in very early on in the health crisis, offering in particular financial support to professionals in the form of interest-free loans in euros by drawing on the reserve funds of euro-denominated assets held against LC issues, which can be considered market resources. Such initiatives bolstered internal solidarity among members of the monetary network. Non-profits were also able to develop interventions in the form of distribution of purchasing power in LCs to targeted audiences. In the case of the *sol-violette*, this took the form of the distribution of food vouchers to people in need through centres for the unemployed and solidarity groceries (both already partners of the issuing non-profit), on the basis of the non-profit's own budget, fed by market resources (conversion fees), membership fees, and gifts and redistribution (public subsidies).
- **T2 – Municipal initiatives independently of monetary NPOs**. This second type of initiative came from municipalities that very quickly (in 2020) issued forms of LC although no LC was in circulation in the local area (*SEL*, *polopolo*[9] – in France). The objective was to support certain shops (members or volunteers of neighbourhood

[8] Demurrage is an incentive to use the currency through the levying of a fee on assets held by users that should prompt them to accelerate spending. A few monetary NPOs have introduced mechanisms of this kind.

[9] As concerns the *polopolo*, the local area (Saint-Pol sur Ternoise) lies within the declared territory of circulation of the *buzuk* LC although no shops there accept it.

economy schemes) in the local area[10] by distributing purchasing power to all the local inhabitants. This two-fold objective led the initiators to combine redistributive resources with donations from local businesses (from small traders to hyper and supermarkets by way of cooperative banks and mutual funds).

- **T3 – Mixed initiatives**. This third type of initiative combined pre-existing LCs and municipal or combined local authority intervention (in France, the *pive*, *roue* and *bulle*; in Switzerland, the *léman*; in Belgium, the *carol'or*, *orno*, *solatoi*, *ardoise*, *lumsou*, *yar*, and *épi*; in Québec, the *dollar solidaire*). Here again the two-fold objectives of support for local professionals and distribution of purchasing power to communities were mixed. In this group, two forms of intervention via public actors were developed depending on the scope of the initiatives: one form involved initiatives aimed at the entire population through the use of vouchers denominated in LC (*solatoi*, *carol'or*, *pive*, *léman*[11]) or of a conversion premium from national currency into LC (*orno*, *roue*, *dollar solidaire*[12]) (Type T3a); the second form was the distribution of vouchers to targeted audiences (*bulle*, *épi*, *ardoise*, *yar*, *lumsou*) (Type T3b). These initiatives mobilized for the most part redistributive resources (managed by the public authorities) and gift resources.

Table 3. Types of initiatives, actors, and forms of intervention

Actors/uses and means of distribution	Loans and other financial support in euros for **professionals**	General support for **professionals via individuals**	Distribution of vouchers in LC for **target audiences**
T1 - LC NPO alone	*Doume*, *gonette*, *méreau*		*sol-violette*
T2 - Municipality alone		*Polopolo*, *SEL*: vouchers in LC	
T3 - Municipality and LC NPO		T3a - *Solatoi*, *carol'or*, *pive*, *léman*: vouchers in LC *Orno*, *roue*, *dollar solidaire*: conversion premium	T3b - Epi, *ardoise*, *yar*, *lumsou*, *solatoi*, *bulle*

Source: authors

[10] In the case of the *polopolo*, these are member stores (other than for gambling and tobacco) excluding supermarkets. For the *SEL*, these are eligible professionals, i.e. those registered with the chamber of commerce or trade, except for supermarkets. This came to 36 shops. In both cases, the shops could be identified by window stickers.

[11] The case of the *léman* is somewhat specific in that the operation involved buying vouchers via the Genève Avenue platform, a sort of local Amazon. From this site, consumers had to choose the shops in which to buy vouchers with 20% reductions and 33% reductions if the shopkeeper was a member of the *léman* network.

[12] The case of the *dollar solidaire* was again specific in that the initiative was launched by commercial development companies of the city of Quebec unrelated to a pre-existing LC, the *blé*. It was only in the second bonus campaign that the commercial development companies turned to the *blé* to include it in the approach. Consequently, two currencies are now in circulation in the area.

N.B. The *solatoi* is the only case combining both types of intervention.

5 Which forms of resilience do local currency partnership dynamics promote?

Examination of these initiatives reveals first of all the significance of Type 3 compared to the other two types with absorptive resilience as a primary objective (section 5.1). However, the effects of their implementation exceed the short run alone, by dynamizing pre-existing experiments with LCs and the development of new instances of cooperation (section 5.2). This is why these initiatives are also consistent with a longer-term perspective of transformative resilience (section 5.3).

5.1 One-shot initiatives as part of absorptive resilience

In the short run, the primary objective in implementing these monetary initiatives is to support individuals and consumers as well as local businesses during the Covid outbreak and so to cope with the emergency. The initiatives vary greatly in scope, from a few thousand euros to millions of euros depending on the actors involved and the type of resources mobilized (cf. Table 4).

Table 4. Budgeted and actual amounts by type of initiative

Budgeted and actual amounts by type of initiative	Number of cases	Budgeted (euros)	Percentage	Actual (euros)	Percentage	Execution rate (%)
T1	4	32 400	0.54	3 900	0.07	12.03
T2	2	170 000	2.85	144 770	2.76	85.11
T3a	7	5 365 812	89.92	4 742 500	90.50	88.38
T3b	5	399 000	6.69	349 250	6.66	87.53
Total	**18***	**5 967 212**	**100.00**	**5 240 420**	**100.00**	**87.82**

N.B. 17 answers; * one initiative launched an operation aimed at the entire population and then used the remainder for targeted operations.

Type 1 initiatives remain limited and make up less than 1% of total spending. The vast majority of expenditure falls under Type 3a initiatives, in which public authorities play a major part and which are almost entirely based on redistributive resources. The amounts in question are far greater, with more than €4.7 million actually injected, that is, more than 90% of spending for all Covid monetary initiatives.

Some of the initiatives did not have the expected effect in that the target audiences did not take them up (cf. table 4). The execution rate of Type 1 initiatives was just 12%. This category contains for the most part initiatives exclusively by monetary NPOs (loans) and based on membership and gift resources. Just one loan was granted by one LC NPO. Loan arrangements were virtually unused during the Covid pandemic (*doume*, *gonette*, *méreau*), probably because of the small amounts involved (compared with the financial needs and state

aid) but also because of the sector-based distribution of potential recipients. These were mostly food shops, but they did not experience any particular difficulties during lockdown. Another possible reason is the poor coverage of the local area and the limited potential for exchange among professionals. In the opinion of actors, these initiatives amounted to "whistling in the wind" (interview B., *gonette*). Without the support, backing, and above all the funding of local authorities, such projects failed to find their audience and to offer aid packages consistent with the needs of professionals facing the difficulties brought about by the crisis and lockdown. As concerns the initiative to distribute vouchers denominated in LCs (*sol-violette*), the objective was to target individuals unable to afford food. Although the operation was not large in monetary terms, it did enable a score of families to obtain vouchers in LCs to be spent in participating grocery shops. Judging from the forms of solidarity and territorial cooperation created, these initiatives were based on solidarity directed at members of the LC or target audiences.

Type 2 measures have been successful in that a substantial audience has benefitted from them. Feedback from inhabitants and shopkeepers in Saint-Pol (*polopolo*) and Capestang (*SEL*) has been mostly very positive and enthusiastic. The amounts allocated came to €68,000 and a little over €76,000, averaging out at €24 per inhabitant. These initiatives made it possible to mobilize redistributive resources (redirected public resources) and, in one instance, gift resources since the businesses in the territory were asked to contribute to the funds formed to cover issuing costs. They can, as such, characterize forms of mixed public and private, territorial cooperation and therefore redistributive and commercial forms over the short run. However, their limited and sporadic character means they fail to establish territorial dynamics for the long run.

As concerns Type 3 initiatives, a distinction is drawn between initiatives involving the subsidizing or distribution of vouchers denominated in LCs (vouchers and gift cards) aimed at the entire population (T3a) and operations to distribute vouchers to a target audience (T3b). These initiatives involve the joint mobilization of the local authority (generally a municipality or combined municipalities) through the use of distributive resources in territories where monetary NPOs are active and that mobilize gift resources.

Table 5. Summary of figures for Type 3 initiatives

	Type 3a	Type 3b
Number of observations	7	5
Total allocated	5,365,812	399,000
Actual total	4,742,500	349,250
Execution rate	88.38%	87.53%
Mean of actual amounts	677,500	69,850
Median of actual amounts	90,000	16,000
Mean amount per person	5.68	60.00
Median amount per person	3.47	30.00
Mean rate of non-take-up	8.21%	23.19%

N.B. 12 observations for 11 cases, one of them counting for both types of initiative.

Higher amounts are involved ranging from a few thousand euros to more than €3 million. However, the initiatives aimed at a target audience mobilize higher mean amounts per beneficiary than those aimed at the entire population. This results in fewer people benefitting from the operation, but the mean individual amount distributed is €60 (median €30) compared with €5.68 (median €3.47) for Type 3a operations.

For the arrangements aimed at the entire population (T3a), an overall rate of execution of redistributive expenditure of 88.4% is observed. This differential can be explained by a phenomenon of non-take-up by some local inhabitants who did not go to the various "outlets" to collect their vouchers or who did not use them when they were sent by post.[13] The mean non-take-up rate of Type 3a initiatives stood at 8.2% (out of 7 observations). However, for four of them, the non-take-up rate was largely meaningless because the operation was limited to the amount injected on the basis of a purely voluntary approach (participatory financing, bonus for members, gift card to be won, etc.): the rate of non-take-up was necessarily zero. The mean non-take-up rate of the remaining three observations came to 19.2%. For initiatives that targeted the beneficiaries (young people, the needy, local council workers, shops that had to close during lockdown, "front line" workers) (T3b), the overall execution rate of redistributive spending came to 87.5% and the mean non-take-up rate was about 23.2%, which was far higher than for initiatives covering the entire population (and 4 points higher than the Type 3a initiatives for which the non-take-up rate is actually meaningful). These non-take-up rates are low compared with non-take-up rates for mechanisms of other kinds such as the minimum income in Europe. Marc et al. (2022) report that these rates stand at 62% in Belgium (2005 data) and 34% in France (2018 data). By contrast, for Brazil, Gonzalez, Cernev, Araujo, and Diniz (2020) emphasize that municipalities are better able to identify and reach their target audiences. The existence of a municipal basic income scheme in Maricá (State of Rio de Janeiro), which is supplied in LC in digital form that can be used on a smartphone application and by NFC card, facilitated the roll-out of emergency aid when the health crisis hit. Among the Type 3b initiatives, it should be noted that the initiative with the highest non-take-up rate (62.5%) was aimed at the temporarily unemployed, shops that had to close, or beneficiaries of social minima or aid (food, school supplies, heating fuel subsidies, and emergency aid), whereas the average amount per audience was much higher (€150) than for other initiatives (for which the average was €60 per person).

5.2 From short to medium term: dynamizing effect on LCs and development of new instances of cooperation

The diversity of these means of intervention reveals a readiness to counter the socio-economic consequences related to the health crisis from a short-term perspective through the creation of new ties and forms of cooperation by mobilizing LCs. The prospects opened up concerning the potential for collaboration between local authorities and NPOs, are substantial. Some local authorities have given precedence to collaboration of this kind by thinking of making it lasting: "this one-shot aspect is troublesome [when towns have distributed vouchers

[13] The ways vouchers were distributed were probably decisive in this non-use. Several means of distribution were observed and sometimes combined: sending a QR code by e-mail, postal distribution of vouchers, obtaining them by online platforms or mobile phone applications, collecting from outlets or the town hall.

with use-by dates]. It is not permanent … we thought that rather than repeat the action 10 times, why not just do it once only with an instrument that would make the operation a lasting one" (interview T., *orno*).

A first recurrent feature in what is said concerns the spotlight that these measures turned on existing LCs. This simple "showcasing" gave LC NPOs some welcome visibility, particularly as the health crisis had negative effects on them, especially for currencies circulating exclusively in paper form. Next, and as a continuation, this new visibility entailed increased trust and legitimacy for NPOs, both among the authorities in their local area, which were able to form a positive initial idea of the work and resources these non-profits could deliver, but also with local inhabitants who, by associating a legitimate player like the town hall with the idea they might have of this "Monopoly money" (interview T., *orno*), changed their mindsets and gained an enhanced awareness of the use of LCs. Accordingly "there are many inhabitants of Gembloux who now know what a local currency is thanks to this operation" (interview T., *orno*). This makes it possible to go beyond an aware and militant audience to reach the entire population, especially when the initiative was directed at all the inhabitants.

This acculturation of local authorities to LCs also went along with the acculturation of LC NPOs to public actors and so opened up new prospects for working together. One respondent commented:

> We realize that the local authorities can play an important role in the institutional framework. That is, so that our project can develop harmoniously among the different economic actors. First by lending credibility to the currency and to the objective it aims at, by giving it visibility, and also by acting as a driving force as a provider (interview J., *yar*).

That, too, has effects on the network and the amount of currency in circulation. For some LCs, these initiatives boosted the number of members. Although we have no systematic view of the effects, some of the respondents emphasized positive impacts. For example, for the *léman*, 430 new accounts were opened during the operation, providers became diversified, and the amount of currency in circulation rose:

> the voucher operation was very worthwhile for us because it brought new actors into the payment community, especially cargo bikes, bike sellers, electric bikes and others, who were not much linked with the payment community until then, a good many restaurants, home-care providers. And above all the amount circulating was multiplied fourfold (interview J., *léman*).

For the *carol'or*, the number of providers rose from 300 to 500 during the operation and new municipalities sought to join the monetary network. For the *bulle*, 5000 new accounts were opened. For the *roue*, membership grew (+20%) and there was an increase in amounts converted and the mass of currency in circulation.

Finally, an atypical case of collaboration, that of the *dollar solidaire* (Quebec), rested on an application for provision of services from the local authority to an NPO managing an LC, the *blé*. For the NPO, the establishment of the *dollar solidaire* was the "last chance" (group

interview, *blé*) to see an LC continue in Quebec with the prospect of bolstering the *blé* network. The objective was to "let the *blé* die a death" so as to bring in a "*blé solidaire*" (group interview, *blé*). This local initiative was a chance for the NPO to continue the work begun with the *blé* while continuing and expanding the work to mobilize shopkeepers and consumers. The user network built for the *dollar solidaire* and the amount of currency in circulation were greater than for the *blé*. Some 400,000 *dollars solidaires* were in circulation among 460 stores and more than 2000 users (versus 10,500 *blé* in circulation, 55 stores, and 300 users). However, the ties with the public actors did not further any shared understanding of the role of an LC as a territorial economic development instrument, and the cooperation was challenged by a former militant who saw the *dollar solidaire* as a voucher in a scheme that fell well short of an LC scheme like that of the *blé*. This case reveals a conflict between emergency monetary engineering and more ambitious objectives of transformation.

5.3 Strengthened local ties to promote adaptive and transformative resilience?

The cooperative ties created or strengthened by the implementation of these initiatives can be distinguished by the type of initiative. At this level, whether or not LC NPOs are involved in setting up the various measures has a considerable influence on the time scale in which the measures are to fit: they may be designed for the long run, that is, the aim is to make them lasting measures, or they may be designed for the short run and be "one-shot" schemes as with a classical economic recovery plan. However, more than the actual measures, it is the collaboration among actors and the various forms of cooperation that they imply that are of interest to us here. Most of these measures consist in distributing a limited amount of money based on a finite budget and they are in essence time-limited and, as seen, the amounts distributed per person are low. On the other hand, some of them do enable innovative rapprochements through the creation of mechanisms for cooperation and solidarity among local actors that foreshadow future collaboration.

Local currencies are deployed with a view to bringing about the transformation or transition of society, a project that implies a distant horizon and a readiness to do something lasting. It is understandable therefore that Type 1 measures have been viewed as new functionalities that LC NPOs might, once in place, propose to their providers for an indefinite period. In this way the providers of the *doume* and *méreau* will still, on the face of it, benefit from cash advances they propose, while the *gonette* has ended its interest-free loans because the measure was thought ineffective, other proposals being preferred to it. For the *sol-violette*, the introduction of vouchers made it possible to "engage again in dialogue with solidarity structures" (interview J., *sol-violette*) and to "break with the image of a local currency reserved for a specific audience, a left-leaning middle-class, and to show that it can be an instrument that can operate coherently as a system for everyone in the food sector" (interview J., *sol-violette*). Accordingly, if local authorities have not participated in the operation, the application (and obtention) by the *sol-violette* for a participatory budget from the regional council will enable the continuation of the "healthy food for all" initiative and to launch other socially inclusive actions with the unemployed and students. That also elicited the interest of other municipalities around Toulouse where the elected officials realized that "what is local is important and that ultimately LCs are more than a gadget and can become meaningful as part of a comprehensive policy directed a little at those topics" (interview J., *sol-violette*).

Type 2 initiatives, that is initiatives undertaken by local authorities without relying on an existing monetary NPO, are explicitly designed to be "one shot", time-limited responses to the difficulties thrown up by the crisis. The vouchers or tokens distributed by the town councils of Capestang or Saint-Pol actually do have use-by dates.[14] However, there was a genuine awareness of the need to roll out more cooperative approaches in local areas as pointed out by one respondent (interview K., *polopolo*): "at the end of the day, everyone contributed. Businesses, shopkeepers, inhabitants, the municipality and non-profit organizations … It's really an original type of operation because it's a model of cooperation." In this sense, the initiatives promoted forms of local solidarity by associating multiple actors around a common socio-economic objective. These associated socially inclusive and cooperative actions could be reactivated for other projects in the territory. The ties established during the health crisis drive a culture of territorial cooperation that could form a crucible for future cooperation.

Type 3 measures (T3a and T3b), those involving both local authorities and monetary NPOs, make up the cases in which timespans can be debated. Even if here again, in most instances, the measures consisted in distributing vouchers denominated in LCs with an expiry date, they were also the opportunity for a first genuine collaboration, or at least for dialogue among the actors of the same territory who so far had had little contact whether with the conventional economy or with local authorities. These measures were an opportunity to make possible the simple idea of collaboration between local authorities and LC NPOs. Those organizations that, before the measures, had not been very visible were able to benefit through the support of local authorities from a boost to their legitimacy and to affirm themselves with greater credibility as important players and vehicles for many proposals that could prove attractive to the inhabitants and shopkeepers in the area and to the local authorities themselves. Accordingly, the person questioned about the *pive* saw the initiative as "a communication operation" which even so "was a first experiment in working together" with Besançon town council and a promising one (interview C., *pive*). This was also an opportunity for the *léman* to engage in talks with the municipality of Geneva about "the payment [in *léman*] of part of the city's wage bill to volunteer employees". Accordingly, "now the point is to get the city council to know us better and to work with them over the longer term" (interview J., *léman*). This readiness to pursue territorial cooperation is also underscored for the *carol'or*: "the idea is to continue the joint building of this project insofar as communication towards citizens was far more efficient with a big administration than through the non-profit alone" (interview V., *carol'or*). Moreover, in Geneva, Besançon, Tournai and Charleroi, it is contemplated that the municipality might join the network, which would make it possible to pay for a number of public services or taxes in LCs or to pay part of the council workers' wages in LCs. This possibility is a fundamental challenge to enable LCs to circulate by increasing and diversifying the potential outlets for their use. These first steps towards closer cooperation have already led for some LCs to contacts with other nearby local authorities (*roue*), through the payment of bonuses to local council workers in LCs (e.g. *roue*, *orno*, *solatoi*). One might also emphasize regulatory political consequences with the unanimous approval of a resolution in Wallonia in December 2020[15] (entitled "resolution to encourage the development of complementary

[14] It should be noted, though, that the NPO that helped develop the *polopolo* project planned to make the vouchers lasting by converting them into LC. Administrative obstacles and the urgency of the situation, among other things, prevented this plan from being materialized.

[15] The resolution is available at: http://nautilus.parlement-wallon.be/Archives/2020_2021/RES/345_4.pdf

currencies in the context of the Covid-19 health crisis and of redeployment of Wallonia") to promote and encourage the use of LCs as part of the Covid crisis and post-Covid recovery plans considered as instruments for regional support of consumption and as complementary to more conventional aid measures. This is a strong signal aimed at acknowledging LCs as public policy instruments attesting the inclusion of these practices in a form of adaptive or even transformative resilience.

As concerns the ties with businesses of the more conventional neighbourhood economy, this has brought about better knowledge and converging interests. Accordingly, "it has allowed two worlds to move closer together. On the one side, the more traditional economy and on the other the social and solidarity economy (interview J., *léman*). Also to be found are the issues relating to transformative resilience and therefore a shared futurity: "Of course there are some who join up through opportunism, but most join because they say things must change, although they are shopkeepers but they realize they are victims of the banking system too – for example they can virtually no longer deal in cash. … It's shopkeepers who are convinced and who tell each customer who comes into the shop: 'you should join the *carol'or'*" (interview V., *carol'or*). These cooperation initiatives have also prompted thoughts about the nature of businesses that can benefit and receive vouchers. While pre-existing LCs were not designed to circulate with all the professionals in the territory but with a set of accredited providers on the basis of their commitment to abide by the expectations of the charter of values drawn up when the LC was created, these initiatives have sometimes extended the number of providers and professionals involved by relaxing the selection criteria. In most cases, these exchanges have taken place between the monetary NPO and the local authority so as to reach a compromise. The aim was, as a minimum requirement, to exclude franchises, supermarkets, and listed companies.

Figure 2. Forms of resilience, actors, time frames and motives

	Monetary NPOs	Public authorities (local, central)	Businesses
Absorption (short-term perspective)	Interest-free loans	Distribution of purchasing power to support consumers and local businesses	Gifts
	Reinforcement of cooperation among actors		
Adaptation (medium-term perspective)	Guidance of consumption and production practices. Transformation of social representations	Support for LCs (subsidies, aid packages). Participation in monetary and governance network. Inclusion of LCs in public policies	Change of practices. Transformation of social representations
Transformation (long-term perspective)	Purposes of LCs (promote local trade, territorialization), producing endogenous development dynamics and reinforcing cooperative ties => territory whose resilience is part of socio-ecological transition		

While the initiatives presented are designed as instruments for short-term recovery, the mobilization of LCs can provide impetus for the creation of new ties and new forms of territorial cooperation with public and private actors. Although the action of these actors may

be limited to the duration of the emergency and to the immediate present, the inclusion of LC NPOs in recovery plans means that a longer period of cooperation can be contemplated, opening up new prospects of future territorial dynamics that can be made part of a form of transformative resilience. Figure 2 below summarizes the different means of cooperation, their time scales, and the objectives of territorial resilience.

6 Conclusion

Examination of 18 Covid monetary initiatives in four French-speaking areas (France, Belgium, Switzerland and Quebec) between March 2020 and June 2021 reveals the range of interventions and the great diversity in the amounts involved, the institutional arrangements in place, and the resources mobilized. The outcome is that the forms of solidarity and of cooperation involved in these interventions vary somewhat.

Some interventions were implemented by existing monetary NPOs and with no ties with municipal policies (four instances; Table 3, Type 1). They focused primarily on making cash advances in euros by allocating part of their reserve funds built up from the conversion of national currency and so they involve market resources. They failed to reach their target audience. Initiatives by municipalities without relying on existing monetary NPOs were rarer (two instances) and involved distributing vouchers denominated in an LC unit for populations with a view to supporting economic activity in the territory (Type 2). They involved greater amounts of money than for Type 1, relying on redistributive resources but also on gift resources from local businesses. But the majority of initiatives harness together municipal (or combined municipal) initiatives and action by existing monetary non-profits (Type 3): either by addressing all actors and populations in the territory through the distribution of vouchers in LC or through premiums on conversion of national currency into LC (T3a), or alternatively by targeting specific audiences to which extra purchasing power was provided in the form of vouchers denominated in LCs (T3b). The amounts issued were far greater in the third type of intervention and more especially in T3a, although the amounts distributed per person were far higher when the aid was targeted at specific audiences (T3b).

These initiatives mobilized various monetary forms: national currency (for cash advances), ordinary units of LC, or lastly and above all, vouchers denominated in LCs. It can be seen therefore that the emergency did not lead, as a matter of priority, to an extension of the ordinary use of LCs (Table 2, box 1c), but more to developing specific forms such as vouchers, although denominated in LCs and not in the national currency; a hybridization of boxes 1b and 1c. How is this to be understood? Distributing vouchers denominated in LC rather than ordinary forms of LC probably marked the exceptional character of the period and made it easy to set deadlines for the use of the money distributed in this way. It may, however, also reflect the caution, not to say mistrust, of the local authorities involved with respect to LC arrangements, that probably covers the gap between the absorptive rationale of resilience and the transformative projects of monetary NPOs.

In this way, these interventions were often part of a broader outlook than the health crisis; either because the sporadic interventions of existing monetary NPOs are part of the transformative perspective that underpins them, or because the cooperation entered into at this time by local authorities and monetary NPOs broke down barriers and opened up new possibilities. In this later instance, the crisis acted as a trigger for an acculturation process

enabling local authorities and monetary NPOs to become better acquainted with one another's rationales and objectives. These new bonds might strengthen cooperation and be vehicles for future territorial dynamics. In several of the cases examined, there emerged a readiness to perpetuate the forms of cooperation developed (*léman*, *pive*, *orno*, *carol'or*). This is why the territorial resilience promoted by Covid monetary initiatives cannot be reduced to its absorptive form, as part of a logic of short-term reaction to a shock. That resilience is also adaptive in the medium term because these initiatives propose new means of resilience through cooperation among actors (including local businesses, through their contributions in the form of resources or above all their participation in the monetary network). This can be reflected in some cases by the continuation of cooperation beyond the short run and by the strengthening of partnerships between monetary NPOs and local authorities. Some local authorities have taken up LCs as public policy instruments. But the territorial resilience being promoted is also potentially transformative, in the long run, because of local authorities' potential reliance on monetary NPOs enabling them to foster their transformative project, reach a wider audience, and promote the circulation of LCs. The issue of the continuity and change of these partnerships is a major one when it comes to determining the extent to which the understanding of the role of LCs and of their potential for bringing about change, like the understanding of their appropriation (or capture), might be institutionalized. As things stand, it might be considered that a further step has been taken towards recognizing LCs as public policy instruments.

In the end, resilience articulates around transition, which may be viewed "as one of the possible pathways of resilience for territories", with a "purpose of far-reaching transformation" (Talandier 2019). In this way the objective of absorbing the health shock was just one factor among the deeper dynamics that gave rise to Covid monetary initiatives. However, emphasis must be placed on the crucial character of cooperation among local actors and more especially on the central presence of monetary NPOs as developers of a narrative of transformation.

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Outline of a multi-currency system to meet contemporary challenges

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1. Introduction

Fundamentally, our monetary system based on a two-tier banking organisation (central banks and commercial banks) is focused on financing the production and marketing of financially profitable products and services. This profitability is essential to make it possible to reimburse the credit granted through money creation.

If, in the 19th century, this structure responded to the priority objective of increasing production and supporting industrialisation in order to meet unsatisfied needs, we can see today that this organisation is generating disastrous collateral effects with dramatic ecological and human consequences. The earth is suffering from a hypertrophy of economic activity.

The question today is not to produce more but better, to adjust production and consumption to the sustainability of living conditions in the long term and to respect social equity.
We consider that our monetary system, which organises, coordinates and informs our initiatives, our production and our exchanges, and which is constrained by financial profitability, does not meet contemporary needs. Of course, it must continue its mission of pre-financing the capitalistic economy, but it must open up to new missions that are essential to the survival of humanity, such as financing the realization of the ecological transition or the restoration of biodiversity that are not financially profitable.

At this time, these missions, which are essential to the future of the planet and humanity, can only be financed through taxation and redistribution policies that imply additional economic growth that is harmful to the environment. This leads to the paradox that in order to repair the earth, we must first damage it even more.

Our work leads us to consider that a multi-currency system would offer a relevant response to contemporary challenges. Such a system would differentiate the denominations, the modes of issuance, the primary allocations, the primary beneficiaries, the counterparties as well as the characteristics of the currencies in circulation by distinguishing between market bank money, public and private non-market currencies or currencies linked to the availability of natural resources. In such a system, the prices of products and services would be expressed in affected or vectorial form, each vector representing a monetary dimension of the multi-currency system.

The different vectors of the multi-currency system would be based on the characteristics of the real world, the availability of (non-)renewable, recyclable, (im-)material resources. Our approach aims to incorporate the environmental and human dimensions into the way we count in economics.

2. On money and its objectives

By adopting a panoramic view of the history of money, we can essentially discern two origins of the monetary phenomenon: the regal origin, on the one hand, which founded the monetary institution and sovereign or regal money, and, on the other hand, the merchant origin, which is at the source of the means of payment which, very often, have responded to the shortage of regal money or aimed precisely to do without it (bank account, bill of exchange, bank note, commercial or bank credit, cheque, credit/debit card).

Today, our monetary architecture, established since the 19th century, is based on a hierarchical system of two tiers of banking institutions; the central banks which are part of the state sector, at the first tier, and the commercial banks which are part of the market sector, at the second tier. Central banks create and lend central bank money to commercial banks and commercial banks create and lend means of payment to their customers. The fundamental criteria governing the operation of banks, both central and commercial, are the financial profitability of the operations financed and the creditworthiness of the borrower.

The aim of the monetary and financial system is therefore solely financial and based on the development of a credit economy which "*can be deployed as long as there are perspectives of growth of wealth allowing not to extinguish the debts but to remunerate them in the form of interest*"[1]. This aim seems to us to be totally out of step with the contemporary challenges of ecological transition, which aim to prevent and adapt to climate change and to regenerate biodiversity, without forgetting the imperative need to achieve social equity. These are existential goals of humanity that the monetary institution cannot incorporate in its current logic. For us, the monetary system must be put at the service of the ecological and social transition.

In this note, we first try to identify some defects of the monetary system and then try to propose adaptations in line with these objectives.

3. The issues of the monetary system

a. First issue: monetary commensurability, the basis for fungibility, full substitutability and weak sustainability

The value of all products and services is expressed through their price. The reduction to the single monetary dimension, the price, of all the components of products and services implies that they are commensurable by the single monetary unit. A single unit, the monetary unit, then expresses all the natural, human and financial resources incorporated in the products and services.

Since everything is expressed through price, everything can be converted into everything. Everything is commensurable and reducible to price. This is the indispensable condition for the affirmation of the liberatory power of money, the foundation of the general theory of equilibrium and the indispensable basis for the thesis of the substitutability of the factors of production (capital, nature and labour) among themselves[2].

Monetary commensurability is a prerequisite for the affirmation of the liberatory power of money. Money, which is perfectly fungible, has a liberating power over all debts regardless of the nature of the services or products exchanged. It is a universal purchasing power on all types of products and services without any limit. It allows one to buy petrol (a non-renewable resource), vegetables (a renewable biological resource) or to go to the theatre (a service) without any ecological, social or moral consideration.

Commensurability underpins the principle of substitutability of capitals. "*According to the neoclassicists, it is possible to envisage substitutions between the various forms of capital: an increased quantity of "man-made capital" (productive equipment, education, research, etc.) must be able to take the*

[1] GOMEZ, Pierre-Yves, (2022), "Le capitalisme", PUF, Coll. Que sais-je ?, 126p. (O.t.Own translation)
[2] VIVIEN, F. (2013). Chapitre 1. Les visions économiques du développement durable : quels enjeux en termes d'évaluation ?. Dans : Franck-Dominique Vivien éd., *L'évaluation de la durabilité* (pp. 23-44). Versailles: Éditions Quæ. https://doi.org/10.3917/quae.vivie.2013.01.0023 (O.t.)

place of smaller quantities of "natural capital" (environmental services and natural resources)"[3]. In the neoclassical conception, the transition from natural capital to productive capital and their supposed equivalence takes place over time through a succession of arbitrages based on price analysis based on a system of equations describing the economic equilibrium. However, prices do not incorporate all the information relating to the products and services exchanged; they only reflect market motivations and are not intended to reflect the environmental or social consequences of production processes. On the one hand, *"social relations to the environment and to natural capital are external to the market and are not mediated by the price system*"[4] and on the other hand, short-term financial interests are privileged[5] to the detriment of future capital.

b. Second issue: a monetary system with unlimited drawing rights on a limited earth

The mission of the monetary system, which is banking in nature, is to create so much money, so many drawing rights on nature and on people, that the investments financed on credit generate profits which are, in turn, invested in profitable projects which thus fuel a race to maximise economic growth. The purpose of the monetary system is profit through economic growth. The monetary and financial system is totally disconnected from the physical or biological environment which it perceives only through financial accounting indicators. Thus, the monetary system has an unlimited right of money creation giving unlimited drawing rights in a finite physical world. This is not a flaw, it is a chasm that separates the conception of money from the real world. "*It is an embarrassment to capitalism, ideologically speaking, that capital is no longer the limiting factor. Anyway, this difficulty was circumvented by asserting that capital could satisfactorily replace natural resources. The denial of any fundamental dependence on nature is the fundamental impulse of neoclassical economics*."[6]

c. Third issue: an intrinsic inability of the monetary system to finance the non-profit sectors and the ecological transition

The contemporary banking mode of money issuance, based on the quest for financial profitability, is intrinsically incapable of financing financially unprofitable investments in the non-profit sector or in the ecological and social transition. Under the current profit-driven rules, biodiversity regeneration, climate protection measures or investments in the non-market sector, which are not financially profitable, need to be financed by another mechanism than bank financing. These investments are currently financed through taxation, through public levies on income or wealth and through public debt. Consequently, in the current conception, the ecological transition can only be a derivative activity, secondary to market activity; it cannot be a priority objective of either society or the monetary system. In the present configuration, in order to finance the transition, it is first necessary to create profitable economic activity in order to create income, which can then, through taxation, be partially allocated to the non-market. Thus, financing the unprofitable parts of the ecological transition implies a prior growth of economic activity which, by definition, is harmful to the environment. This leads to the paradox that to repair the earth, we must first damage it further!

4. The proposal

To address the first issue of the monetary system, monetary commensurability, we propose the introduction of a multi-currency system whose objective is to reduce the liberatory power of money to control the consumption of resources deemed valuable. Therefore, the monetary vectors we propose are closely linked to these resources and are non-fungible.

To respond to the second and third issues, we propose to reform the aims of the monetary system by adding the mission of financing the financially non-profitable sectors, first and foremost the ecological

[3] VIVIEN,F. (2009), "Les modèles économiques de soutenabilité et le changement climatique" in "Regards croisés sur l'économie" N°6 2009/2, La découverte, pp. 75-83 (O.t.)
[4] VIVIEN, F. (2009). Les modèles économiques de soutenabilité et le changement climatique. Regards croisés sur l'économie, 6, 75-83. https://doi.org/10.3917/rce.006.0075 (O.t.)
[5] CARNEY Mark, (2015), « Breaking the tragedy of the horizon - climate change and financial stability », Bank of England, 29 september 2015
[6] DALY, Herman, E. (2004), "From Uneconomic Growth to a Steady-State Economy", Edward Elgar publishing, 272 p., p.326.

transition and the regeneration of biodiversity. In concrete terms, this means introducing new modes of money issuance in line with this purpose, the issuance of "voluntary money", money created through donations, possibly conditional and free-interest loans..

The solution we propose is based on a vector-based monetary system that would complement the current monetary system. This linkage would make it possible to finance the investments of the non-profit sectors by making it possible to control and limit the consumption of precious resources. In this way, the profit and non-profit spheres of society would be financed by appropriate solutions.

a. Reducing commensurability by introducing monetary vectors

If we agree that price is information to guide the economic decision-making, then the price formation mechanism should, in our view, incorporate all the information on the physical, biological, chemical transformations and human inputs that made the production possible. We are thus in line with N. Georgescu-Roegen[7], H.E. Daly[8], F. Roddier[9] or the CARE-TDL[10] accounting method for which prices must include the costs of consumption but also those of reconstituting human, natural and financial capital. Financial information can only be valid if it includes all dimensions of the production and consumption process

To achieve this objective of extended information, we propose to use four monetary units instead of one (or four monetary vectors). The price of each service or product would be expressed by four vectors, each representing a single type of natural or human resource. The one-dimensional price is then transformed into a four-dimensional price and the different dimensions are not reducible to each other. Consequently, commensurability and monetary fungibility decrease.

The four types of resources have been defined based on whether the resource is renewable or non-renewable and whether it is human or natural. We have also given a name to each vector.

The four types of resources and their monetary vector are:

1° Non-renewable physical resources: underground, ground, atmosphere, including mineral resources, air and water, which appear to us as common goods. The stock of these resources is limited, as is their availability. Consequently, the principle of their governance should be "sparing use" so that future generations can also benefit from these resources. In terms of governance, at present, the exploitation of the underground and the atmosphere is generally done through the granting of exploitation licences (mines, air traffic, GSM network, etc.) whereas the exploitation of the land is generally subject to private property rights, possibly limited by general rules (urban planning, land use planning, protected areas, etc.)

We propose to call the monetary vector associated with non-renewable physical resources: "**Terra**".

2° Non-renewable biological resources: these are the fossil fuels, coal, oil and natural gas, all three of which are the result of biological degradation processes. We distinguish these resources from the previous ones insofar as they are the basis of organic chemistry, a key industrial sector, and because the combustion of these fossil fuels is one of the causes of climate change. The governing principle of these energies should also be "sparing use" with the additional constraint that it is imperative to stop the accumulation of carbon dioxide (CO2) in the atmosphere.

We propose to call the monetary vector associated with non-renewable biological resources: "**Carbo**".

[7] GEORGESCU-ROEGEN, Nicholas, (1971), "The Entropy Law and the Economic Process", Harvard University Press, 472p.
[8] DALY, Herman, E. (2004), "From Uneconomic Growth to a Steady-State Economy", Edward Elgar publishing, 272 p.
[9] RODDIER François, (2015), "Thermodynamique de l'évolution – Un essai de thermo-bio-sociologie", Editions Parole, 215p. (English version : The thermodynamics of evolution, 2020)
[10] https://www.chaire-comptabilite-ecologique.fr/la-chaire?lang=en

3° Renewable biological resources: these are the products of agriculture, forestry, animal farming, fishing or hunting, the characteristic of which is that the resources can be reconstituted relatively quickly on a human scale so that they can be consumed sustainably. They are the combined product of nature and human activity and are highly dependent on climatic conditions. The governing principle should be the conservation of the natural reproductive capacity of the resource. Specific regulations for the sustainable exploitation of these resources seem appropriate (fishing or hunting quotas, standards for the exploitation of cultivated or farmed species).

We propose to call the monetary vector associated with renewable biological resources: "**Vivat**".

4° The resources of humanity: these are the means or capital that humans can use; productive and creative activities, knowledge, techniques, finance; to produce what they consider to be necessary, The fundamental principle of governance should be the search for continuity and permanence of human flourishing.

We propose to call the monetary vector associated with human resources: "**Euro**" to keep the current name but we would have preferred "**Huma**".

In concrete terms, in everyone's wallet there will be four currency units, terras, carbos, vivats and euros. The price of products and services will also be expressed in the four currency vectors.

For example :

a. The purchase of a new house made of bricks and cement (non-renewable resources):
100.000 terras ; 10.000 carbos ; 1000 vivats and 120.000 euros
b. The purchase of a new wooden house (renewable resources):
5.000 terras ; 10.000 carbos ; 80.000 vivats and 85.000 euros
c. The purchase of a pre-existing house will require:
0 terras ; 0 carbos ; 0vivats ; 150.000 euros
d. The purchase of natural gas by a bakery:
0 terras, 500 carbos, 0 vivats ; 20 euros
e. The purchase of flour by the bakery
0 terras, 10 carbos, 500 vivats, 10 euros
f. The purchase of bread by a consumer
0 terras, 2 carbos, 4 vivats, 1 euro

The examples lead to some initial observations

- Each price is composed of four vectors - if not applicable, one or more vectors is zero.
- Money vectors are used as regular money, money units are obtained and money units are spent. We will come back later on to the different ways of acquiring the different units as well as the rules of issuance, remission and exchange between the different money vectors.
- Business accounting systems need to be adapted to work with four money vectors.
- A price or service can only be acquired if the buyer has sufficient units of each of the vectors needed for the acquisition. The unavailability of one of the vectors makes it impossible to buy.
- The purchase of a pre-existing house does not require terras or carbos. These vectors are linked to environmental extraction. They are used in all stages of production up to the moment of release for consumption. The subsequent use of these resources through reuse, reutilisation or recycling no longer requires the use of these vectors as there is no longer any extraction of resources from the environment. This is a positive element for the establishment of a circular economy[11].

[11] With the normal losses due to entropy during successive recycling

b. Adding the non-profit sector as a monetary objective and transforming the modes of money issuance to finance its investments

We have seen that in its historical development, money has pursued two types of purpose: regalian and merchant. We propose to add the "non-profit" purpose. Under this heading, we include all financially unprofitable activities deemed indispensable by society, such as education, health care, the enhancement of the place of the old in society and their support at the end of life, for example, and, of course, the ecological transition. At present, investments in these sectors are financed via chronically deficit public budgets and therefore, indirectly, via public debt, the cost of which is equal to the interest paid to the holders of this public debt.

In the regalian context, the preferred method of money issuance is purchase through the putting of coins into circulation (bearing the effigy of the sovereign). In the mercantile context, the preferred mode of money issuance is lending or credit. In the non-profit context, the preferred method of money issuance should be through donations or zero interest loans. We can think of several forms of donation and therefore several forms of money issuance:

1° The voluntary mode of money issuance
2° The zero-interest loan
3° The Universal allowance of melting money

1° The voluntary mode of money issuance, a conditional gift on the restoration of the planet

Money donation can take the form of "voluntary money issuance"[12], which consists of issuing money without financial compensation and without repayment on condition that the amount issued is used exclusively for the restoration of nature. Through this conditional gift, financial capital is created to restore natural capital. In our proposal, the voluntary mode issues euros, however, if necessary, the voluntary currency can be issued in the form of a regional currency in order to couple the objectives of regional development, relocation of activities and use of local resources with the objective of environmental regeneration. This money issuance would be controlled by a multidisciplinary body combining political power, monetary power and representatives of various constituted bodies (employers, trade unions, nature conservationists, NGOs, etc.).

From time immemorial, the issuance of money without repayment, of permanent money, has been an essential feature of so-called sovereign or regal money. Money was not given by the sovereign, but once it was in circulation, it did not have to be paid back. This type of money has allowed humanity to produce and exchange for over two thousand years. From our point of view, this issuance without repayment is justified because the regeneration of nature has no profitability other than ecosystemic; it has no economic or financial profitability. Nature cannot therefore repay financial debts because it offers what it produces free of charge. It is in the name of this absence of financial profitability and in the name of ethics - leaving a viable planet for future generations - that we consider that this money should not be paid back.

The voluntary mode of money issuance is the only one in human history that reverses the relationship between nature and humanity. It allows humanity to put itself at the service of nature rather than nature at the service of humanity!

2° Bank money issuance at zero interest rate by the central bank to finance non-profit investments

In order to provide the necessary financing for non-profit investments, it is essential that public authorities have access to zero interest bank financing from the central bank. This type of zero-interest financing, a form of interest donation, is particularly suitable for public investments and amortising investment grants that are currently financed through public debt. It could be, for example, to accompany the development and generalisation of passive energy buildings, to rethink and reorganise

[12] COUPPEY-SOUBEYRAN, J. and DELANDRE, P., (2021), "The Case for Money serving the Common Good", Veblen Institute, https://www.veblen-institute.org/Monetary-Transition-The-Case-for-Money-serving-the-Common-Good

the occupation of the territory, to rebuild a health system centered on respect for the individual, etc. All these situations in which amortisable investments of a non-profit or public type must be made.

In this scenario, the interest burden of the public debt devoted to investments is reduced to zero. The public debt is then simply a monetary advance necessary for the realisation of useful projects, which is repaid in proportion to the duration of use of the investment. In such a scheme, public debt is valued, it becomes a symbol of civilisation and restoration and no longer has the negative character of an unbearable burden. At the same time, it ceases to be the raw material of finance and no longer offers any financial return to the holders of the debt. It is no longer a private tax on public investment.

3° The universal allowance of a melting currency to limit the consumption of non-renewable resources

In the name of inter-generational solidarity and sustainability, non-renewable resource stocks must be used sparingly by each generation. These resources are scarce and not substitutable. Therefore, an intergenerational system of distribution of resources until they are replaced, if possible, must be developed. An intergenerational distribution method, such as quotas per generation, could be applied. Within each generation, a technique for the fair distribution of these quotas must be found. We are thinking of a periodic universal allocation, a form of recurrent donation, whereby each citizen would receive a periodic quota - a drawing right - on non-renewable resources.

This proposal is particularly suited to the consumption of fossil fuels (non-renewable biological resources) through the allocation of carbon quotas to each citizen. A public institution would be in charge of issuing free of charge the carbos - individual carbon quotas[13,14] - and of allocating them according to a universal allocation logic in the form of "carbon units" on a personal account. From these accounts, citizens would have the right to buy a volume of fossil energy, goods and services that required the consumption of fossil energy. This mechanism of universal allowance of non-renewable resources could also be extended to non-renewable physical resources, in particular water. In this way, everyone would receive an annual drawing right on a volume of drinking water in the form of terras.

To avoid the accumulation of terras or carbos leading to forms of capitalisation of drawing rights or to forms of speculation, they would have a deadline for use. After this deadline, the unused units would be cancelled. Terra and carbo would be melting currencies. The total volume of allowances issued by the institution would be in line with the collective maximum cap. For example, for fossil fuels, the amount of allowances issued would be less than the maximum amount of carbon emissions allowed annually to preserve the climate. Each purchase of a product or service would be made by paying a price in euros and in allowance units. Through successive transmissions within the trade chains, the units would eventually be traced back to the original importer or operator of the resource, who would then have to hand them over to the authority responsible for the original emission of the units. The issuing authority could then check that the quantity of units delivered is in balance with the quantity of resource put on the market and destroy the units used. As the volume of allowances issued is controlled, the volume of resources consumed is also controlled. Considering their characteristics, currencies that melt if not used and are destroyed as soon as they are returned to their issuer, terras and carbos are genuinely ecological currencies that allow the consumption of certain resources to be limited. As their volume of emission is defined in relation to the quantity of real resources available, long-term resource management can be easily implemented and even if a secondary market is created, it will be certain that no more than the admissible volume is consumed.

c. Establish rules of exchange between currency vectors

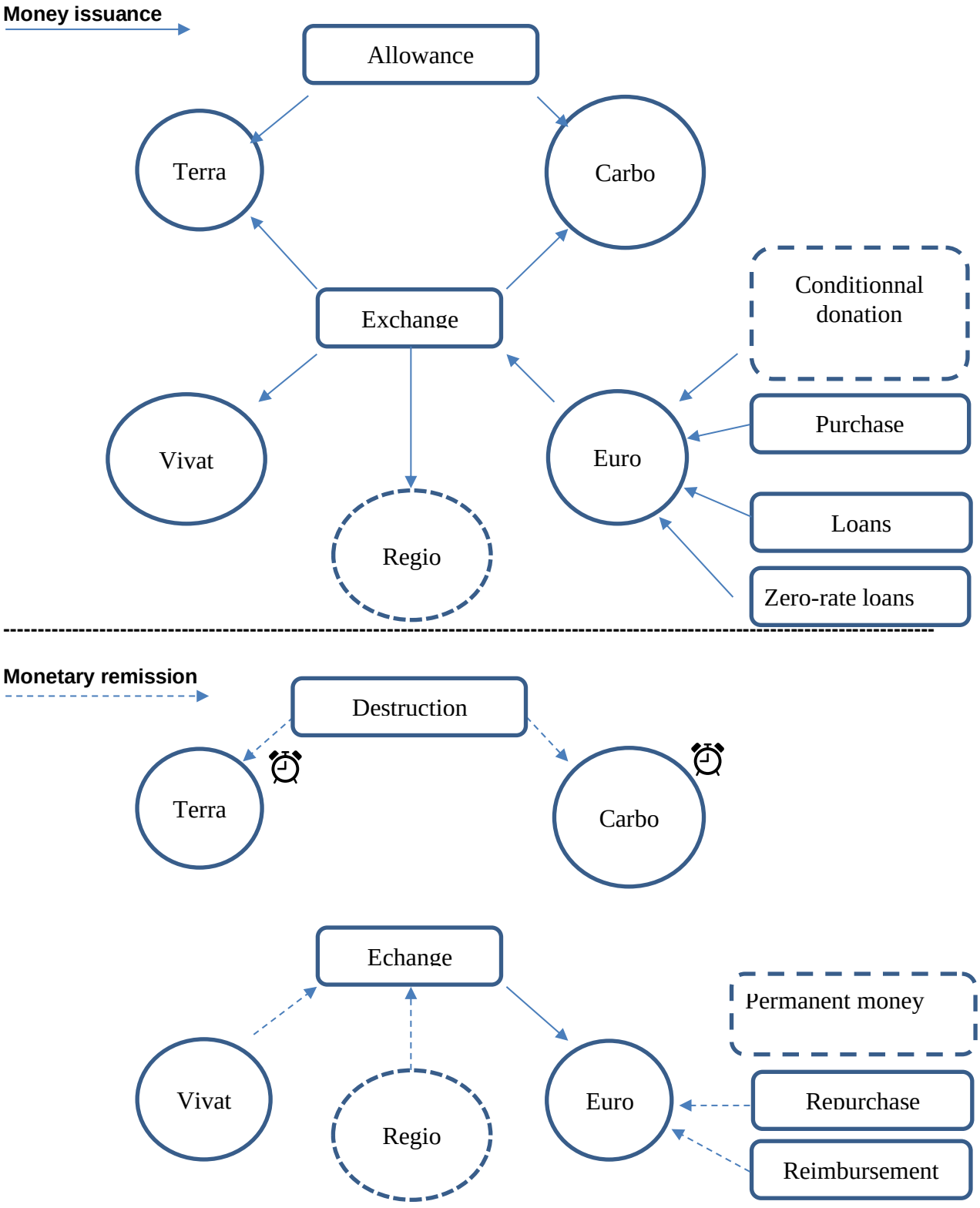
With this proposal, the vector monetary system remains essentially based on the euro with its current modes of issuance to which we add a "voluntary mode of issuance" and zero interest loans. All euros are perfectly fungible, nothing distinguishes them whether they are issued by the banking sector or by the voluntary mode. Where appropriate, with a view to promoting regional development, euros can be

[13] A. VAN DER CAM, (2021), "Designing an end-user carbon account scheme as a climate policy tool in the EU context", https://dial.uclouvain.be/memoire/ucl/en/object/thesis%3A30422
[14] https://comptecarbone.cc/mouvement/#ressources.

converted into complementary currency or into vivats for the exploitation of renewable biological resources. Vivats and regional currency units may, where appropriate, be converted back into euros at some form of exchange loss.

Terras and carbos can be issued and allocated to the population by universal allowance, but can also be acquired in exchange of euros (currency exchange) within the limits of annual availability. The terras and carbos issued cannot be converted back into euros since they are ecological currencies with a limited life span.

Schematically, this gives:



5. Synthesis

While the current context requires humanity to engage in a vigorous ecological transition and in the development of the non-profit sector, the profit-oriented nature of the monetary institution remains hegemonic. Its banking, profit-driven architecture not only leads to an intrinsic inability to finance the non-profit and the ecological transition but, worse, it gives humanity unlimited drawing rights on nature's limited resources. The use of a single unit of account (monetary commensurability) to express the price of various types of resources leads us to dead ends in terms of sustainability and substitutability of natural resources. All this leads to the dramatic conclusion that our way of life is unsustainable.

Therefore, in the monetary field with which we are concerned, it seems desirable and conceivable to complete the objectives of the monetary system by adding to it the financing of non-profit sectors, first and foremost the ecological transition and the regeneration of biodiversity.

In practice, our proposal is to introduce new modes of money issuance based on donation, such as voluntary mode of issuance, interest-free loans and universal allocation of drawing rights on the physical resources of the planet. At the same time, to reduce the liberatory power of money and to allow a control of the consumption of resources, we propose to introduce a quadri-monetary system (or vectorial money) in which each monetary vector addresses one and only one type of resource, the terra for physical resources, the carbo for fossil energies, the vivat for renewable biological resources and the euros, possibly converted into regional currency, for human productions. In order not to fall into the trap of commensurability, the different monetary vectors are only fungible with each other through precise rules.

In our view, this monetary configuration could meet the challenges of the time. It would reduce the pressure of finance on society and the environment, finance non-profit investment and land repair, and reduce public debt. It could also allow for economic restructuration without hindering or placing the burden of ecological reconstruction on the market world alone, while allowing for the recognition of necessary activities that are currently not valued, remunerated or quantified.

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A Circular Flow Economic Framework for an Agent-Based Model of a Community Currency

Ferdinand C. Maquito, McAngelo M. Miro, Kenichi Kurita

This paper presents an agent-based model (ABM) of community currency, which is an improved version of an EU-based model using basically three categories of agents: 1) community consumer/worker; 2) intra-community producer; and 3) extra-community producer. The economics of this ABM is based on a simple circular flow similar to that found in macroeconomics, relating these three agent categories. Community currency is accepted by the first two agent categories, while the third category only deals in fiat money. The community consumer/worker buys from and works for the two other agent categories, which are linked to trades across the community border. Equilibrium conditions are derived in the fiat money flows linking the three agent categories. The model allows an elaboration of the role of community currency, or volunteerism, in making the community robust against shocks. The external shocks could either be through imbalances in the fiat currency transactions of the intra-community producer or the community consumer/worker. As expected, the use of a community currency contributes to the robustness of the community vis-a-vis the fiat money flow deficits within the community generated by the external shocks. Simulations also indicate that there might be optimal levels in the degree to which community currency is utilized by the community.

Keywords: agent-based model, external shocks, robustness, community currency, circular flow

1. Introduction

In this paper, we further advance in our study of simulations of community currencies. Our survey of such simulation models provides insights on various aspects of a community currency system. We adapted insights that we felt were useful for our purposes and abstracted from those which were not.

The original idea of using simulation models to help in designing CCs was taken from (Yoshida & Kobayashi, 2018). We are convinced of the usefulness of using simulations as a tool to design such currencies for local communities in developing countries. The long-running pandemic has made face-to-face field work very difficult if not impossible. This is compounded by the lack of a real world case of community currency in a developing country such as the Philippines. Under such conditions, computer simulations offer a convenient approach to continue in our quest to understand community currency.

This is the basic objective of our study of simulations in CC systems: to use it as a tool for designing a CC system. A previous paper of two of the authors (Miro & Maquito, 2021) was derived from an agent-based model developed for EU conditions. The EU simulation model was repurposed to arrive at a model that was more aligned to our basic objective.

(Yoshioka et al., 2022) provides another simulation model which delves into the micro factors, such as place attachment of agents, underlying the use of consumers and the acceptance of merchants of community currencies. We think that these are important factors but for our purpose, we choose to set the variables related to these concepts as design variables. The acceptability of community currencies is treated as exogenous variables. This stems from the belief that acceptability of the community currencies is the result of the level of volunteerism or social capital within the community. Such social capital could be formed through various community development approaches which ultimately empower communities.

(Boik, 2014) constructed an agent-based model that is the closest we found to a model of the macroeconomy using a community currency. Boik's model imposes a stock-flow consistency requirement to the monetary flows, which we apply to our macroeconomic simulation model. Boik's model, however, takes on a micro approach when it tracks the state of each agent (person). We find this not really necessary in our model, at this point, and instead focus on the circular flows of money within the two-currency model.

In general, the above-mentioned simulation models tend to be micro in their perspective. Moreover, they focus on the developed country examples. Our simulation model looks at the monetary circular flows in the context of a developing country. More concretely, our model will look at the response of a community to an external shock. In the context of developing countries, this one weakness of poor communities that are usually embedded in urban sectors, from which many of the members of such communities depend on for their livelihoods.

The basic features of the agent-based model are discussed in the next section. In Section 3, the model is then subjected to simulations to study its performance. Section 4 provides the major findings of the simulations, which is then discussed further in Section 5.

2. The Model

The model is based on the agent-based model of Miro and Maquito (2021). The agent-based model has the following components:

1. Community Markets, which constitute the sellers within the community, and also hires community members
2. Shops, which constitute the sellers outside the community, and also hires community members
3. Tanukis, which are the members of the community, and are the agents of the ABM. A total of 150 Tanukis populate our model.

There are two currencies in the model. One is the fiat currency, which in this case is the PHP (Philippine Peso), and the other is the community currency, which is called the "tane". Each tanuki is given a certain amount of both currencies. The amount of tane is determined as a pre-set proportion, between 0 and 1, of the amount of PHP, which is determined randomly. The relative share of the pricing of the markets of its goods is also a pre-set variable, which can be varied from 0 to 1.

The agents in this agent-based model are members of the community with the following features:

1. The agents are initially randomly distributed within a two-dimensional world, and randomly moves at every tick (day) of the simulation
2. At every tick, the agents could decide to spend in the markets based on its proximity to the community markets or shops

At every 30 ticks, the following accounts are settled:

1. The payment of Shops to Community Markets in PHP for community goods sold to Shops by Community Markets
2. The payment of Community Markets to Shops in PHP for external goods sold to Community Markets by Shops
3. The payment of Community Markets to Tanukis in PHP and Tane for services rendered
4. The payment of Shops to Tanukis in PHP for services rendered

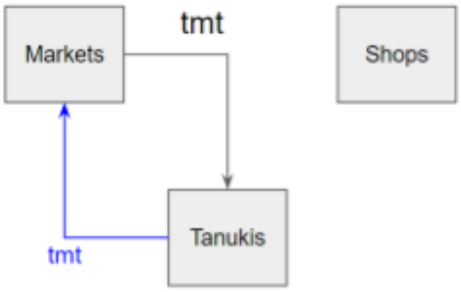

Figure 1. Tane Flow Diagram
Notes: tmt = tanuki to market tane

We assume a steady flow condition for currency flows in the model. Figure 1 shows the Tane flow every 30 days. The blue tmt indicates the total spending of Tanukis on Community Markets using Tane. This amount is returned to Tanukis after 30 days as payment for services rendered to the sellers in the Community Markets. There is no Tane flow with the Shops, which deal only with PHP.

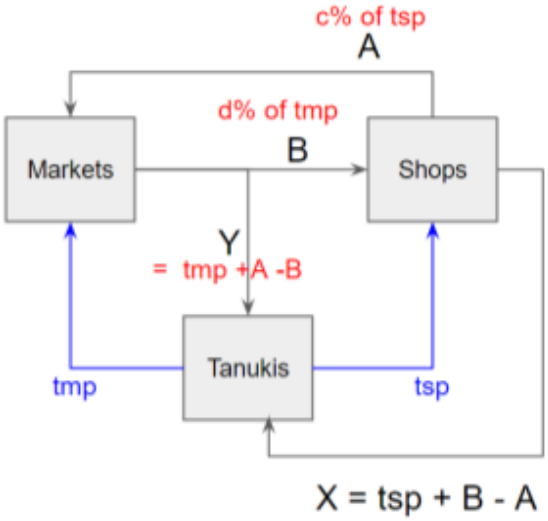

Figure 2. PHP Flow
Notes:
tmp = Tanukis to Markets in PHP
tsp = Tanukis to Shops in PHP

Figure 2 shows the PHP flows that occur every 30 days, under steady flow conditions. Community Markets and Shops trade with each other, and it is assumed that quantity of goods bought with each other are simple functions of the spending of the Tanukis at the Community Markets or Shops. It is to be noted that the PHP price is assumed, for simplicity, to be constant. Hence, the quantity flows have a one-to-one correspondence with the PHP flow. For the case of PHP payments from Shops to Markets (flow A), which is the payment of Shops for goods bought from

Community Markets, is c% of tsp. For the case of PHP payments from Community Markets to Shops (flow B), which is the payment of Community Markets for goods bought from Shops, is d% of tmp. Both c and d are positive constants that would depend on the interlinkage of Community Markets and Shops.

Flows X and Y are computed as residuals so as to satisfy the steady flow condition. Flow X is basically payments to Tanukis by the Shops for services rendered, and is equal to tsp + B - A. Flow Y is basically the payments to Tanukis by the Community Markets for services rendered, and is equal to tmp + A - B.

The performance variable being monitored in this model is the rejection rate, which essentially measures the rate at which Tanukis are not able to buy goods, due to lack of money, from either Community Markets or Shops, even though they are within buying distance. This is computed as follows

$$rejection\ rate\ = \frac{(tan\ go - tan\ buy)}{tan\ go} \times 100$$

where
tan go = the number of times that Tanukis are within buying distance from a vendor
tan buy = the number of times that Tanukis have sufficient money to buy from the vendor.

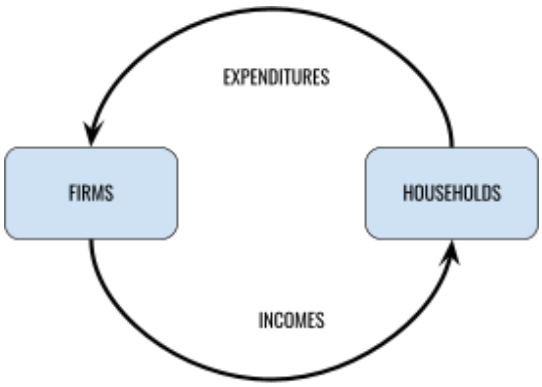

Figure 3. Two-Sector Circular Flow Diagram

From a macroeconomics perspective, our model draws inspiration from the circular flow diagram often used in macroeconomics courses. The origin of this diagram goes all the way back to French economists in the 18th century, but the modern circular flow diagram is attributed to Knight (1933). The most elementary depiction of this circular flow diagram is shown in Figure 3, which has two sectors: households (consumers) and firms (producers). At steady state equilibrium, the money flows from the households to the firms, labeled as expenditures, should equal the money flows from firms to the households, labeled as incomes.

3. Simulations

The model was coded using NetLogo 6.2.2. The total number of ticks for one run is 1440 days or roughly five years. The stock of Tane was set to be 20% of the randomly set stock of PHP, and 20% of the pricing of the community goods. These values are inspired by the reported share of CC-denominated trade (amounting to 22%) in the Kenyan community currency case of Bangla-Pesa (Ruddick et al., 2015). The values for c and d were both set to the intermediate number of 0.5.

There were basically two sets of simulations. The first one was to establish the acceptability of the model under the assumptions of the model. The model was accepted when it displayed the expected economic behavior of a sawtooth type of PHP and Tane stocks of the Community Markets and Shops, following the inventory theory of money holdings (Baumol, 1952), as could be seen in Figures 4a and 4b. The second simulation was to observe the model behavior when it was subjected to income shocks from the external economy. Such shocks represent dips in income received by members of the community from unexpected events such as lockdowns prompted by the pandemic.

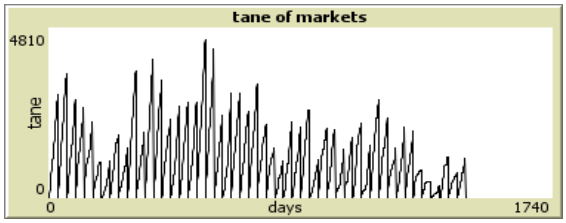

Figure 4a. Stock of Tane in Markets

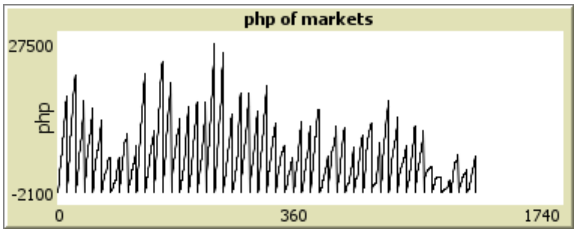

Figure 4b. Stock of Tane in Markets

There were basically two sets of simulations for the second simulation. The first one simulated for the following different values of the shock factor: 0.85, 0.9, 0.95, and 1, without the use of Tane. The second simulation was done for the same values of the shock factor but with the use of Tane, where the shares of Tane in the stock and pricing were set at 20%. The shock factor is multiplied to flow X (see Figure 2), which represents the PHP income earned by members of the community from the Shops. This range of shocks was chosen based on the negative growth rate of 10% in the GDP of the Philippines in 2020, at the height of the pandemic. A negative 10% income growth rate is taken to correspond to a shock factor of 0.9. The shock factor range is chosen to be spread more or less around this value. Note that a shock factor of one means there was no income shock. The shock factor was applied for the period from the 360th to the 720th tick (or a period of about a year).

A total of 100 runs were done for each simulation for a given shock factor value. The rejection rate was recorded for each run. Each run goes on for 1440 ticks (days).

4. Results

There are basically two findings from our simulations. The first finding confirms the claim that community currencies are effective in keeping a community's economy afloat when there is a sudden shortage in fiat currency in the outside world. The second finding is, less expectedly, a significantly high attenuating effect of external shocks by the community currency.

Here are the figures from our simulation that bear out these two findings. Table 1 shows the minimum, maximum, and average rejection rates for the four shock factors being considered, without the community currency, tane. As you can see, the average rejection rate is in the order

of 50%, indicating that about half of the time a tanuki goes hungry since s/he does not have the money to buy goods.

SHOCK FACTOR	0.85	0.9	0.95	1
MINIMUM	38.87	40.20	38.26	37.50
MAXIMUM	60.27	60.70	60.80	61.17
AVERAGE	49.57	50.45	49.53	49.33

Table 1. Averages of Reject Rate for Various Shock Factors Without Tane

In the case of the introduction of tane into the system, however, Table 2 shows that the average rejection rates significantly drop to around 0.7%. The average of the minimum rejection rate, in fact, is zero (no rejection).

SHOCK FACTOR	0.85	0.9	0.95	1
MINIMUM	0	0	0	0
MAXIMUM	1.21	1.36	1.50	1.62
AVERAGE	0.61	0.68	0.75	0.81

Table 2. Averages of Reject Rate for Various Shock Factors With Tane

Given the above results, we thought it worthwhile to conduct additional simulations at lower levels of Tane in both stock and pricing of the community market goods. We arbitrarily set these values to 0.05, which was significantly lower than the 0.20 levels that underlie the simulation results of Tables 1 and 2. The results of these additional simulations are shown in Table 3.

SHOCK FACTOR	0.85	0.9	0.95	1
MINIMUM	0	0	0	0
MAXIMUM	1.60	1.20	1.72	1.40
AVERAGE	0.80	0.60	0.86	0.70

Table 3. Averages of Reject Rate for Various Shock Factors With Tane
Note: Shares are set at 0.05

Compared with Table 1, it could be seen that the average rejection rates are still significantly lower than in the case where there is no community currency. Compared with Table 2, the rejection rates of Table 3 does not seem to be monotonically bigger.

5. Discussion of Results

The two findings from our simulations support the introduction of a community currency scheme to enhance the resilience of a community to protracted reductions in fiat-based income from the external sector of the economy. Moreover, such resilience could be obtained even through a small injection of the community currency. This finding is suggestive of the significant potential of CCs to attenuate income shocks that emanate from outside the community. For example in Kenya in Africa, local residents issue their own currency and use it for exchanging goods and services among them. This community currency helps the people to protect their community economy against the very shocks outside the community. Such attenuation stems from the CCs inherent ability to circulate a currency that does not leak out to the outside world. The existence of such attenuation effects creates the possibility of greatly reducing the welfare support from the government during times of protracted shocks.

The findings also suggest, however, that anything that significantly lowers the acceptability of the CC could undermine its attenuation of external shocks. CC acceptability is manifested in the model through the relative amount of CC made available, and its share in the pricing of community goods. Acceptability could be lowered by factors such as limited use of the CC by the local market, when community members tend to use a limited number of shops or when shops tend to be far away (Kobayashi et al., 2012). Significantly low acceptability could also arise from high transaction cost (Perez, Maquito, Bello, 2020), indicative of low community social capital, or low community volunteerism. The findings of this simple model, however, gives us hope that we do not really need a massive amount of acceptability for a CC scheme to provide significant resiliency. There is a useful case for promoting the acceptability of community currency. In Japan, local residents who are users of community currency in Sagamihara-city try to increase goods and services available for users by using the online information tools. By using the digital tool, they can easily find many skills of local residents and goods that they want to get and exchange them smoothly.

The simple model developed here also provides a viable platform for designing the broad features of a community currency scheme. Towards this end, the design variables here would be the amount of CC to be introduced and the appropriate share of CC in the pricing of the community's goods. These design variables are dependent on the following economic features of the community: amount of fiat currency initially in the community; the dependence of the community on external goods for producing the community goods; and the amount of fiat money the community obtains through members working in the external sector. The last one is ultimately dependent on the spending of community members both inside (through the community market) and outside (through shop) of the community. These economic features should be included in a survey of the peculiar context of a community for which a CC is being

developed. These economic features would generally be different from one community to the other, and, therefore, would indicate different optimal levels for the design variables.

The comparison with lower shares of community currency showed that external shocks are still significantly attenuated with the introduction of community currency. Rejection rates with lower shares of community currency appear to be neither monotonically higher or lower than those with higher shares of community currency. This would imply the existence of optimal levels of community shares in the stock of currencies and pricing of community goods.

Just like the simple circular flow model in macroeconomics, our model could be gradually upgraded to introduce other important items, such as local government taxation and spending, and an elaboration of the community's trade with the external sector. These are left as topics for future research.

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TOKENOMICS BEYOND THE BLOCKCHAIN: BRISTOL PAY BUILDING FORWARD RESILIENCE IN THE LEGACY OF THE BRISTOL POUND

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Diana, Finch[2]

Abstract: *In the world of community currencies Bristol Pound was a success. Yet in the realm of behavioural change it failed to bring about the great transition. In the face of the enviroclypse we need a new approach. By using countable tokens to encourage positive flows in social capital and environmental capital, rather than financial capital, Bristol Pay CIC is designing a new complementary system. This paper contains a historical review of the Bristol Pound with the lessons learned: the unintended barriers to entry for the majority of the population, the lack of value propositions to engage people; the technical shortcomings. It then outlines the hypotheses behind Bristol Pay, from behaviour change to gamification, and from multi-capital accounting to social economics.*

Keywords: *Community development, ecological economics, utility tokens, local development, energy transition, NFT*
JEL: *D16, Q56*

1. Introduction

The local currency movement has for many years been working to create economic interventions to correct the functioning of local economies to reduce environmental harms and build community capital (Kennedy et al., 2012; Rogers, 2013). Bristol Pound (hereafter £B) was one such currency (Marshall & O'Neill, 2018), operational from 2012 to 2021. In its early years, the £B became the largest UK local currency, both in terms of numbers of users: 1 600£B account holders and 600 business users reported in 2014 (Gilbert & Kenny, 2014); and quantity of money, with over a million £B issued and over 700 000£B in circulation (Hickey, 2015). It, along with the Brixton Pound, which used the same technology (Bindewald & Steed, 2015), was one of the first local currencies to offer digital and paper money. It was the first local currency to be accepted as payment for local taxes.

Here we look at the impacts of the £B currency, the reasons for its inability to become viable as a business in its own right, and the learnings that must be addressed in the design of Bristol Pay, the currency project planned for the future. We then explore the principles

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behind the design of Bristol Pay. We are influenced by The MetaCurrency Project (Brock, 2014; Wagter & Russell, 2016). There, the idea is that a value-flow can be seen as a current: a currency can be understood as a 'current-see' (Petz, 2020). Brock (Brock & Harris-Braun, 2011, m. 20:25) says "current-sees are the symbol systems to make flows at different levels visible". There is additionally, more than one current flowing in one direction at any time. Instead of seeing money as a marker of transactions, and focusing on money, currency can be seen as a way of making visible a reciprocal relationship between two parts of a system.

Money itself can be a wide variety of tokens; coins, notes, digital tokens (CoreLedger, 2019) or even commodity money, which contains both an actual usable function as a good, e.g. rice, squirrel skins, cigarettes or gold; and a token function, which has a store of value that can be transacted as a system of account as a service, thus fulfilling the properties of money (Petz, 2020). Tokens may be fungible (mutually substitutable with other tokens e.g., a 5-pound note can be swapped with any other 5-pound note) or non-fungible. An example is digital NFTs (or non-fungible tokens) (Popescu, 2021), they are non-fungible as they are related to a specific asset or service which cannot be substituted with another.

However, money is polymorphous and can have different uses and aspects (Gómez & Dini, 2016; Zelizer, 2000). Money may be special-purpose money, which is designed to be only spendable in certain situations or on defined products or services. The £B can be seen as a special-purpose money, which was locally restricted and limited to use with Bristol-based traders. Money is generally associated with market transactions, acting as payment for products and services. Yet, tokens can be created that act outside a market-based economy.

A token can be designed to mark an activity (such as pledging to avoid using herbicides and pesticides in your garden) that creates a specific value (in this example, an improvement in biodiversity) that does not involve two parties trading a product or service in a market. Marking that value creation with a token does not necessarily grant purchasing power; whether or not a token can be exchanged (for another token, a product or service) is part of the definition and protocol of each token type. This prompts the research question which led to this paper:

Can tokens be used to shape alternatives based on non-financial values?

To explore this wider role of tokens, we need to step back from how the economy is usually viewed. If we see the economy only as a system of investment, production and markets (the conventional macroeconomic approach), it is hard to understand the potential and use of tokens that do not confer purchasing power or financial value. However, if we take a broader view of the economy; as an emergent pattern of human behaviour through which resources and human effort create the goods and services to meet the needs of the population (behavioural economics), tokens can be seen as potentially transformational.

In a market economy model, in which money is seen as a store of financial value, the tools of choice for altering market mechanisms are financial; there have been many attempts to use

financial penalties and incentives to change individual and corporate behaviour; from carbon trading (Spash, 2010), to legislation to introduce charges for using plastic bags (Borg et al., 2021; Le Page, 2018), to volunteer reward schemes offering discounts for local services, e.g. Citizen Coin Bradford (T&A Reporters, 2021) in Bradford; and CounterCoin (Ntounis & Bailey, 2018) in Newcastle-Under-Lyme.

However, these sorts of financial incentives and penalties do not properly value the additional resources required to make the sought change, nor do they base the value of the reward or incentive on the true value of the intended outcome.

Moreover, there is a bigger problem with trying to change decision-making on the basis of financial value: Many human decisions are not made solely on the basis of financial gains or losses (Kim et al., 2009; Kurita et al., 2015).

A better understanding of the motivation for human behaviour is provided by the ISM model (Darnton & Horne, 2013). This postulates three main factors in determining behaviour:

- **Individual context:** what people themselves think about themselves, their beliefs and values, in turn dependent on their roles
- **Social context:** what people think others think about them, and the desire to be thought of well by those they aspire to emulate, social norms and institutions
- **Material context:** the infrastructure, both in terms of physical reality, technologics, legal and other regulations; and in softer terms, time and day-to-day schedules of life

From Bristol Pound to Bristol Pay

With this perspective, Facebook likes (Kosinski et al., 2013) can be seen as a powerful social token reputation currency that has been successful in changing the social and individual contexts in the ISM model for millions of people, and undoubtedly changed behaviours, albeit in an unhelpful direction from the perspective of BPCIC's aims (Bristol Pay Community Interest Company, formerly Bristol Pound CIC, hereafter BPCIC)'s aims. BPCIC has been exploring the application of behavioural economics to socio-ecojust ends (Finch, 2022).

Bristol Pay seeks to create token currencies that build on the ISM model, affecting both people's self-view and their view of how society sees them and their actions. Bristol Pay is hoped to be the first implementation of this City Pay proposition. The tokens are planned to be used to encourage pro-social and pro-environmental value-creation, and in turn to enable new positive social norms to develop. The Tipping Point (Gladwell, 2002) indicated there is a threshold to change behaviour and make this happen. While different subcultures and situations vary, around how many people need to be converted, BPCIC are using a heuristic of ~20% of the target population to adopt a behaviour under the idea this will cause a new norm that the rest of Bristolian society will adopt. We are building a new forward resilient society that has been nudged in a different direction (Revell & Dinnie, 2020).

To give a simplified example of how this might work in practice, consider the ideas the Bristol Pay team have explored with an environmental charity local to Bristol; Avon Wildlife Trust (AWT). AWT wants to create significant changes in how people design and maintain their gardens. AWT's Grow Wilder hub's "mission is to bring about urgent action for the restoration of wildlife by educating, upskilling and empowering people, communities and businesses to bring about positive change through wildlife-friendly gardening and sustainable food growing" (AWT, 2020). AWT aim to "deliver biodiversity gain", "restore and create … carbon sinks", and reduce run-off, thus reducing both drought and "local flooding"(Barrett & Relph, 2021). However, in the UK, social norms prescribe the antithesis, i.e. having a neat garden, with closely mown weed-free lawns, low maintenance patios, and neatly presented shrubberies and floral borders. Cf. Gaston et al., (2007); Goddard et al., (2013); Harwood, (2004) for details of how historical, social, and spatial factors affect garden design).

By "empowering people to take action for wildlife" through Team Wilder, based at Grow Wilder, AWT hope to get "25% of the population … [to] visibly take action, [and] create a social 'tipping point', where the majority will follow" (Barrett & Relph, 2021). Bristol Pay offers the opportunity of celebrating people's pledges to give up herbicides and pesticides in their gardening, or returning part of their patios and lawns to nature, via tokens. The tokens can be a measure of value with a unit of account for each of these varied behaviours, which is transparent to the people, Team Wilder and other stakeholders. Ultimately they can be used to evaluate whether a tipping point has been achieved (as evidenced by a rapid change in the rate of adoption of a certain behaviour) and what that tipping point was. Then to have a "messy", nature-enhancing garden will be acceptable, and people will feel less (real or imagined) pressure from neighbours to show off a pristine garden.

Similarly, Bristol Pay has explored potential use cases with local utility companies: such as Bristol Water, limiting showers to three minutes maximum per person per day in their households; or Bristol Waste, creating zero landfill waste in their household for a month. Here the aim is to encourage people to be more aware of their resource use through gamified tokens, and to set targets and suggest pledges.

At a wider scale, Bristol City Council, following consultation with people and organisations across the city, produced the One City Plan (Rees et al., 2021), which is aligned to the UN's Sustainable Development Goals (Brunnhuber, 2015; UNDESA, 2015). The plan offers a road-map of strategies and milestones to achieve net zero carbon for the city by 2030, as well as to make progress against various social targets.

To achieve this plan, which creates a new material context, significant behavioural changes are needed across society. Each of these could be gamified and tokenised, encouraging people to create and maintain new habits, simultaneously creating a data-set through which the council can measure the extent their engagement exercise is delivering the desired changes, and create communications that reinforce positive emerging social norms.

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2. Methods

We present our results as a case study (Yin, 2018) of the now closed £B currency and early research to support the design of Bristol Pay. As action research (Lagae, 2012; McNiff, 2013) this is an ongoing intervention in the city of Bristol. We are informed by an analysis of nudge economics (Sunstein & Thaler, 2021). We surveyed currently functioning reputational schemes. We carried-out market analysis and population surveying within the cultural milieu of Bristol targeted for behavioural change.

From £B, we have surveys of business and individual users. BPCIC, the organisation that designed, implemented and managed the £B currency, used semi-structured questionnaires and guided interviews to capture the data, as well as feedback and complaints received by BPCIC. Additionally we consider quantitative data from the operation of the currency. For Bristol Pay, BPCIC surveyed various local businesses (former members and non-members) on their attitudes towards the proposed payment methods. As yet, structured consultation has not included detailed discussions on the token operations, though this is planned as part of the development and implementation co-creation process.

BPCIC has been working with: Bristol Water, Bristol Waste, and the University of the West of England, Bristol, about the role of tokens to cut resource use and waste; the University of Bristol and the University of Edinburgh, about shaping student behaviour in line with the universities' aims for positive environmental and social performance; and the third sector, the most positive of which was Avon Wildlife Trust, and the need to set a new norm.

Additionally we have econometric data, from the operation of the £B, with a sufficient market capitalization and time-series that makes it realistic to consider technological transfer implications for other comparable sized cities.

Our data is generalizable. Our innovative field-based approach is linked with common business practices and not only a limited academic study. Thus we are not looking at only a pilot, but actual implementation in a social system. We are networked with academics and practitioners and would like to see what we have learnt shared more widely in a form others can apply in their situations. This means both academic audiences can be informed, for heterodox economic theory development, and those that might take action can hear about a real working case to learn wisdom from it.

3. History of the Bristol Pound

The £B was available in two formats: paper vouchers (£B notes) and digital money. Digital payments could be made online, via SMS messaging, and from early 2018, using a smartphone app. Usage of the £B notes did not require membership of the Bristol Pound scheme, whereas to open a digital account, users had to become members, not only of the currency scheme but also the then Bristol Credit Union (BCU), now named the Great

Western Credit Union. The reason for this joint membership was that digital currency fell within a UK regulated area of activity, and the Credit Union was already a regulated body.

It is worth noting that at the time the digital currency was first being designed, the Electronic Money Institution (EMI) regulatory framework (first enacted in 2011) did not exist (FCA, 2017). Had the currency been designed a few years later, other options that could have simplified the technical architecture would have been available, allowing real-time transactions and enabling BPCIC to use data to manage the network more effectively.

There were two classes of members: individual and business. The BCU rules ensured that only people who lived or worked in the BS postcode area could join as individuals, and that only businesses registered or operating mainly in the BS area could join as businesses.

Individual membership grew quickly in the first three years of operation, and continued at a slower pace throughout the period of operation. By contrast, business membership grew quickly initially, then dropped. Whilst some new businesses continued to join, others left, either by choice or because they ceased trading.

Analysis of the types of individuals joining showed that the vast majority (82%) were educated to degree level, had well-paying jobs (77% in professional or managerial roles), and were less diverse in terms of ethnicity than the population of the city in general, with 89% describing themselves as 'white British'.

Analysis of the business members showed that the majority were small and micro sized businesses, with 35% being self-employed unincorporated businesses. They covered a variety of sectors, but were predominantly retail and service businesses. Geographically, they tended to be situated in areas that were more deprived than average, and clustered in particular neighbourhoods.

There were two main transaction types: B2C (consumers paying businesses) and B2B (businesses paying other businesses). B2C transaction levels grew rapidly in the first three years of operation, plateauing in 2015-2016 and then reducing until the end of the scheme. B2B transactions by contrast started to drop in 2016, yet recovered and reached a peak in 2018, after which they declined sharply.

A key metric for the organisation was the velocity of the currency (de la Rosa & Stodder, 2015), calculated as the ratio of transaction values over a specific period compared to the value of balances held in the system. This was seen as an indicator of how effectively the currency was recirculating. Records show that the velocity of the currency dropped from 2016 to the end of the digital currency.

4. Analysis

The aim of localising supply-chains drew directly from the Transition Town movement, which seeks to empower local communities and reduce environmental harms (Aiken, 2012). The currency sought to encourage individuals to favour independent retailers and

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businesses, and in turn to encourage those businesses to favour other local businesses in their supply-chains. This was expected to:

- reduce CO_2 emissions, via reducing long distance transportation of goods
- increase turnover of local businesses, in turn creating profits locally that would be reinvested in growing local businesses
- create closer, mutually supportive relationships between local businesses, in turn creating more resilience in the sector
- encourage diversity and plurality in the local economy, helping to make the local economy as a whole less affected by changes in global markets

The data produced by the operation of the £B was not sufficient to enable any analysis of how well the currency performed in relation to any of the above aims. Given the scale of the currency operations (approximately £B1 million per annum at its height in 2015) in comparison to the entire Bristol economy (approximately £14 billion GVA in 2015 (see ONS, (2022) for various datasets, changing methodologies and spatial designations for relevant GVA estimations), any direct contribution to overall metrics in any city-wide data set of the £B currency would be impossible to detect.

However, there is evidence both from surveys of individual and business members, along with analysis of transaction data, that the currency did create changes in behaviour, and enable or at least make visible local trading loops through which money was recirculated.

For example, with regard to individual members, when asked what changes they had made to their wider economic behaviour to improve their impact after joining the Bristol Pound scheme, whilst as might be expected; over 70% said they changed where they shopped and what they bought; over 50% had begun to buy more second-hand goods, over 40% moved their main bank account, over 25% started to grow their own food, and 7% moved their pension, even though such behavioural changes were well beyond the explicit aims and functions of the currency.

As for business members, whilst as expected; over 70% had changed their policies around purchasing; 50% had changed various aspects of their HR policies, and over 15% moved their business bank accounts, despite these being activities not directly advocated.

In 2019, a retrospective analysis of B2B transaction data by Geofutures Ltd. (Thurstain-Goodwin, 2020) showed, over the first four years of operation, the network of businesses became significantly more connected, with key nodes emerging that enabled all transactions to be part of a connected network. After this point, as some key nodes left the network, there was a gradual disintegration of the network, with several businesses trading only with one other business, unconnected by trade with the rest of the business network.

5. Discussion

The pressure of climate change necessitates that more localised circles of production and consumption are developed. This was a primary aim for the £B in Bristol, with the local currency used as a tool to encourage localised economic behaviour for SME businesses and Bristolians.

Bristol's business community and customers have been open to fintech innovation in the past, with widespread issuance of coins (merchant tokens) by businesses in the 19th century (Mays, 1978). Product innovations (from paper to digital money) and process innovations (paying by mobile phone) in our time have seen this community alter its behaviour, yet more disruptive innovation is required due to institutional pressures, cultural change and increasing digitalization.

Regrettably, uptake of the £B currency was low as a percentage of the adult population (approximately 0.3%, based on ONS population figures), even though a large number compared to many local currencies. It seems part of the problem was that the motivation of the BPCIC team was not shared by most people.

For individuals, the currency had no clear value proposition. To commit to the call to action, individuals had to both understand the concept that a special sort of money could have beneficial impacts on CO_2 emissions and localisation of supply, believe that the currency would indeed deliver these benefits, and have the time and resources to change their shopping behaviour in ways that would require more of both. Commonly, BPCIC staff were asked questions like, 'What's in it for me?', or 'Do I get a loyalty discount card?'. With no obvious benefit for participating, it is not surprising that usage of the currency was restricted to a largely well-educated and wealthy minority.

Businesses joining were given a value proposition: Join the Bristol Pound currency scheme and you will benefit from additional marketing and increased footfall from people seeking places to spend their £B currency. This got many businesses to join, but given the low numbers of individuals using the currency, in reality they received very little additional footfall – if any. Indeed, most business members reported existing customers had changed their payment method, rather than any new customers had come seeking to spend their £B currency. Given this lack of delivery against the initial proposition, it is unsurprising that after a few years, some businesses started to leave the scheme. Based on customer complaints, many other businesses continued to be members officially, and yet refused to take payments in £B.

For the £B to make more impact in terms of localisation of the economy, and create a viable business model for its operations, its usage needed to have grown by at least a factor of ten, with adoption by at least 5% of Bristolians, as well as participation by most locally owned high-street businesses.

Additionally, given the aim of localisation, BPCIC wanted business members to change their supply chains, choosing local businesses wherever possible, and encouraging these businesses to join the Bristol Pound scheme if not already a member. In reality, businesses

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were reluctant to change suppliers if their business operations were going well: changing suppliers brings an element of risk along with significant administrative work. Encouraging one's suppliers to join a scheme that brings few benefits and several costs (such as training customer-facing staff, setting up tills, managing a more complex cash-flow situation) is also problematic in building or maintaining good relationships with suppliers.

Bristol Pound can be seen as having inherent inconsistencies. On the one hand, it was aiming to create community wealth, but on the other hand, it was inaccessible to most people without significant resources. It aimed to support local businesses, and yet failed to understand small business imperatives. It tried to reduce global transportation, and yet operated at a business rather than at a product level when judging whether something was 'local'. To some extent these inconsistencies can be seen as complementary and part of a wicked problem's nature, however they can also be seen as reasons why £B was a success in terms of a functioning community currency, yet a failure in the realm of creating measurable outcomes.

Already, by early 2019, BPCIC had become increasingly aware of the many problems with the model for the £B currency, and had started work on thinking about how the organisation could develop a different approach. It was clear that the organisation's mission of creating a more environmentally sustainable, equable and resilient local economy was still relevant, but the method of achieving this through a local currency in the Bristolian context had been shown to be non-viable as a business operation and had not achieved the scale of impact hoped for.

A key question at this point was:

Should the organisation remain focused on local independent businesses, or should it think in broader terms about influencing behaviours amongst both individuals and businesses using some kind of money as a tool?

Business focused ideas included developing the potential for businesses to create their own loyalty points, to reward returning customers with discounts. This could replicate aspects of the original Bristol Pound scheme, by encouraging people to buy from local independent businesses, but give people more reasons to get involved. As there are a range of organisations trying to assist SMEs in the region (including the chamber of commerce, the Federation of Small Businesses, and a range of networking and business support initiatives), it was felt by the team it would make more sense to take a wider focus around behavioural change.

A further concern was that enabling businesses to create incentives to purchase more from their shops could be seen as promoting and encouraging the growth of consumerism, which was at odds with the overall objective of creating an economy in which we live within the planet's boundaries. A modal change in the direction of degrowth rather than just product-

switching brings Bristol Pay to more of a behavioural modification than the product substitution of marketing that Bristol Pound appeared to have been manifesting.

Given these learnings and the difficulty in creating a proposition that would attract the required levels of usage, BPCIC stopped focusing on localising supply-chains and local independent businesses. It began focusing on other ways to encourage reduced consumption, pro-environmental choices, and the creation of social cohesion.

Various key ideas were discussed at this early stage. The first was the use of non-fungible tokens (Majer & Barbosa, 2022; Popescu, 2021), which offered the potential to create digital representations of unique activities or objects, and to track and count these on a distributed ledger thus avoiding the reliance on a single trusted authority to control data, and so allowing a more open monitoring and accounting system.

Another idea was to encourage behaviour change through a reward mechanism. Initial conceptions assumed extrinsic rewards would be the most effective approach, for example rewarding volunteering with discounts at participating businesses, who could in turn promote themselves as having a positive corporate social impact, much in the way Citizen Coin has done in Bradford (T&A Reporters, 2021). However, there were concerns that low-level financially framed incentives could undermine intrinsic motivation to change behaviours.

Research suggests that humans consider things very differently when a reward is stated in financial terms rather than as part of a social interaction (Dawnay & Shah, 2011). Indeed the mention of a financial value was shown to make people less likely to behave in a requested way (Ariely, 2009; Rustichini & Gneezy, 2000). This research furthered the team's conviction that any rewards should not be able to be equated in any way to money through market transactions.

It was felt by the team that one focus for behaviour change could be encouraging people and businesses to reduce their resource footprint, which would entail buying and using less of everything, and reusing things where possible. It was clear that social media was being used to drive demand for new goods and services, driving behaviour towards increased consumption. This view of what was really driving behaviour took the team towards looking at the ISM model of understanding behaviour. It seemed that minor changes to pricing, monetary rewards and penalties were less important in determining how people behaved on a daily basis than how they viewed themselves in relation to friends or people they aspired to be like on social media.

Reputation counters (likes, retweets, content repostings, and numbers of followers) were key currencies used in social media, determining how much social reputation and influence people had. These currencies had no extrinsic purchasing power; rather they were powerful in creating a feeling of social status, rewarding or punishing people by making them feel intrinsically good or bad about themselves and thus influencing individual beliefs and social attitudes.

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The team looked at a variety of apps and products that sought to create positive behaviours. Successful examples include: Fitbits, which encourages people to be more physically active (Kerner & Goodyear, 2017); and Duolingo, which engages people in learning languages (Munday, 2017). In cases such as these, there are points and achievements that encourage habit formation, but these rewards generally do not have utility outside the app.

In the autumn of 2019, the team became aware of the work of Arthur Brock (Brock, 2005; Brock & Harris-Braun, 2011) through a currency design course run by the MetaCurrency Project (Brock, 2018). This approach sees currency not as only a tool for market interaction accounting for flows of financial value, but as a wider tool for measuring and thus making visible any flows of value: 'current-see'. Brock identifies different types of wealth: Tradeable wealth that enables one to exchange and purchase is one type of wealth that is concerned with quantities; whereas rankable wealth enables a qualitative measure. Rankable wealth may be reflected in market pricing, but equally, it may not.

Alongside this, Brock identifies different sorts of capital: Financial capital, natural capital, social capital, knowledge capital, health capital and manufactured capital, amongst others. This approach led the BPCIC team to consider using tokens to make visible values and how they can change over time by offering specific tokens for specific pro-environmental and pro-social choices, such as switching to active transportation (Mueller et al., 2015) or volunteering with community organisations and outlined these ideas in the City Pay White Paper (Finch, 2022). Fundamentally the tokens show creation of value, which may increase, degrade, or remain constant over time.

These token ideas (see Table 1. Bristol Pound Tokenomics) would count different sorts of activities or behaviour changes, and would offer intrinsic rewards, such as improvements to self-esteem; rather than extrinsic rewards, such as discounts on goods and services. Tokens would act differently depending on what they were counting. For example, an Item Token could be created and assigned to an object by any user, and would increase in value each time it was passed on to a new user encouraging re-use, with possible provision of a new asset after a time to the system e.g. a drill after so many uses could be replaced or serviced. These ideas can be stated as protocols for particular types of NFT.

Table 1. Bristol Pound Tokenomics

Token Type	Protocol	Example
Action Token	These are non-transferable, but degrade over time, promoting continued activity. Like demurrage.	Active transportation, regenerative gardening, community volunteering.
Item Token	Tokens represent real world manufactured products. Their value increases with each transfer to a user or each re-use.	Tool sharing, clothes swaps, refillable water-bottles and take-out coffee containers.
Badge	Recognize skills in areas that can improve environmental performance or social cohesion. Like a certificate.	De-escalation training, cooking seasonally from local ingredients, repairing (clothes, appliances etc.).
Counter	Are awarded via a universal budget allocation, with tokens being burned as used. Like a prepaid meter.	Carbon budget. Water use.

Voting	Awarded by groups to educate and activate participation in decision-making by token usage by different cohorts, over time, for different decisions. A tool for monitoring and activation of democracy.	Community decision making. Voter and civic education.

In early 2021, the Dasgupta Review (Dasgupta, 2021) was published. The Review made it clear that the environmental capital of the world needs to be accounted for and valued. Whilst Dasgupta does not specify this valuation should be stated in anything other than financial terms, which is debatable (Costanza et al., 2015), he does recognise market mechanisms have not been sufficient to reverse the degradation of environmental capital – something going-on for over 200 years.

For example, carbon trading has now been in place in Europe since 2005 (Spash, 2010), and yet "Global GHG emissions have continued their steady rise" (Lamb et al., 2021). As finance is a way of valuing things specifically in relation to a market economy, the BPCIC team is interested in the power of NFTs to measure environmental capital itself, rather than a financial proxy of that value. If this approach is to gain traction, there is a need to experiment with non-financial accounting methods, and the team therefore sees the ideas it has been developing around the use of NFTs to measure and count activity without reference to financial equivalents as an important area for research.

In the longer term, the BPCIC team sees the potential of such tokens to create a 'triple bottom line' (Elkington, 2018) accounting method, in which financial accounts can be compared with token accounts that consider a company's impact on environmental, social, and manufactured capitals.

However, it was clear to the team as this thinking emerged that there was a danger of recreating some of the problems from the original £B currency. First, there was a danger of creating a non-viable operation that would remain grant-reliant in perpetuity, which is not an economically sustainable option. Second, the only people likely to join such a token scheme would be people who already saw a value in reducing their resource footprint. It was therefore agreed that a separate market-based operation was needed:

a) to create an income stream

b) to create an easy way to onboard people, by engaging with them in their current daily lives

This led the team to look again at the development of a payment platform.

In general when shopping using a debit or credit card or payment app, money leaves the customer's bank account, which may be at any bank in the network, and money arrives (less a transaction fee) in the merchant's account, generally at a completely different bank. This is an open system, in which any two accounts can transact.

However in such an open system, a variety of third-party services providers are required to create a bridge between the two accounts: the card issuer, the card network provider (e.g.

Visa and Mastercard), the merchant service provider (e.g. Worldpay, Stripe or Zettle), as well as clearing banks.

In a closed-loop system, the payer and recipient both have accounts in the same institution, meaning that there is no reliance on costly third-party services. Once accounts are set up and money loaded on, all transactions within the system are ledger entries between accounts, incurring no additional costs. Payji Ltd (who BPCIC is in talks with) were creating an EMI-regulated solution for closed loop payments. They are keen to create such a system operating within localities that would offer a slightly cheaper payments service for businesses, whilst also creating surpluses (thanks to lower operating costs) that could be used to fund voluntary and community sector organisations. Such a platform would only create significant surpluses by operating at scale.

As such, rather than limit people or businesses that can join in any way, the approach is to make the payment platform as easy to access as possible, and to encourage its use in chain and independent stores. Rather than trying to create a specific economic impact through the payment method as £B did, this payment method seeks only to help fund voluntary and community organisations through surpluses generated from payments, providing an easy value proposition for both individuals and businesses: By using this payment method, you can directly help to support voluntary organisations working in your community.

By creating a simple and widely accessible value proposition, the new platform not only generates funds to support the token-based approach already described, it can also introduce a far wider audience to the token schemes than would be the case without such a value proposition.

There is a further benefit to operating an EMI-based payment platform in terms of addressing digital financial exclusion. In the UK 3% of the adult population were unbanked in 2017 (Ripley & Watmough, 2018). Whilst many are working to safeguard the ability to use cash (Post Office, 2021; Statham et al., 2020; Wolman, 2013), this ignores some of the problems of being trapped in the cash economy.

Firstly, digital exclusion is one of the factors in creating the poverty premium paid by many disadvantaged people (Davies & Collings, 2021), for example paying more for utilities because they cannot pay by direct debit, or being unable to shop around for the cheapest deals online because they cannot pay digitally.

Secondly, with most jobs in the UK paying salaries direct to bank accounts rather than in cash (McLeay et al., 2014), not having control of a bank account means either people are reliant on a third-party processing their monies for them (putting them at risk of financial abuse and with a cost premium (Datta, 2007)), or people being trapped in cash wage jobs which are often either casual, or in the grey economy (resulting in precarious employment situations, unprotected by employment law, and potentially with national insurance contributions not being paid, further impacting on people's long-term access to benefits and pensions).

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Thanks to the very different regulatory environment offered by EMI regulations, it is possible to take a different, proportional approach to Know Your Customer (KYC) based on balance and usage levels, enabling many more people to open an account with access to digital money.

6. Conclusion

BPCIC has shown that, despite having the technical competence to run a community currency over time, the £B failed to bring about the desired ecological change, and this is perhaps generalizable to all the "town pounds" tried in the UK. An alternative is Altcoins and associated tokenization. However, it appears that Bitcoin and similar don't work either – so far. This can be ascribed to frothiness, with the hope that speculative bubbles will burst, current practice might change and a more sober usage follow.

Several projects have already started to experiment with blockchain as a tool for good. We can see this with the positive blockchain (PB) movement. Here there is a range of technologies, holochain, different consensus protocols (e.g. proof of work; proof of stake; proof of authority) and other adjustments and developments from the original cryptographic origins of the blockchain (Nakamoto, 2008). Positive blockchain projects aim to "solve social or environmental issues … and what all PB projects share in common is the aim to positively impact people's life" (PositiveBlockchain.io, 2020).

Such perspectives can help us to develop new sorts of money. In particular, NFTs potentially offer a good solution for currencies that work on principles other than trade and exchange. For example for carbon reduction, it can be truly said that, " Not All Blockchains are Created Equal" (Majer & Barbosa, 2022). NFTs and the associated techbro culture have been rightly criticised (Olson, 2022), yet the design of currencies, bit-tokens rather than bit-coins that operate outside the field of traditional financially driven market economies is an area that is worthy of further action research regardless of the technology used. Tokenomics is just at the beginning.

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Alternative currencies: instruments for disconnection.

By José Sbattella

The difficulties encountered by peripheral countries when joining word order dutifully and orderly entails to produce alternative proposals that pursue a reconfiguration of the power relationship, strengthening the alliance among the most vulnerable ones. Thus, it is not about thinking of unachievable utopian dreams of autarchic isolation but about giving a new meaning to the way we understand our participation in this global scheme so difficult to escape from.

In this sense, the theoretical development of Amin (1988) is interesting. He thought about the possibilities of an alternative to globalization. In one of his most famous works, "The Disconnection", he analyzed the place of the peripheral countries within the global capitalist economy during the 70´s and he developed a political theoretical proposal opposed to the neoliberal ideas that were starting to be in the spotlight. Thus, the "disconnection" was an intent to offer a feasible choice for developing countries to undertake their disadvantaged situation in the world economic order.

The author fully rejected the idea that underdevelopment is a transition to development, which will "naturally" arrive, and the faster the more these countries give in to the demands of capitalism. Instead, he highlighted the important contributions of Structuralism and the then-recent "Dependency Theory".

On the other hand, Amin questioned concepts of the Left itself. Capitalism as an indispensable stage to strongly boost development of productive forces is a notion supported by Marx himself.[1] In that sense, Samir Amin considered that Marxism has underestimated the historic nature of this aspect. The effects of the establishment of a global capitalist order produced at the same time different outcomes for central and peripheral countries. In consequence, he rejected the "commercial" solution to overcome underdevelopment.

Besides that, in opposition to the Keynesian paradigm, which claims that a development open to the advantages of interdependence could be managed at national level, Samir Amin did not understand development as a process where each country is an autonomous stage. For that reason , the "disconnection" implies an alliance among the peripheral countries and it is not a path to be taken independently. "*The critical thinking is interested in learning which could be the alternative alliances capable of breaking the vicious circles imposed by the market*" (Amin, 1988).

The core theoretical definition arises form the idea that capitalist globalization triggers a system of global prices defined by transnational conglomerates.

These prices give value to the work of central countries, so there is a continuous polarization between central and peripheral countries.

[1] That´s why he considered that the capitalist mode of production was a historic "necessary" stage for the development of the productive forces, prior to any kind of "socialist" order.

These processes break down when a country or a region is able to establish a domestic price system, independent from the global system, which fosters a wealth accumulation system favoring the development of national productive forces.

Within the history of global capitalism, starting when European countries launched the territorial conquest more tan 500 years ago, the only way out from the dual logic central-peripheral country was the disconnection from the regulations setting the value of the price system imposed by colonial countries.

Thus, the victory of the Industrial North over the Slave South, producer of cotton for England, in USA should be interpreted as one of the first disconnections .

So should the Russian Revolution of 1917, which also disconnected the Soviet Bloc from the globalization process for more than 70 years.

China, Vietnam, North Korea and Cuba underwent the same situation.

In Argentina, the first disconnection was done with Peronism within the 1945 - 1955 period.

During that decade, Argentina started a wealth accumulation process that enhanced worker´s salaries and the domestic market and enabled the creation of a national bourgeoisie, modifying domestic relative prices through the Argentine Institute for Exchange Promotion(IAPI, for its acronym in Spanish).

The second disconnection was conducted by Néstor and Cristina Kirchner within the 2003 - 2015 period, when domestic prices were modified through different instruments, such as withholding taxes and subsidies, allowing the expansion of the domestic market, together with the relative increase of salaries.

Other countries in Latin America, such as Venezuela, Ecuador, Bolivia, Brazil, less intensively Chile and Uruguay, and for a short period Paraguay, came along with similar processes.

Nothing comes for free and least of all to challenge the global hegemonic dominance of the transnational conglomerates (CONTRA), which have reacted firstly with soft coups in Honduras and Paraguay and later through the offensive led by the Judicial Branch and the Media in Latin American countries.

The success of this offensive enabled Administrations related to the globalization process to take office in the government.

The reconnection to the colonial system was brutally reinstalled, dismantling the domestic price system, favouring financial business and the increase of the CONTRA's incomes.

Again, the national, popular and democratic sectors began a process of resistance to recover the National State, the only instrument that enables the political measures necessary to support the conflicts derived from disconnection.

This resistance produced the election victory of the Frente de Todos in December, 2019, a national and popular alliance, under the leadership of the kirchnerist peronism, but appointing as president a representative of the sectors considered tepid when confronting the powerful.

After more than three years in office, the State structures have proved helpless to limit the abuses of the old Argentine oligarchy, allied to the transnational conglomerates and supported by United States, jeopardizing the democratic process.

The perspective of recovering the popular initiative implies to start considering the disconnection view as a concrete process, that shall be implemented by means of State policies, using the domestic and international experiences, which were successfully enforced.

One of the most important policies is the one on Currency, and consequently the financial issue.

The question to be answered is how to implement the disconnection from the global financial system, today controlled by the transnational banking and the International Monetary Fund (IMF).

Disconnection and Money

The dominance system of the central countries is based on the control of the Transnational Conglomerates (CONTRA) over the 5 monopolies:

1) Natural Resources
2) Financial Resources
3) Scientific and Technological Research
4) Weapons of mass destruction
5) Media

The problem of alternative currencies occurs within the dispute over the second monopoly: the financial resources.

It is necessary to clarify the importance of the monetary sovereignty in the development of the global capitalist system.[2]

[2] Jose Sbattella.¨Teoría de la moneda y significado de las monedas alternativas.(Theory of the Currency and importance of alternative currencies). Paper published in the book “Criptomoneda y soberanía” (Cryptocurrencies and Sovereignty). Editorial Punto de encuentro 2022.

Theoretical Aspects.

To think the currency as a barter substitute within the exchange process and, in consequence, as a result of the expansion of the capitalist market as the unique system of social functioning is a mistake from the historical, anthropological and sociological viewpoint. It is a concept developed by liberal economists, apologist of global capitalism.

In fact, this monetary phenomenon takes places since the beginnings of humanity. There are records of currencies in almost every pre-capitalist society.

To understand this phenomenon, it is necessary to make an interdisciplinary theoretical approach, departing from Anthropology, going through History and Sociology and finally including Economy.

Michel Aglietta[3] developed deeply this theory by articulating three concepts, debt, sovereignty and confidence.

Money and debt.

Every social fabric in any of the stages of humanity can be considered as a network of debts from different backgrounds and natures, caused by the ownership transfers of real or symbolic assets. These debts may be produced by different transactions: exchanges among human beings, among human beings and deities or other spirits, commercial exchanges, or exchanges derived from collective activities that must be settled by each individual.

Currencies are the means that allow to measure, to quantify, the set of relationships establishing society. Through currency intervention, social interdependences created and transformed into reciprocal rights and obligations among members and between them and their collective organizations or their representatives are translated in terms of debt.

In turn, currencies arise as a "unit of account" and settle the first way of symbolic representation of the "unit" of the social set in which it circulates.

Money also allows debts to be sustained in time, strengthening claims among the members of a society, becoming a dynamic unit that makes a fundamental cycle for the social reproduction process possible.

As they are "counting units" and "means of payment", currencies are the key of the social link unifying the debt system and its reproduction over time.

In summary: Currency is a key social institution, thought as from the human communities, which differs from the individualist vision of the neoliberal economists that reduce its existence to ease the transactions of the capitalist market economy.

Bruno Théret [4](2008) considers currency under three conditions: Under the objective condition it takes different concrete forms that enable it to ease daily

[3] Aglietta, M. “La monnaine soverraine”. Odile, Jacob. Paris 1998

[4] Bruno Theret. Les trois états de la monnaie. Approche interdisciplinaire du fait monétaire. Revue économique, vol.59, No.4 p. 813-841.

transactions. Under the incorporated condition, it gains the user´s confidence. Under the institutional condition, it is the expression of a monetary community, the society. On balance, is a complete social fact, inseparable from the system of values, which are not inherent or unchangeable, nor shared by all the members of the said community. Wealth distribution is in the middle of it.

The Life Debt

In every society, receiving, giving and producing life is the essential process of the individual and social reproduction. The "life debt" receives several religious and social acknowledgments,reflected in offerings to the gods and the tax payment in current societies. It is essential, for its social reproduction, that any group or organization, in order to survive over time, faces the need to ensure its reproduction beyond the death of its members. This requires the preservation of the global society and the debt transfer over generations.

Asset transactions, symbolic rituals linking human beings with their ancestors, with deities, with spirits, ceremonies for births, initiations, weddings or funerals, sacrifices are all demonstrations of life transfers.

It is here where we should look for the origin of currencies; in the payments to the deities for the "life debt", replacing victims sacrificed and offered as a tribute. It is the result of a social process produced by the transformation of the violence, replaced in a civilized manner by tax payment to the clan or the State authority.

Anthropology shows the currencies appear when nomadic people become sedentary and developed the division of labor. When writing allows defining equivalents of accounting value, and the State centralizes social sovereignty over its members, the meaning of monetary sovereignty comes up.

Invention of currency as a "unit of account" and the advent of writing come together, so we can infer that they precede the market relationships (Aglietta and Orleans, 1982) and more fundamentally, as it means a belonging relationship of members from a social group with a larger organization.

According to Aglietta, money is "a social contract objetivated in a common medium. In the act of payment, the collectivity that uses this medium gives back to each of its members what it judges it has received from that member through their activity" .

As an institution, it relies on the trust of its users, who must necessarily consider it legitimate. In consequence, the State fulfills the role of legitimizing a currency, through the tax process, establishing which is the legal currency.

But the legitimate violence in the tax and legal process is not enough and the economic agents consider that it loses legitimacy, as it happens in the hyperinflationary processes, citizens end up sheltering in an alternative currency.

Three forms of confidence

Methodical confidence: achieved by the repetition, over time. It is exchange routine, that ensures the realization of exchanges and allows to pay debts without problems.

Hierarchical Confidence: it appears when there's a monetary authority, whose aim is to preserve the stability of the banking system and to ensure the continuity of the payment system: The Argentine Central Bank or the US Federal Reserve, for example.

Ethical Confidence: it is based in the cohesion and legitimacy of the values and principles at the basis of a sovereign society's constitutional monetary order.

If one of them is eroded, the whole system can fall apart: It is monetary crisis which frequently leads to political crisis.

The Constitutional Order.

It includes and formalizes the values that enable members of a community to recognize one another as citizens of the same nation.

It is comprised of the language, the religion, the politics, the myths, the art, the Law and the political and legal institutions. It is any aspect that could be called a people's culture. It is whatever citizens accept and set as the Principle of Sovereignty.

The constitutional order establishes the authority of the State as a public power.

As a consequences, the central bank, as representative of the State sovereignty, assures the public debt because it has the ultimate capacity to monetise its debt, a sine qua non condition of sovereignty.

Constructing confidence in money is essential, but it is not easy to achieve nor established by law. To understand it, we must take as a starting point the fact that it institutes a relation of belonging to a community, where members consider that the sovereign central bank assures the value, the symbols, the principles and the regulations in force.

Monetary creation and liquidity.

The integrity of the payment system is based in three principles:

1) A common unit of account that allows to assess the wealth and debts.
2) Currency issuance regulations which organise access to the means of payment.
3) Regulations for the management of bank balances among the different banks.

The central bank operates this system, and as a consequence, the hierarchical confidence is unavoidable.

So erosion of confidence affects the principle of monetary sovereignty directly, enabling the issuance of alternative and supplementary currencies, whose aim is to regain access to liquidity in order to implement changes that allow the recovery of the monetary sovereignty.

This practice directly challenges the appropriation of the role of the central banks and raises a new issue about the future control of the means of payment.

Alternative currency issuance challenges the place where the monetary sovereignty lies.

It can be appropriated again by the people as a common asset or it can stay in the hands of the growing global financial power, increasingly concentrated in few hands and devoted to financial speculation.

Previous Alternative Currencies in Argentina.

Subnational currencies (quasi-currencies).

Following the analysis of the regulation school[5] regarding the different forms of confidence behind a currency: methodical, hierarchical and ethical, we can highlight that in the Argentine dual currency system the lack of ethical confidence in its own currency lie beneath. It is due to the political process undergone as society, which has just achieved stability in the last years of democracy, but the currency was and still is in permanent conflict.

Inflationary processes in Argentina, which ended up in 1989's hyperinflation, in practice produced a dual monetary situation: population continually refers to the value of the dollar for mid and long term transactions.

This situation takes place despite there were recent events in Argentina, in relation to the currency, that showed the limitations of the traditional financial interpretation on what is and what isn´t possible to implement in terms of State economic policies: the emergence of parallel currencies and barter during the deep economic and social crisis between 2000 and 2002 as an answer to the most extreme position of the orthodox liberalism which intended to dollarize the Argentine economy and lose the Peso as the national currency[6].

Subnational currencies did not come out as the result of a theoretical "experimentation". However, the unpredictable results of this practical implementation impacted in the theoretical field, as it made some of the limitations of the traditional understanding visible.

Subnational complementary currencies emerged as an answer to the Provinces' needs when they faced with their provincial State bankruptcy and their impossibility of indebtedness. The provincial States issued "bonds" to pay salaries, pensions and suppliers. Receptors, in turn, used these bonds to pay provincial and

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[5] Therét, Bruno. Revue économique LES TROIS ÉTATS DE LA MONNAIE: APPROCHE INTERDISCIPLINAIRE DU FAIT MONÉTAIRE. ISSN 0035-2764, Vol. 59, Nº. 4, 2008, pags. 813-842

[6] To fully understand the 2001 crisis in Argentina caused by the implementation of neoliberal policies, it should be enough to mention that 30 citizens lost their lives in the police repression on December the 19th and 20th of that year. Moreover, at the institutional level the President, De la Rúa, had to submit his resignation, enabling the implementation of the Presidential Acephalia Law, and having 5 different successive presidents in the last 10 days of that year. Before this, there was a capital flight for over US$ 20 billion from the reserves, so the Minister of Economy, Domingo Cavallo, was forced to forbid to withdraw money form the saving accounts of the citizens (so called "Corralito"). Foreign banks withdrew funds from their branches, leaving the deposits without support, violating the trust of their clients, as the deposits were supposed to be supported with their reserves. Finally, the State took responsibility for giving the deposits back at future, by means of different financial schemes.

national taxes, public services and the Province of Buenos Aires in particular, for final consumption. This implementation meant a breath of fresh air from the practical aspect and a challenge from the theoretical aspect, as it questioned the virtues of tying up to the dollar as the referent currency, like the Argentina national economy did from 1991 to 2001. Despite this double success, some economists still consider this policy as a symbol for the economic and social deterioration instead of considering it as an overcoming strategy.

The sequence of the creation process of the subnational currencies is as follows:

- Provincial States go bankrupt. Impossibility of indebtedness.
- Bonds issued to pay salaries, pensions and suppliers.
- Receptors used them to pay provincial and national taxes, public services and for final consumption.
- It meant a breath of fresh air from the practical aspect and a challenge from the theoretical aspect.
- It questioned the virtues of tying up to the dollar as the referent currency.
- Some economists consider this policy as a symbol for the economic and social deterioration instead of considering it as an overcoming strategy.
- In summary: Provinces and Municipalities need to issue provincial currencies because they have lost their revenue collection capacity, bearing at the same time a greater social spending. Education and health services were transferred to the Provinces in 1993.
- **In 1982**, Provinces and Municipalities were responsible for 31% of the total of primary expenditure.
- **In 1993**, it was almost 51%
- **In 2001, 55%.** (More than half the whole consolidated public expenditure).
- The recovery of the national State monetary sovereignty started by the end of 2002 and finished in October, 2003.
- Provinces committed to stop issuing quasi-currencies and the State rescued, by means of bills of cancellation of provincial obligations, these currencies and its own currency.
- On January 31st ,2003, debt was issued for $7,595 million. By August 2003, 50% of the debt had already been swapped and by December 2003, 100%.
- For financial statistics, for the International Monetary fund, those were Treasury bills, not money supply.
- It did not produce inflation growth. Larger amounts were issued, which were consistent with reduced inflation rates.
- Provincial economies were reactivated during the period of acute crisis and withdrawal.
- It avoided the capital flight form the provincial circuits of accumulation.

- Imports were reduced. Quasi-currencies were not exchangeable for dollars. It was only possible to buy in the domestic market.
- Loss of the control of the centralized monetary policy.
- Restrictions to sell among provinces.
- Except for the Province of Buenos Aires, quasi-currencies were not useful to pay national taxes.
- Risk of dissolution of the National State and eventual debate on a new tax agreement.
- There was a proposal to replace the national monetary system with another one using the dollar as currency and to move the monetary system to off-shore banks.

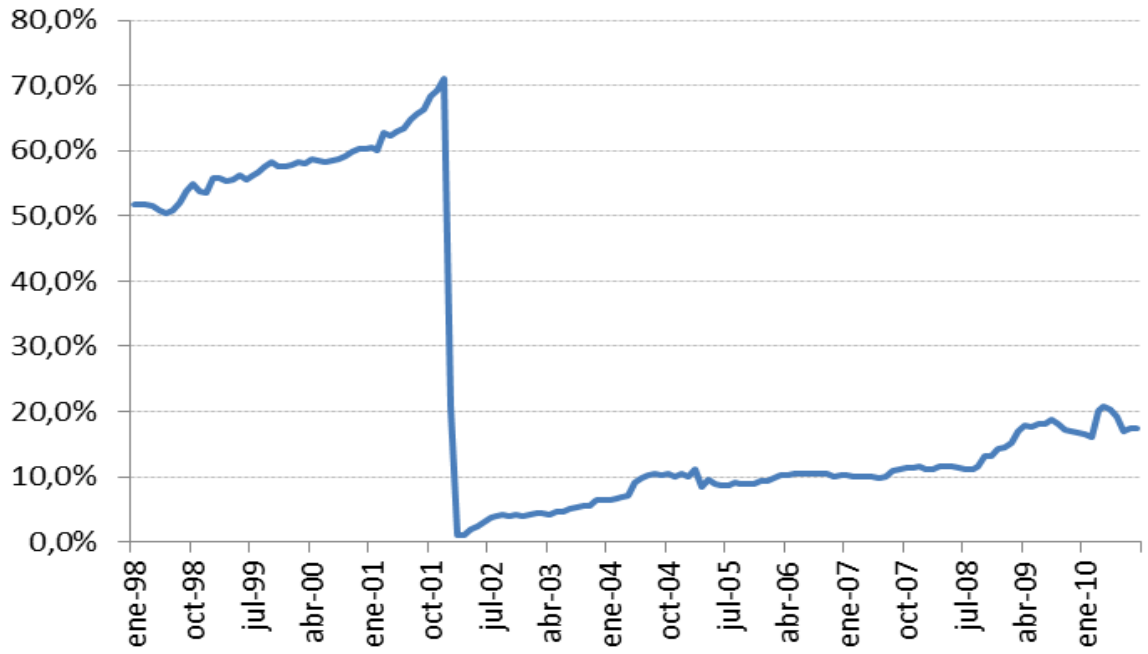
Share of quasi-currencies of each Province and the Nation to January 31st, 2003.

NAME OF THE QUASICURRENCY	ISSUING PROVINCE	% SHARE OVER $VN
LECOP	Estado Nacional	42,8%
PATACON	Buenos Aires	35,4%
LECOR	Córdoba	8,5%
FEDERALES	Entre Ríos	3,3%
BOCANFOR	Formosa	1,1%
BOCADE	Tucumán	2,2%
BONOCAT	Catamarca	0,7%
QUEBRACHOS	Chaco	1,3%
CACACOR	Corrientes	3,2%
PETROM	Mendoza	0,9%
BOCADE A	La Rioja	0,6%
TOTAL		**100,0%**

- As from the monetary unification and the quasi-currency rescue plan, Argentina has showed significant signs of macroeconomic prosperity due to the scheme implemented as from 2003.
- As a result of the macroeconomic scheme, in 2009 the GDP was 65% higher than in 2002. The unemployment rate fell from 22% to 7.4% in the same period, thanks to the creation of 4.5 million job positions, mostly in the formal sector. Poverty reduced from 54% to 24% and informal employment from 55% to 35% of the workforce.
- Despite the macroeconomic strength of the outcomes which prevailed even within the framework of the worst international financial crisis since 1930, the

economy, in the collective unconscious, still considers the dollar as the currency for reference.

Dolarization of bank deposits in percentage of total amount of circulating money, 1998 - 2010



	Holding of dollars in cash	
	in billion dollars	in dollars per capita
Argentina	50	1300
Belarus	3	288
Brazil	1	6
Chile	0,25	16
China	50	39
Colombia	2	52
Panama	2	648
Russia	80	550
Singapore	1	294
Turkey	10	157
United States	243,3	918

Fuente: sobre la base de datos de "The Use and Counterfeiting of United States Currency Abroad, Part 2" http://www.federalreserve.gov/boarddocs/rptcongress/counterfeit2003.pdf y US Bureau of the Census

- Between 2008 and 2009, the formation of external assets in the private sector (financial and non-financial) reached US$14,800 million.
- Only US$2,000 million were allocated to direct or production investment. The rest (almost US$ 13,000 million) were allocated to speculative investments or directly to the so-called "under the mattress" (dollars in cash).
- Currently, it is estimated that the foreign currency stock "under the mattress" or of unknown origin (deposits or other speculative investments) reaches the US$134,000 million.
- Productive investments in companies or real state developments are of only US$30,000 million.
- The experience underwent between 2001 and 2003 due to the massive issuance of provincial quasi-currencies was positive and enriching, both from the practical and theoretical aspects.
- As regards conflicts provoked by the current economic crisis, produced by the Pandemic, it is important to take in account the positive aspects of the Argentine experience when it implemented provincial currencies in order to recover the money supply that diminished the impact of the crisis.
- From the practical aspect, it was the mandatory answer of the Provinces that went bankrupt because of the 2001/2002 crisis.

OVERVIEW:

According to the analyses of the forms of confidence supporting money circulation in Argentina, it is inferred that:

- Methodical Confidence: Provincial quasi-currencies.
- Hierarchical Confidence: the Peso, circulating today.
- Ethical Confidence: The dollar, as a store of value.

It shows the lack of vision of a geopolitical and value strategic project, especially in the sectors with accumulation capacity.

CRYPTOCURRENCIES.

The emergence of the Blockchain technology enhances the benefits provided by the Argentina's subnational currencies during the crisis period.

Now, it is possible to use the domestic and provincial currency issuance to promote circulation processes, avoiding the flight to other circuits and strengthening domestic economies.

The aim of a Local Currency fostered by a subnational government is to raise the impact of the public expenditure on the local trade and industries, increasing the level of activity and employment in the economy of the Municipality.

Thus, we can consider the proposal as an instrument seeking to foster

employment development, domestic consumption reactivation, greater money circulation, and to avoid capital flights to neighbouring districts.

This project of a Local Currency is based on the technological advancement implied by the Blockchain technology. This technology allows computer records, from the mobile phone or the web, with the highest levels of security, transparency, traceability and scalability. In this way, it allows to create and manage a digital means of payment of local voluntary use, equipped with the security of the most sophisticated cryptocurrencies. Besides, as it is digital, it allows to instantly learn all the users' balances and their transaction traceability. The system management is absolutely transparent, reliable and scalable.

Benefits

- Promote local consumption.
- Strengthen local trade and industries.
- Protect and/or create local and quality job positions. Encourage collaborative social economy systems.
- Foster community relations among neighbours and tend to social cohesion.
- The government accepts them to pay municipal service taxes.
- Increase the investment capacity of the Municipality, as it is useful to finance its expenditures.
- Parity with the Peso is adjustable.
- These mechanisms tend to increase the money circulation speed, so as a result there is a greater economic activity with the same money supply. Moreover, as the currency circulates within the limits of the jurisdiction where it was issued, the extra wealth is invested within the community, avoiding capital flights.

Legal framework

The social currency issued is not money but a thing (sections 765 and 766 of Argentina´s Civil and Commercial Code.)

CONCLUSIONS:

1) the positive assessment of the use of subnational currencies during Argentina´s 2001 crisis, which avoided the bankruptcy of the Provinces that issued them and produced economic activity allows to imagine that the

emergence of cryptocurrencies issued by national, provincial and municipal states creates an instrument that, if well used, will help to support the economies of those jurisdictions.

2) These issuances will, of course, be subject to assessment of the mentioned confidences. The methodical, the hierarchical and the ethical confidences.

3) The methodical confidence will be ensured if the currency its accepted as a means of payment in daily transactions.

4) The hierarchical confidence will be ensured by the issuer and its respectability.

5) The ethical confidence is reserved to those currencies that could be useful for saving purposes, an aspect that is not a need, as they have been issued to promote the exchange circulation and not to produce hoarding.

6) The inevitable accumulation produced by the proper functioning of the system poses a greater challenge: to define that the said accumulation is not personal but social, whether through cooperatives or the issuing organization. It implies to abandon the capitalist system logic: wealth accumulation is not an individual but a social asset.

7) When writing allows defining equivalents of accounting value, and the State centralizes social sovereignty over its members, the meaning of monetary sovereignty comes up.

8) Alternative currency issuance challenges the place where the monetary sovereignty lies: It can be appropriated again by the people as a common asset or it can stay in the hands of the growing global financial power, increasingly concentrated in few hands and devoted to financial speculation.

Digitalization

Circulation of a digital community currency

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ABSTRACT

Circulation is the characteristic feature of successful currency systems, from community currencies to cryptocurrencies to national currencies. In this paper, we propose a network analysis methodology for studying circulation given a system's digital transaction records. This is applied to Sarafu, a digital community currency active in Kenya over a period that saw considerable economic disruption due to the COVID-19 pandemic. Representing Sarafu as a network of monetary flow among the 40,000 users reveals meaningful patterns at multiple scales. Circulation was highly modular, geographically localized, and occurring among users with diverse livelihoods. Network centrality highlights women's participation, early adopters, and the especially prominent role of community-based financial institutions. These findings have concrete implications for humanitarian and development policy, helping articulate when community currencies might best support interventions in marginalized areas. Overall, networks of monetary flow allow for studying circulation within digital currency systems at a striking level of detail.

Introduction

The circulation of money is generally studied in an abstract sense, for example as the extent to which monetary policy, productivity improvements, supply disruptions, or other shocks affect aggregate indicators of economic output[1–4]. Detailed observation has long been impractical for lack of empirical data. However, modern payment infrastructure is increasingly digital[5], and the circulation of money is leaving real-time records on the servers of financial institutions worldwide. These transaction records offer especially high granularity in time and in space, and open up the possibility of fined-grained data-driven studies of financial ecosystems[6–12]. In this paper we consider the question of how best to study the *circulation* of money as observed in transaction records. We argue that *networks of monetary flow* are a suitable representation for patterns of circulation over a period of time. Our findings show that techniques in network science — in particular walk-based community detection, measures of cyclic structure, network mixing patterns, and walk-based centrality metrics — together capture key aspects of circulation within a real-world currency system. We demonstrate that important practical and theoretical questions around the circulation of money can be studied using networks of monetary flow.

The main focus of this paper is on complementary currencies whose modern implementations produce comprehensive digital records—cases where transaction records are available for an entire currency system. Complementary currencies circulate in parallel to national currencies in that tokens are *not* legal tender, nor necessarily exchangeable for legal tender[13–15]; they are used under mutual agreements that come in many forms, from local community currencies[6,16,17] to global cryptocurrencies[18–20]. Sardex, for example, is a digital complementary currency used among businesses in Sardinia. Digital records of transactions in Sardex have been studied to show that cycle motifs are related to performance and stability of the currency system[21,22]. The full transaction histories of Bitcoin and other cryptocurrencies can be reconstructed from public ledgers[23–25]. Bitcoin transactions reveal a currency system that supports substantial trade outside centralized marketplaces, but where inequality has been increasing over time[19,26]. Sarafu, the currency considered in this work, is a "Community Inclusion Currency" (CIC) that incorporates elements of both community currencies and cryptocurrencies[27].

Digital administrative records of the Sarafu CIC from January 2020 to June 2021 have been published by Grassroots Economics (GE)[28]. GE is a non-profit foundation based in Kenya that operates Sarafu and leads related economic development projects in marginalized and food-insecure areas of the country. What began as several local, physical, community currencies was progressively digitized and then brought together onto a single platform, as Sarafu. The observation period began as this consolidation occurred, at which point Sarafu was available throughout Kenya. Mimicking the well-developed mobile payment infrastructure of the national currency[29–34], each Sarafu account was tied to a Kenyan mobile number and accessible over a mobile interface. An account could be created with an activation code sent to a particular mobile number, then used and managed via a series of simple menus. The resulting digital records became a dataset that includes anonymized account information for tens of thousands of users and records of hundreds of thousands of Sarafu transactions. Previously, the published

dataset has been described in raw form[27] and used in a case study introducing CICs as a modality for humanitarian aid[15].

In the context of community currencies, circulation is a crucial measure of economic impact—these currencies are typically created with the aim to support local economic activity[16,17,21,35]. We detail transaction volumes in Sarafu over time and then study the resulting circulation of Sarafu as a network of monetary flow among around 40,000 regular users. This weighted, directed, time-aggregated network captures the patterns of circulation in intricate detail, allowing us to study what shapes the Sarafu currency system as a whole. Anonymized information on account holders allows us to label each node with a geographic area, livelihood category, registration date, and reported gender. We apply network analysis techniques to the Sarafu flow network to answer three research questions with important implications:

Among whom is Sarafu circulating? The Sarafu user base grew rapidly over the observation period, especially as the COVID-19 pandemic disrupted regular economic activities. We summarize the resulting patterns of circulation using a so-called community detection method developed especially for flow networks. Specifically, the map equation framework and the associated Infomap algorithm[36,37] group nodes into modules that capture as much volume as possible. Since the link weights of the Sarafu flow network reflect observed flows of money, the discovered modules signal sub-populations within which Sarafu was *circulating*. We go on to investigate the composition of these sub-populations.

What network structures support the circulation of Sarafu? Degree disassortativity has been noted in a variety of economic networks[19,38–40] in that high-degree nodes generally transact with low-degree nodes. It has also been noted that network cycles may be key to the 'health' of currency systems and of individual accounts[21]. Indeed, detecting cycles and brokering 'missing' financial connections is seen by private actors as a promising credit clearing and risk management service[22,41]. In a similar vein, Ussher et al.[15] argue that community currencies compare favorably to cash assistance as an economic development intervention because they help establish economic connections that keep money local. We study the network structure underlying the observed circulation of Sarafu using several suitable network analysis techniques. Specifically, network assortativity measures and the density of cycles.

What characterizes the most prominent Sarafu users? We would like to understand patterns in who holds Sarafu accounts that are especially prominent, or perhaps even systematically important. Prominent users are identified by means of a network centrality measure that is directly related to the circulation of Sarafu, as captured by a network of monetary flow. Specifically, weighted PageRank[42] computes a metric that corresponds to the share of funds a given account would control, at any given time, if the observed dynamics were to continue indefinitely. We calibrate this measure against empirical account balances and use it to investigate the account features most associated with prominent users.

Our results indicate that circulation was modular and geographically localized, occurring within particular areas and among users with diverse livelihoods. Moreover, using network analysis, we confirm the intuitive notion that circulation requires cycles. This implies that community currencies can help support specific areas during periods of economic stress, so long as local economic activities are sufficiently diverse and adoption is sufficiently coordinated as to allow cycles to emerge. This has concrete implications for humanitarian policy in marginalized areas, in that rapid deployment may be necessary and impact can be expected to be higher in areas with a mix of economic activities already present. Community currencies also support localized economic development over longer periods of time[13,15,21]. We find that community-based financial institutions, and, in a few cases, faith leaders, are especially prominent among Sarafu users. Furthermore, these local "hubs" play a key structural role in that the network underlying Sarafu is consistently degree-disassortative.

The findings presented in this paper provide a fine-grained understanding of the circulation of Sarafu over a highly dynamic period that includes the arrival of the COVID-19 pandemic to Kenya. Our work demonstrates how networks of monetary flow capture key features of circulation. Moreover, walk-based and cycle-based network analysis are interpretable methods for understanding the underlying currency system. Noteworthy is that the methodology presented in this paper can be applied to study any currency system where digital transaction records are available. Indeed, there appear to be important regularities in the network structure underlying the circulation of money in such systems, and these would be well worth exploring further.

The remainder of this paper is organized as follows. The Data section briefly describes the Sarafu system over this especially tumultuous period. The Results section presents our findings on patterns of circulation, prominent users, and the network structure underlying circulation. We synthesize these contributions and discuss the implications of our findings in the Discussion section. Finally, the Methods section details the data preparation, network analysis measures, and statistical methods used in this study and provides references to facilitate data, code, and software availability.

Data

Sarafu expanded dramatically as the COVID-19 pandemic arrived in Kenya, growing from 8,354 registered accounts in January 2020 to almost 55,000 in June 2021. Figure 1 shows the transaction volumes for each of the complete months over the observation period. Beginning in April 2020 and continuing through the second wave of COVID-19 in Kenya, Sarafu saw transaction volumes almost ten times higher than in February 2020. This dramatic expansion occurred primarily in particular regions, described below, and we see a return towards the baseline in these areas by the end of the observation period. The

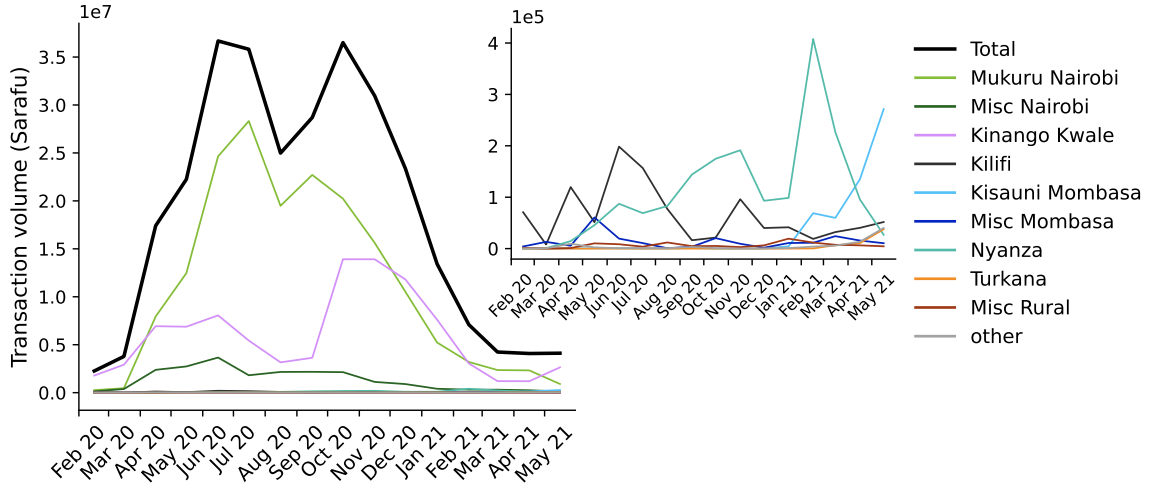

Figure 1. Monthly transaction volumes in total, and in each geographic area (shown at two different scales).

overall pattern is perhaps best explained by the counter-cyclical nature of complementary currencies, which are known to see spikes in usage levels during periods of economic disruption[13,43,44].

The figures in this work employ a consistent color scheme for geographic area. Purple corresponds to *Kinango Kwale*, a rural area where GE has had a substantial presence for many years; this area saw much growth during the COVID-19 pandemic due largely to word of mouth. Light green is *Mukuru Nairobi*, an urban area that was the site of a targeted introduction beginning in March 2020. For details we refer to the Data preparation section. Accounts located elsewhere in *Nairobi* are shown in dark green. In light blue are accounts in *Kisauni Mombasa*, the site of a second introduction beginning in early 2021. Accounts located elsewhere in *Mombasa* are shown in dark blue. *Kilifi*, in dark grey, is the county where GE is headquartered. Users with an unknown location (the largest category within *other*), are in light grey. In Figure 1, *other* closely tracks the remote rural county of *Turkana*, in orange. Teal and red correspond to locations in *Nyanza* county or elsewhere in rural Kenya, respectively.

Results

The Sarafu system supported over 400,000 transactions among more than 40,000 regular accounts between January 2020 and June 2021. This resulted in the circulation of 293.7 million Sarafu, visualized in Figure 2 as a network of monetary flow. The *nodes* are registered accounts, for which we know attributes such as the geographic area, livelihood category, and reported gender of the account holder. An *edge* from one account to another indicates that at least one transaction occurred across that link. The *edge weight* corresponds to the observed monetary flow along an edge, i.e., the total sum of transaction amounts across that link. The Sarafu flow network is a *weighted, directed, time-aggregated network representation* of the total circulation over the observation period, excluding system-run accounts. For details on the construction of the network, we refer to the Data preparation section of Methods. The network visualization employs the same colors for geographic area as does Figure 1, revealing patterns suggestive of modular and geographically localized circulation.

In the remainder of this section, we share findings resulting from network analysis of the Sarafu flow network. The Modular circulation section considers sub-populations within which Sarafu was circulating, and their composition along lines of geographic area and livelihood category. In the Underlying network structure section, we consider the network structure that supports this circulation, including analyses of cyclic density and network mixing patterns. The Prominent Sarafu users section compares relevant network centrality measures and describes the most prominent users of Sarafu.

Modular circulation

To more precisely understand the patterns of circulation present in the Sarafu flow network, we apply an especially suitable community detection method. The map equation[36] is defined in terms of flow networks and the associated Infomap algorithm[37] groups nodes into hierarchical *modules*. Specifically, Infomap assigns nodes to modules (and sub-modules) within which a "random walker" on the network would stay for relatively long periods of time. In our case, the weights on the edges of the Sarafu flow network reflect real, observed flows of Sarafu and so the Infomap algorithm will seek to discover modules that

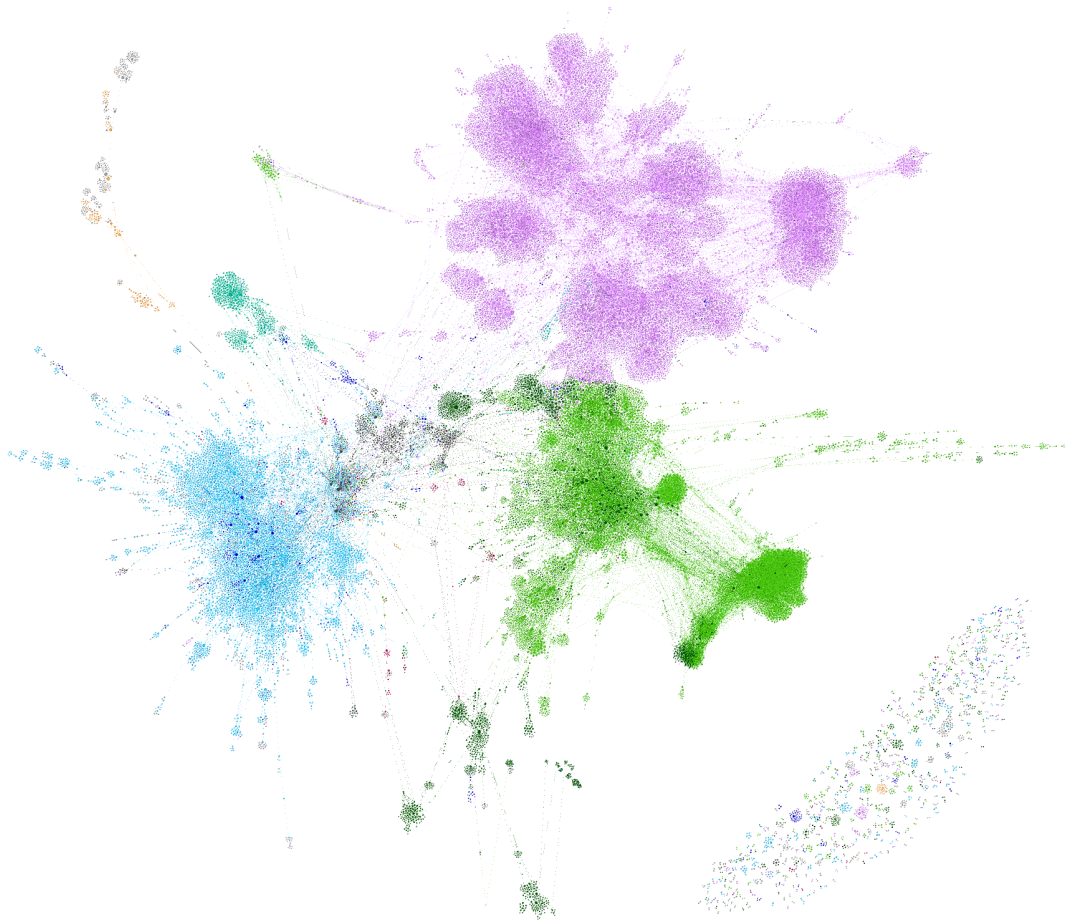

Figure 2. Visualization of the Sarafu flow network. Nodes are colored by the geographic area of the location reported for the account (see Figure 1 for legend), and node size is proportional to the value of unweighted PageRank as computed for that node.

contain especially much transaction volume. This identifies sub-populations within which Sarafu tended to *circulate*. For details about these methods, we refer to the Circulation section.

The Infomap algorithm recovers a hierarchical, nested, modular structure to the Sarafu flow network. The hierarchical structure consists of top-level modules, sub-modules and sub-sub-modules at respectively the first, second and third level of the community hierarchy. Circulation of the Sarafu community currency was highly modular in that activity occurred almost exclusively within distinct sub-populations. At the first hierarchical level, 99.7% of the total transaction volume was contained within the five largest so-called *top-level modules*. Moreover, there are 37 *sub-modules* composed of 100 or more accounts and these contained 96.5% of the total transaction volume. Only a small share of the overall circulation took place between the sub-populations defined at the second hierarchical level, and circulation within these sub-populations itself had a nested, modular structure. Indeed, the 455 *sub-sub-modules* composed of 10 or more accounts capture 80% of the total transaction volume. Altogether, these findings suggest that the circulation of Sarafu was extremely modular over the observed period.

Geographic localization

We investigate the extent to which the distinct sub-populations discovered above correspond to geographic location, as reported in the account dataset described in the Data section. Figure 3 shows the geographic composition of the top-level modules—four of the five map directly onto one of the main areas labeled in the data: *Kinango Kwale*, *Mukuru Nairobi*, *Kisauni Mombasa*, or *Turkana*. Only one of the modules has substantial membership from several regions; its sub-modules are, however, also geographically delineated. This top-level module combines several less prominent localities, including in *Kilifi*, in *Nyanza*, and in two localities elsewhere in *Nairobi*. We conclude that the circulation of Sarafu was geographically localized over the observed period.

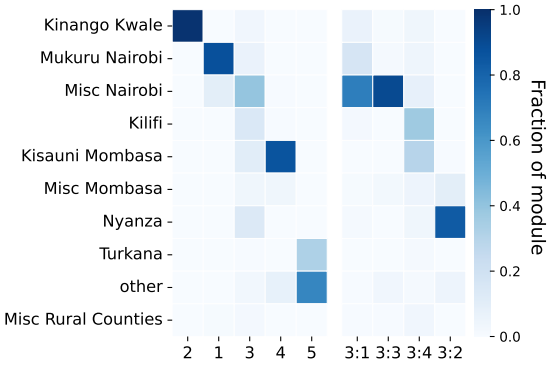

Figure 3. Geographic composition of the five largest top-level modules and relevant numbered sub-modules.

The top-level modules are amalgamations of circulation within sub-modules, which appear to correspond to geographic areas more granular than those labeled in the data. Indeed, raw reported locations were often quite precise and were converted to broader area labels in the anonymization that occurred prior to the publication of the data[27]. Several of the sub-modules highlighted in Figure 3 coincide with areas where early, physical community currencies were operating in the years before Sarafu became all-digital[45]. Within *Kinango Kwale*, moreover, the sub-modules likely correspond to individual rural villages or clusters of villages[15]. Thus, circulation was geographically local, predominantly. We will further consider the sub-populations delineated by the Infomap sub-modules in subsequent analyses.

Diversity of economic activities

Now that we understand the modular structure and geographic localization of circulation, we consider the composition of the localized sub-populations with respect to economic activity. This is of particular interest to practitioners as it helps illustrate *among whom* Sarafu was circulating. There are 14 categories of economic activities into which user-reported livelihoods were grouped, the most common of which are *labour* in urban areas and *farming* in rural areas. Many other users (in both urban and rural areas) report selling *food*, running a *shop*, or providing *transport*.

Most notably, we see a mix of the different economic activities within the largest second-level sub-populations. Figure 4 illustrates the livelihood category given for each account in the 15 largest sub-modules identified by the Infomap algorithm. To give a sense of how this diversity is experienced within sub-populations, we compute and report the view from the average user. The average user participates in a sub-module with around 2000 other users, and of these others, 66% report a category of work that is different from what they themselves report. Little diversity is lost as we consider even finer scales. The average user appears in a sub-sub-module with around 250 other users, 59% of whom do not share their same livelihood category. We conclude that the circulation of Sarafu involves a diversity of economic activities, even at the scale of a single village.

We also see that the composition of the sub-populations using Sarafu is substantively different in urban and rural areas. In Figure 4, the sub-modules where *farming* or *fuel/energy* are prominent are rural and composed of users reporting a location within *Kinango Kwale*, almost exclusively. Those where *labour* is prominent correspond to sub-populations localized primarily in urbal or peri-urban areas including *Mukuru Nairobi*, *Kisauni Mombasa*, and *Kilifi*. The geographic aspect of circulation is further refined by means of the type of geographical area.

Underlying network structure

In this section, we consider the network structure underlying the circulation of Sarafu. Each of the sub-modules considered above in the Modular circulation section is associated with not just a sub-population of 100 or more accounts, but also a sub-network of 100 or more nodes. An (unweighted) edge from one account to another indicates that at least one transaction occurred across that edge. Node degree corresponds to an accounts' number of unique transaction partners, incoming and outgoing, in their same sub-population. In the Cyclic density section we count the cycles present in the sub-networks, relating the presence of cycles to the notion of circulation and the sustainable operation of complementary currency systems. Next, the Structural correlations section quantifies network mixing patterns, relating degree disassortativity to the structural importance of local "hubs" in the sub-networks.

Cyclic density

Network cycles may be key to understanding the conditions under which an area is, or overtime becomes, able to sustain local circulation[15,21,22]. We explore the presence of cycles in the Sarafu sub-networks using k-cycle density[21]. This measure

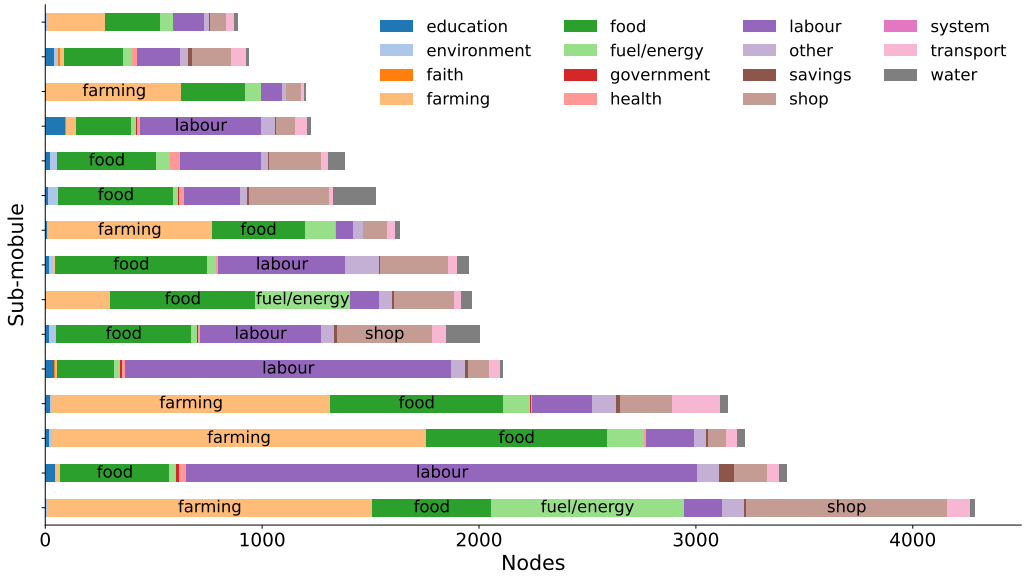

Figure 4. Composition of discovered sub-modules (bars) in terms of user livelihoods (colors, as shown in legend).

quantifies how much higher, on a log scale, is the number of cycles in the empirical network as compared to the expectation from a null model. We use two of the most common null models, as in prior work: Erdős-Rényi (ER) networks and randomized degree-preserving (RD) networks. ER networks have the same number of nodes and edges as the empirical network, but are wired randomly. RD networks preserve the indegree and outdegree sequences. For details we refer to the Network cycles section of Methods.

Figure 5 shows the cycle densities computed for each of the Sarafu sub-networks. The k-cycle density has values mostly in the range from 3 to 6 for cycles of length 2 and 3, indicating that the empirical networks have orders of magnitude more cycles than do the null models. Moreover, the k-cycle density appears to be even higher for longer cycles of length 4 and 5. These findings are closely in line with prior results computed for the Sardex currency in Sardinia[21]. Notably, this is the case even though the currency management practices followed by the two providers are quite distinct[21,27]. Based on these findings, we can conclude that cycles are a prominent network connectivity pattern in the circulation of (community) currencies.

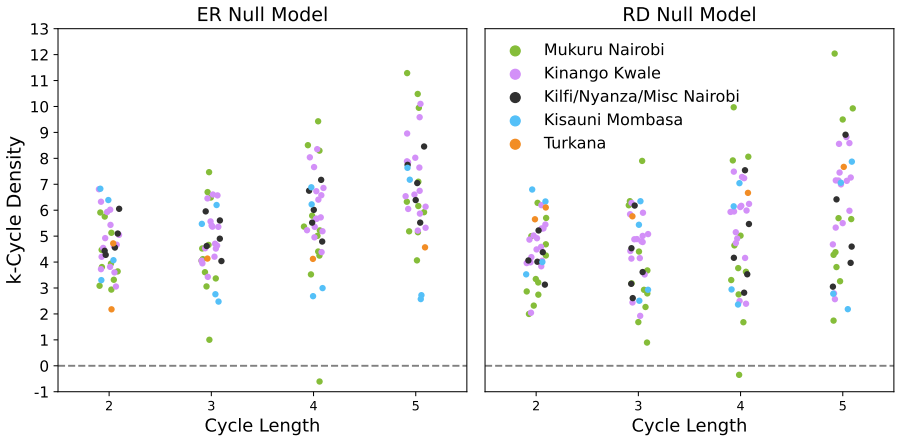

Figure 5. Values of k-cycle density for each sub-module, at different cycle lengths. Points correspond to sub-modules, and are colored based on the dominant geographic area of users placed in the top-level module to which it belongs.

Structural correlations

Degree disassortativity is an expected feature of specifically currency networks[19,40] and of economic networks, more broadly[38,39]. In networks with this property, high-degree nodes generally interact with low-degree nodes, not other high-degree nodes, and local "hubs" play a key structural role. Recall also that Sarafu sub-modules are diverse with respect to the livelihood reported by accounts (Diversity of economic activities section). Here we consider these and other structural correlations that help us better understand the circulation of Sarafu. Since the overall influence of account attributes on the Sarafu flow network is limited by the constraints of geography, and may be heterogeneous across sub-populations, we consider degree and attribute assortativities across the Sarafu sub-networks. For details we refer to the Network mixing patterns section of Methods.

Table 1 reports the average, the median, and the range for each property as computed on the undirected version of each sub-network. We find substantial disassortativity in degree across nearly all sub-networks. As expected, we also find that attribute assortativity is consistently low along the dimension of livelihood category. The consistency of these observations across sub-populations suggests that there may be important regularities in the structural correlations of networks that support the circulation of money.

Table 1. Network statistics and feature assortativity across sub-modules with 100 or more nodes.

	Network Statistics			Assortativity				
	Nodes	Edges	Volume	Business	Gender	Registration	Degree	W. Degree
mean	1021	2636	7.67m	0.032	0.146	0.154	-0.215	-0.066
std	1082	3789	10.83m	0.047	0.188	0.273	0.119	0.143
min	136	170	0.01m	-0.104	-0.081	-0.323	-0.448	-0.428
25%	222	544	0.59m	0.003	0.017	-0.072	-0.265	-0.168
50%	537	1151	2.99m	0.029	0.121	0.147	-0.221	-0.096
75%	1522	3513	11.05m	0.058	0.208	0.322	-0.152	0.012
max	4286	20458	43.64m	0.121	1.000	0.845	0.247	0.269

Correlations with respect to *gender* and *registration date* in the structure of the sub-networks can also be substantial, although these effects are not consistent across sub-populations. Again from Table 1, attribute assortativity on gender is present in about half of the 37 sub-populations and substantial in several. This may be related to the activity of community-based savings and investment groups, where women's participation is high[46,47]. Within Sarafu, such groups provide opportunities to transact assortatively on gender. Gender assortativity in payment networks may also reflect, for instance, gendered economic roles in ways that deserve further study. Strong correlations in registration date also appear in several sub-networks, indicating a cohort effect. For example, during targeted introductions as described in the Data preparation section, groups of users who share latent economic ties would together adopt Sarafu over a relatively short period of time. Correlations by cohort are likely to appear in any digital payment system where adoption and use are voluntary.

Prominent Sarafu users

Local hubs play a key structural role in the circulation of Sarafu, and it is important to understand who takes on such prominent positions. We ask what features are especially consistent among accounts with high network centrality, now across the entire Sarafu flow network. In the section Identifying prominent users we consider an account's number of unique transaction partners, transaction volumes, and additional measures for computing network centrality. Next, the Characterizing prominent users section asks what features of Sarafu accounts are strongly and consistently associated with high network centrality.

Identifying prominent users

As a first step towards understanding prominent Sarafu users, we consider distributions of relevant account statistics. Figure 6 (left) shows smoothed empirical distributions of node degree on a logarithmic scale. We note that values are highly heterogeneous across accounts; the tail of the right-skewed distribution indicates that a small share of accounts has orders of magnitude more unique transaction partners than do most accounts. Transaction volumes into and out of accounts are spread over an even wider range, also exhibiting a "heavy tail". Figure 6 (right) shows smoothed empirical distributions of weighted degree. A relatively small number of account holders spend orders of magnitude more (or less) Sarafu than do the bulk of the users. As expected, the Sarafu flow network has so-called "hubs" in that a small share of nodes are especially prominent.

Figure 7 shows the Pearson correlation between node degree, weighted degree, and the centrality metrics discussed in the Network centrality section in Methods. First we note that degree and weighted degree are not interchangeable, capturing different notions of prominence in the network. Weighted in- and out- degree themselves are exceptionally highly correlated, because accounts must receive large amounts of Sarafu in order to spend large amounts of Sarafu. This empirically confirms the underlying accounting consistency present in networks of monetary flow. The unweighted PageRank algorithm produces a

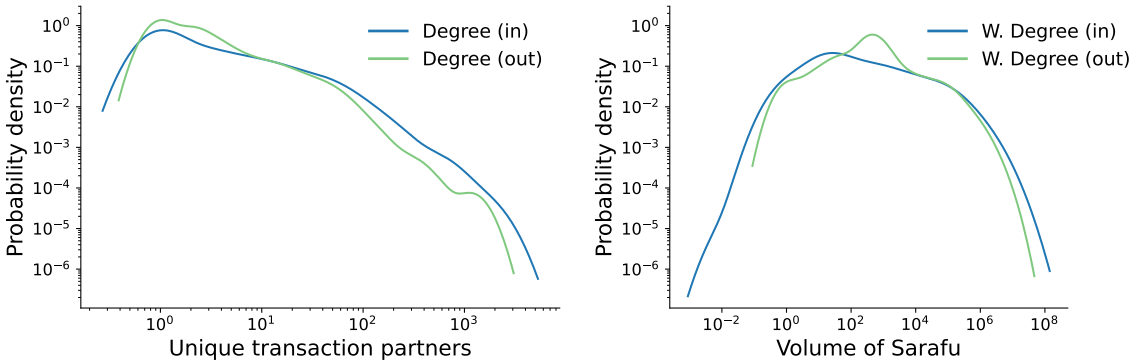

Figure 6. Distribution of degree (left) and weighted degree (right) for the Sarafu flow network. Probability densities are scaled such that nodes with a degree value of zero shrink the distribution total, as zero cannot be plotted on a logarithmic scale.

non-zero value for each node that is correlated with both the in- and out- degree; this makes it a practical centrality metric for downstream tasks involving the unweighted network. Most interesting, weighted PageRank captures something distinct from the in- or out- degree, the weighted in- or out- degree, and unweighted PageRank. Noteworthy is that values of weighted PageRank are interpretable as the share of system funds that the accounts would eventually control, if the observed dynamics were to continue. An empirical calibration to account balances is presented in the Network centrality section in Methods.

Characterizing prominent users

To characterize prominent users of the Sarafu system, we ask what features are especially consistent among accounts with high network centrality. Figure 8 illustrates the regression coefficients on account properties when PageRank and weighted, inflow-adjusted PageRank are used as outcome variables. Ordinary least squares (OLS) provides an estimated statistical contribution for each account feature, while Elastic Net (EN) incorporates regularization to highlight only those features most consistently associated with centrality. For details about this methodology, we refer to the Linear regression section.

PageRank and weighted inflow-adjusted PageRank capture distinct aspects of node importance, but are positively and negatively associated with many of the same account features. Most strongly and consistently associated with high network centrality are accounts held by *savings* groups. Indeed, community-based savings and investment groups are a key feature of local economies in Kenya and of the Sarafu system (as noted in the Data section). The size of this category is quite small, however, containing only 264 accounts. The number of *faith* leaders is even smaller, and some appear to play an especially prominent role in the local circulation supported by this community currency.

The other regression coefficients in Figure 8 reveal additional nuances among some of the largest categories of users. Accounts that were created *prior* to the consolidation of Sarafu, which occurred as the data collection period began, are consistently associated with high network centrality; early adopters show a higher tendency to be prominent users. We also find that account holders reporting their gender as *female* are associated with higher centrality in the Sarafu flow network—this

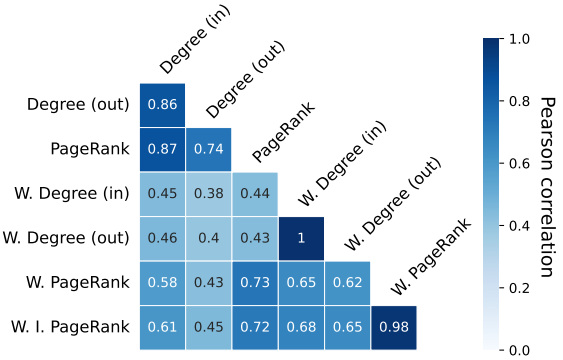

Figure 7. Pearson correlation between values for degree, weighted degree, and centrality metrics.

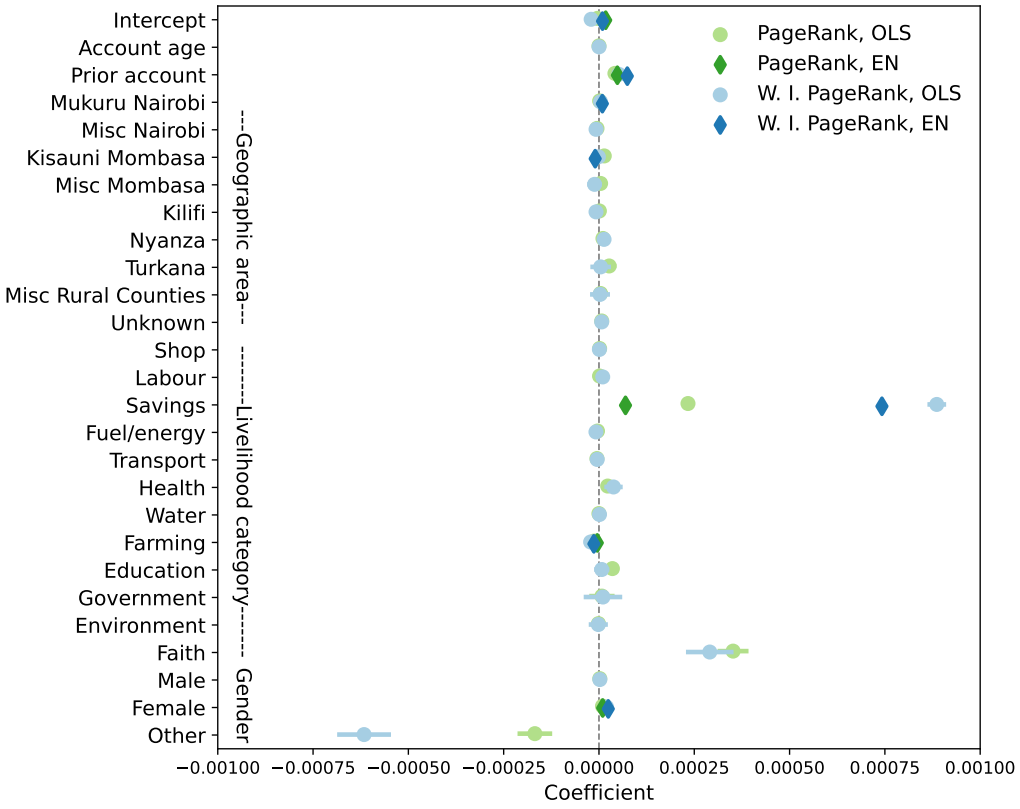

Figure 8. Regression coefficients for linear models fitting account features to centrality measures, using Ordinary least squares (OLS) and Elastic Net (EN). For the three categorical predictors, the reference categories are accounts that report a location in *Kinango Kwale*, report selling *food*, and do not report a gender.

prominence of women is remarkable. In fact, it conforms to qualitative accounts from field studies in Kinango, Kwale that report strong participation of women, and women's leadership, within community-based savings and investment groups that use Sarafu[46]. This has also been noted about savings groups in Kenya, more generally[47]. With respect to geography, recall that *Mukuru Nairobi* and *Kisauni Mombasa* refer to the site of targeted introductions in spring 2020 and early 2021, respectively. Timing appears to have made a substantial difference: the second intervention did not spur large transaction volumes, while those reporting a location within *Mukuru Nairobi* have higher network centrality (on average) than users in *Kinango Kwale* (the reference category). Perhaps most interestingly, *farming* is associated with lower centrality than other reported economic activities. Non-farming activities (e.g. selling *food*, running a *shop*, or providing *labour*) appear to be "central" to local economies even in areas of rural Kenya, such as *Kinango Kwale*, that rely heavily on subsistence agriculture.

Discussion

With respect to the circulation of money, this work has demonstrated how a network approach can unveil meaningful patterns and extract relevant insights from individual transaction records. Coinciding with the arrival of the COVID-19 pandemic to Kenya, the Sarafu community currency saw dramatic growth in its user base and accommodated large spikes in transaction volumes. We find that Sarafu remained a community currency wherein circulation was very modular, happening predominantly within distinct sub-populations constrained to a large extent by geography. Circulation within these localized sub-populations occurred among users with diverse livelihoods over networks with many short cycles. The underlying sub-networks are also consistently disassortative, indicating that local "hubs" play a key structural role in the circulation of Sarafu. Savings and investment groups, and perhaps other community-based institutions, appear to take on these prominent positions in the underlying network.

Our results shed new light on the conditions under which community currencies might form part of successful humanitarian or development interventions. In response to acute economic stress, rapid deployment appears to be possible in areas where local economic activities are already diverse. It may be that coordinated adoption helps to quickly establish the cycles needed

for circulation to take hold. Over longer periods of time, and in more peripheral areas, community currencies support economic development to the extent that they encourage diverse productive activities and strengthen short, local supply chains that keep money within a community[15]. Practically speaking, it may be possible to identify "missing links" in local economic or financial networks such that policymakers and organizers might intervene to close cycles by brokering among local businesses[22,41]. Our findings complement and corroborate a growing body of work informing policy on alternative interventions in marginalized areas[15,48–51].

Methodologically, our conclusions demonstrate the explanatory power of representing the circulation of money as a network of monetary flow. Walk-based methods applied to such networks, specifically PageRank and Infomap, produce readily interpretable results that can provide clear answers to context-rich research questions about currency systems. Notably, these methods rely on scalable algorithms meaning that our approach can be applied to study sizeable currency systems where transaction data is recorded in digital form. This includes other community currencies[6,16,17,21] as well as major global cryptocurrencies[19,20,26,40]. Recent methodological advances[10,52] promise to extend applicability also to payment systems that are not themselves full currency systems, such as mobile money systems[10,53,54], large value payment systems[55–61], major banks[12,62–64], and, in an exciting development, centralized national payment infrastructures[65–67] or central bank digital currencies[68]. Modern economic infrastructure makes detailed observation possible, and the circulation of money can be studied as (interconnected) networks of monetary flow.

Finally, the structural features we identify in the Sarafu network—degree disassortativity and an elevated cycle density—are likely to be general features of the economic networks underlying currency systems. Indeed, degree disassortativity has been found across many economic networks[19,38–40]. And our results regarding the presence of cycles are closely in line with prior analysis of the Sardex currency system[21]. This is despite considerable contextual differences. Kenya and Sardinia differ in their level of economic development, Sardex is aimed at businesses whereas Sarafu is aimed at individuals, and pandemic times are certainly different from regular times. Moreover, the two currency systems are operated differently[21,27]. There appear to be important network-structural regularities underlying the circulation of money, which deserve to be further explored across currency systems large and small.

Methods

The Data preparation section provides a detailed description of the portion of the raw Sarafu data used in constructing our timeseries and our network of monetary flow, plus three peculiarities of the Sarafu currency system that are of relevance to the implementation or interpretation of our analyses. Network analysis methods are used to quantitatively analyze the Sarafu flow network. The Circulation section articulates how the map equation framework captures and quantifies the circulation of money given a network of monetary flow. The Network centrality section describes walk-based measures of network centrality for characterizing prominent users. The Network cycles and Network mixing patterns sections introduce cyclic density and assortativity as tools to analyse the structure of the underlying, unweighted network.

Data preparation

The Sarafu CIC data[28] includes a transaction dataset and an account dataset collected from January 25th, 2020 to June 15th 2021. The raw form of this data has previously been described in detail[27]. The transaction records are labeled with a transaction type, and we consider the STANDARD transactions. Figure 1 shows the total volume of such transactions for each complete month. Note that the value of one Sarafu was understood by users to be about that of a Kenyan Shilling, though actual exchange was facilitated only in very limited instances. The Sarafu flow network is constructed from the STANDARD transactions that occurred within the Sarafu system over the observation period. Basic network statistics are shown in Table 2. As noted in the main text, the *nodes* are registered accounts, for which the account dataset includes relevant account features (detailed below). An *edge* from one account to another indicates that at least one STANDARD transaction occurred across that link. The *edge weight* corresponds to the total sum of all STANDARD transaction amounts across that link. Then, system-run accounts are filtered out from the Sarafu flow network. Regular accounts who neither sent nor received even a single STANDARD transaction from another regular account are isolates, which we also exclude from the network. Note that the giant connected component (GCC) encompasses nearly all the nodes, meaning that the majority of users are indirectly connected through their transactions.

Account features. The account dataset includes the registration date and reported gender of the account holder as well as categorical labels derived from reported information on home location and livelihood. Mattsson, Criscione, & Ruddick[27] provide a descriptive overview of each account feature. Notably, each geographic area is a combination of user-reported localities that could be quite precise. Ussher et al.[15] present an overview of the user-reported work activities that make up the livelihood categories. System-run accounts are those labeled with *system* in place of the node attribute indicating the user's livelihood, or assigned a formal role as an ADMIN or VENDOR account.

	Nodes	Edges	Transactions	Volume (Sarafu)
STANDARD transactions	40,767	146,615	422,721	297.0 million
Sarafu flow network	40,657	145,661	421,329	293.7 million
GCC	38,653	143,724	418,675	293.4 million

Table 2. Basic statistics for the network of aggregated STANDARD transactions, the Sarafu flow network, and its giant connected component (GCC).

Savings & investment groups. Community-based savings and investment groups are common in Kenya[69,70] and a key feature of many localities that use Sarafu, specifically[15,45]. Several hundreds of so-called "chamas" are present in the data, many with the label *savings* in place of the node attribute indicating the user's livelihood. For a time, Sarafu operator Grassroots Economics also had a program whereby field staff would verify the operation of community-based groups and provide additional support to verified chamas[27]. Notably, verified groups were conduits for development initiatives and humanitarian aid on several occasions. Some of these initiatives involved payments made to system-run accounts, in Sarafu, in exchange for donated food, items, or Kenyan Shillings.

Targeted introductions. There were two so-called targeted introductions during the observation period, conducted by the Kenyan Red Cross in collaboration with Grassroots Economics[27]. These consisted of outreach efforts and training programs in specific areas. The Mukuru kwa Njenga slum in Nairobi was the site of the first; educational and outreach programs began in April 2020. Soon thereafter, this intervention was scaled up in response to the COVID-19 pandemic and related economic disruptions. Again, community currencies tend to gain in popularity during times of economic and financial crisis[13,43,44]. A second Red Cross intervention began in in Kisauni, Mombasa in early 2021. This resulted in a wave of account creations[27] and rising activity by accounts with location *Kisauni Mombasa*[15]. However, as we can see in Figure 1, overall transaction volumes did not rise as dramatically during this targeted introduction, as they did during the first.

Currency creation. The digital payment system, as a whole, saw inflows when new units of Sarafu were created. For instance, newly-created accounts would receive an initial disbursement of 400 Sarafu, later reduced to 50 Sarafu. New users could receive an additional sum if and when they verified their account information with staff at the non-profit currency operator Grassroots Economics. Existing users could also receive newly created funds, such as in reward for transaction activity and as bonus for referring others. These and other non-STANDARD inflows are summarized as an aggregated value in the account dataset. We refer to prior work for a full account of currency management and system administration over the data collection period[27].

Circulation

To study circulation we turn to the map equation framework[36] and the associated Infomap algorithm[37]. This is an approach based on computations involving a walk process over a given network, which is relevant in that financial transactions describe a real-world walk process[10]. Infomap takes a weighted, directed network as input and outputs a hierarchical mapping of nodes grouped into discovered *modules*. This grouping is done via computational optimization. Specifically, the map equation defines a notion of entropy whose value is higher the more of the flow over the given network occurs between rather than within modules. The Infomap algorithm exploits meso-scale network structure to minimize that value, grouping nodes with much flow among themselves (and little outside). These are discovered sub-populations among whom a "random walker" would tend to stay for relatively long. We refer to top-level modules, sub-modules and sub-sub-modules at respectively the first, second and third level of the discovered hierarchy. The composition of these sub-populations can then be understood by means of an approach where we quantify their heterogeneity along dimensions of geography, livelihood, and gender, i.e., the node attributes. Implementation details for running Infomap and analyzing the resulting module mapping are included in Supplementary File 2.

Network cycles

To describe the network connectivity patterns underlying the circulation of Sarafu, we consider cycles. A *cycle* is a simple path starting and ending at the same node. In the context of complementary currencies, cycles ensure the flow of liquidity throughout the system. For cycles to occur, users must be willing to both spend and earn in complementary currency. Following this observation, we analyze cyclic structures in the Sarafu network using k-cycle density[21]. The measure of k-cycle density is defined as the logarithm of the ratio between the number of cycles of length k detected in an empirical network and the number expected from a relevant null model. Equation 1 reproduces the definition of the k-cycle density for an empirical network G and the chosen null model for G, G_{null}.

$$C_k(G) = \log\left(\frac{|P_k(G)|}{\mathbb{E}\left(|P_k(G_{null})|\right)}\right) \tag{1}$$

where $P_k(G)$ is the set of cycles of length k for the network G and $|P_k(G)|$ is its cardinality, that is, the number of unique cycles of length k in the network G. We use $\mathbb{E}$ to denote an expected value. Hence, $\mathbb{E}(|P_k(G_{null})|)$ is the expected number of cycles of length k for the chosen null model for G, G_{null}.

We consider two common null models: Erdős-Rényi (ER) networks and randomized degree-preserving (RD) networks. ER networks have the same number of nodes and edges as the empirical network, but are wired randomly. RD networks preserve the indegree and outdegree sequences of empirical network, but instead has edges assigned to link endpoints randomly.

The cycle density is computed separately for each sub-module identified by the Infomap algorithm described in the Circulation section. Directed cycles are detected and counted using an existing approach[71]. This is done for each empirical sub-network, and for ER graphs generated with the number of nodes and edges of the empirical sub-network. We use 30 realizations, and the expected number of cycles in the ER null model is the average over these realizations. As in prior work, the expected number of cycles in the RD null model (for each sub-network) is computed analytically[21,72]. The k-cycle density is computed using cycles of length 2, 3, 4, and 5. An implementation is provided in Supplementary Files 4 and 5.

Network mixing patterns

To characterize the mixing patterns underlying the network structure of the Sarafu community currency, we consider degree and attribute assortativity[73,74]. Values are computed separately for each sub-network delineated by the sub-modules identified by the Infomap algorithm described in the Circulation section. The categorical attribute assorativity is calculated along dimensions of livelihood category and reported gender, using the undirected version of the networks. These measures compare the number of links between accounts with the same livelihood or gender to that which would be expected at random, and can range from -1 to 1. A value of 0 corresponds to random expectation; a value of 1 corresponds to a network where transactions only occurred between accounts with the same attribute value. When there is no variation within a sub-population, the sub-network is given an assortativity value of 1. Similarly, we calculate the numerical attribute assorativity to quantify mixing patterns with respect to registration date, in-degree, and out-degree. Implementation details are reported in Supplementary File 2.

Network centrality

To characterize prominent users of Sarafu, we employ network centrality measures on the Sarafu flow network. Purely structural node-based metrics such as degree and weighted degree correspond to straightforward statistics about accounts. We also use walk-based methods for node centrality as these are especially interpretable with respect to monetary flow; the well-known PageRank algorithm is flexible and computationally tractable. These centrality measures are computed for our network, and then interpreted in the context of node attributes of the account-holders using linear regression. This lets us characterize prominent users without highlighting individual account holders, which is neither our goal nor desirable for privacy reasons (see the Data availability section). Below, we briefly discuss each employed measure.

Indegree and outdegree in the Sarafu flow network correspond to an account's number of unique incoming and outgoing transaction partners, respectively, over the observation period. It is possible for nodes to have zero indegree *or* outdegree, but accounts with neither incoming nor outgoing transaction partners would be isolates and hence do not appear in the network.

Weighted indegree and weighted outdegree in the Sarafu flow network correspond to total transaction volumes into and out of accounts over the observation period.

PageRank is an algorithm that produces a walk-based metric for node centrality given a directed network[6,42]. The obtained centrality values approximate the probability of finding a random walker at a given node at any given moment. More specifically, PageRank computes the stationary probability of a random walk process with restarts on a given network. A single parameter α is used to control the propensity for the simulated walkers to restart. An α value of 0.85 is the long-established default, meaning that 15% of times a random walker will restart rather than follow an out-link from the node where it currently resides. By default, restarts are uniformly random across the nodes. However, it is also possible to specify the probability of restarting at any particular node using a so-called personalization vector.

Weighted PageRank is an analogous centrality metric for weighted, directed networks. Over a weighted network, the random walkers choose among available out-links in proportion to their edge weights. These are flows of money, in our case, and so the stationary probability then corresponds to the share of the total balance held by each account at equilibrium. This is especially applicable in a currency system context, since it means that the values obtained by the Weighted PageRank algorithm are interpretable as the share of system funds that an account would eventually control if observed dynamics continued. Within this intuition, **Weighted Inflow-adjusted PageRank** employs a personalization vector to better capture idiosyncratic patterns of currency creation; real-world currency systems may be poorly represented by the default assumption of uniformly random restarts. Recall from the Data preparation section that Sarafu users could receive disbursements and rewards in addition to inflows from regular transactions. We use the aggregated values of non-STANDARD inflows, available in the account dataset, to set the PageRank personalization vector. The simulated random walk process is then constrained to reproduce the observed pattern of currency creation, on average.

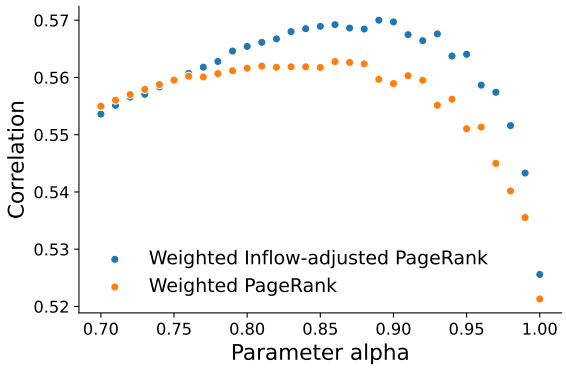

Figure 9. Pearson correlation of Weighted and Weighted Inflow-adjusted PageRank with final account balances.

Empirical calibration

Running the Weighted PageRank algorithm requires specifying the aforementioned parameter α. We would like to understand whether this parameter affects the suitability of these values as a centrality measure for networks of monetary flow. Recall that Weighted PageRank extrapolates the observed patterns of circulation towards a future where an equilibrium is reached. This means that the output values can be understood as a prediction for hypothetical future account balances (as a fraction of the total balance). While we cannot expect such strong modeling assumptions to produce especially accurate estimates, it is nonetheless instructive to compare to empirical account balances. In particular, we can determine whether this centrality metric is sensitive to α and whether modeling non-random currency creation, via the PageRank personalization vector, matters for this particular real-world system.

We consider the correlation of our centrality metrics computed on the Sarafu flow network with Sarafu balances observed at the time of data collection on June 15th, 2021. Figure 9 plots the correlation between these final balances and the values given by the Weighted PageRank algorithm, with and without adjusting the simulated walk process to account for currency creation. The resulting correlations are at most $R^2 = 0.57$ and $R^2 = 0.56$, respectively. Taking the perspective that Weighted PageRank estimates hypothetical future account balances, it is encouraging to note that these values correlate more closely with final balances than do the in- or out- degree ($R^2 = 0.28$, $R^2 = 0.21$), and the weighted in- or out- degree ($R^2 = 0.52$, $R^2 = 0.47$). Moreover, both versions of Weighted PageRank produce values that are consistently correlated with final balances over a wide range of parameter values that includes the long-established default ($\alpha = 0.85$); our centrality metrics are not overly sensitive to the propensity for restarts. We conclude that Weighted PageRank, especially Weighted Inflow-adjusted PageRank, is a highly suitable centrality metric for downstream analyses of networks of monetary flow.

Linear regression

To assess what recorded features of the account holders associate with higher prominence, as measured by network centrality, we use linear regression. Ordinary least squares (OLS) is used to fit a linear model to an outcome, in our case a network centrality measure, providing an estimated contribution for each input feature[75]. Regularization is a fitting technique that introduces a penalty term to the optimization limiting the number of regressors and/or their magnitude[76]. So-called Elastic Net (EN) regularization, as we use it, penalizes the number of regressors and their magnitude equally. The penalty weight is selected using five-fold cross validation, just before the point where additional features begin entering the model without qualitatively improving the statistical fit. Further implementation details are noted in Supplementary File 3, alongside the code that replicates the analysis.

Data availability

The dataset analyzed in this study is available via the UK Data Service[28] under the UK Data Service End User License, which stipulates suitable data-privacy protections. An extensive description of the raw data is available[27].

Software availability

All software used in this study are available under an open-source licence:

- `infomap v1.6.0`[77]
- `networkx v2.6.3`[78]

- `netdiffuseR v1.22.3`[79]
- `sna v2.6`[80]
- `statsmodels v0.13.2`[81]
- `seaborn v0.11.2`[82]
- `matplotlib v3.5.2`[83]
- `pandas v1.4.2`[84]

Code availability

The code required to reproduce each analysis is included the Supplementary Information:

- **Supplementary File 1** is a Jupyter Notebook containing the code to construct the network from the raw data.
- **Supplementary File 2** is a Jupyter Notebook containing the code to reproduce the analysis in the Modular circulation and Structural correlations sections.
- **Supplementary File 3** is a Jupyter Notebook containing the code to reproduce the analysis in the Prominent Sarafu users section.
- **Supplementary File 4** is an R Notebook containing the code to reproduce the analysis in the Cyclic density section.
- **Supplementary File 5** is a Jupyter Notebook containing the code to reproduce the figures in the Cyclic density section.
- **Supplementary File 6** is a high-resolution version of Figure 2.

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Author contributions statement

C.M. and F.W.T. developed the methods. C.M. conducted the research and drafted the initial manuscript. T.C. performed the cycle analysis and drafted the corresponding sections. All authors contributed to the final manuscript.

Additional information

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Centralizing or sharing the digital community currencies governances? Proposing ways of thinking DCCs from the Mumbuca case

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ABSTRACT: This work deals with the implications of different ways of digitalizing social or community currencies (CCs) in Brazil. It starts from the following tension, verbalized by representatives of Brazilian Community Development Banks (CDBs): on the one hand, the digitalization of CCs would maintain "the same idea, [only] in different ways"; on the other hand, its governance would be nowadays "the most complex issue". The investigation examines this tension in Mumbuca Digital CC (DCC) case (Maricá, state of Rio de Janeiro), one of the greatest world's DCC experiences (considering the number of financial resources involved) and part of the Brazilian CDBs Network - which has brought together around 150 experiences since 1998. We collected data from 2015 to 2021, from semi-structured interviews, fieldnotes from an ethnographic research approach, and the Mumbuca DCC system administrative interface as well. The article advances in understanding DCCs: besides demonstrating that their materialities are inseparable from the "social arrangements" around them, it adds new elements to previous researches, proposing an analysis framework for different sociotechnical governance dimensions of DCC (GDs). Precisely, using tools and concepts from Actor Network Theory (such as translation, symmetry, networks, sociogram and technogram), we begin describing moments of Mumbuca DCC, each one corresponding to different versions of CDBs principles and to different sociotechnical governance configurations. Finally, we present a framework that brings together new DCC governance dimensions (like "management" dimension and "economic appropriations" involved) dialoguing with previous investigations GDs ("requirements", "data" and "source code" of a DCC), and classifying each one as "Centralized" (meaning strong state / private company presence) or "Shared" (strong self-management / community approach).

Introduction

This work deals with the implications problem of different ways of digitalizing the so-called social or community currencies (CCs) in Brazil, considering as reference the practices and the principles of the Community Banks of Development (CDBs). In this work, we dialogue with a vision of currencies as constitutive of society and as a common (Dissaux, Fare 2017), and additionally we seek to associate the reflection, already well consolidated by different studies in the Science and Technology Studies (STS) field, which technological issues are not separated entities from the political-social world. The problem presented is considered decisive by the Brazilian CDBs themselves, as well as it matters for different knowledge communities, related to digital currencies, complementary currencies (Siqueira, Diniz, Pozzebon 2020; Faria, Severo, Cukierman, Diniz 2020; Dissaux, Fare 2017; Blanc 2011; Théret, Zanabria 2007), democracy (Yates, Bakker 2014) and development (Walsham 2017). To analyze the digitalization of Brazilian CCs implications, the starting point taken is the following tension, concerning two statements assumed by CDBs representatives: community banks would have remained with “the same idea, [only] in different ways”, but the digital community currency (DCC) platform governance used by banks is “today the most complex issue” – both assumed by CDBs representatives. The work examines this tension in Mumbuca DCC case (city of Maricá, state of Rio de Janeiro), one of the greatest world’s DCC experiences (considering the amount of financial resources involved) and part of the Brazilian CDBs Network - which brings together more than 100 experiences. The authors collected data from 2015 to 2021 through semi-structured interviews, materials provided by Mumbuca CDB, data access at the digital platforms involved, and adopting an ethnographic research approach and organizing discussions with CDBs representatives as well.

The article advances on DCCs understanding, and particularly demonstrates the materiality of the digital community currency is inseparable from the “social arrangement” around it. A point “some way surprising in relation to theory or to common sense” (Burrel, Toyama 2009, 87), not only for the “popular knowledge community” around the CDBs, but also for some academic approaches in CCs knowledge community. We do so by discussing how some elements of the discourse of the community development banks (practices of autonomy,

proximity, and financial sustainability (Faria 2018)) were reconfigured, to a certain extent, during the CCs digitalization process. As a result, also considering the CDB principle of economic democracy, we propose what we nominated the five “sociotechnical governance of DCCs” dimensions: their requirements, data, codes, the platforms management, and their economic appropriation.

The article is organized as follows: initially, methodological options adopted in approaching the case in study are presented. In the second section, we address CDBs principles and practices discussed here (and captured from our field work), as well as some of the partnership first effects with Maricá local government on them. Then, we emphasize the scale effects required to implement the DCC Mumbuca, and the decision to use the magnetic cards materiality as well. The following section narrates the E-dinheiro platform entrance (which stands for “electronic money”, also “it is money”) on the network, and some of its consequences. Next, we discuss the inseparability between "technical aspects" and "social aspects" (precisely among the practices of the CDBs) in each DCC Mumbuca configuration, and finally present the “sociotechnical governance of DCCs” five dimensions. The discussion is supported by the sociogram/technogram approach (Latour 1998), in dialogue with the notions of discourse (Edwards 1996) and DCCs governance (Diniz, Siqueira and Heck 2019).

Methodological approach

This work dialogues with the notion of local / emergent approaches (Avgerou 2008), in an effort to seek developing concepts and knowledge regarding the organizations under study. Thus, it aims to address of one of the problems in the ICT4D (Information and Communication Technologies for Development) field, according to Qureshi (2015, 1), namely the “ICT4D researchers do not engage closely with the users of their research findings thus disconnecting findings from real-world issues”. In this way, research accuracy is achieved through “closeness of the researcher to the phenomenon under study - with the strength of claims of what is directly observed trumping second-hand reports” (Burrel, Toyama 2009, 84).

This engaged approach considers an openness regarding the categories that emerge from the field, as we can see throughout the text. In the case studied here, we use data collected from 2015 to 2021. It includes semi-structured interviews, specifically in 2015 and 2016i. Data collection also considered materials provided by the Mumbuca CDB (2016), as well as Mumbuca E-dinheiro DCC data, accessed through the administrative interface system (2018-2019)ii. Additionally, to achieve a "closeness of the researcher to the phenomenon under study" (Burrel, Toyama 2009, 84), an ethnographic research approach (which generated field notes) was also used, thusly producing a more detailed description of the referred Mumbuca CDB culture. It relied on immersive observations about Banco Mumbuca (in Maricá, from 2015 to 2016), for six monthsiii. Finally, a Banco Palmas Coordinator took part in a debate at the Esocite.BRiv meeting in 2021, presenting the E-dinheiro platform[v] experience.

To analyze our study object, we looked for approaches which would allow us to carefully discuss this supposed separation between "social aspects" and "technical aspects". Here we emphasize contributions related to ICT4Ds and STS (Science and Technology) fields, such as the Actor Network Theory (ANT), considering "the constructions of sciences and technologies [are analyzed] as phenomena in which the 'social' and the 'technical' are inseparably intertwined in a seamless network" (Marques 2003, 678). Precisely regarding to ANT, we use translation, symmetry, networks, sociogram and technogram concepts. As highlighted by Callon (1986, 18-19), "the notion of translation emphasizes the continuity of the displacements and transformations which occur in this story: displacements of goals and interests, and also, displacements of devices, human beings (…). To translate is to displace (…). Translation is the mechanism by which the social and natural worlds progressively take form". We use translation to narrate the facts (such as CDBs methodology) and artifacts (such as digital community currency) displacement, from which we can understand as its origin (Banco Palmas) to the different stabilizations of Mumbuca network.

In this approach, the symmetry concept is also fundamental: seeking to include non-humans and their agency, for ANT not only people do act, but also software, protocols, computers, the Internet, and other technologies do act (in the sense of making difference), e.g., when performing a currency functions. In Bruno Latour's terminology (1998), if we want (albeit

provisionally) to separate a network into technical characteristics (technogram) and social characteristics (sociogram), the analysis of an artifact technogram would provide clues to the sociogram that makes up its network (Faria 2010), and vice versa, as shown by figure 1.

Despite some critics regarding this approach - such as “paying little attention to broader social structures that influence the local”, or offering “no view, in itself, of the meaning of the term development” (Walsham 2017, 4) –, we consider that ANT seems adequate in this case. Further the reasons already explained, ANT is a research approach that promotes a cross disciplinary perspective on the DCCs topic, something relevant to ICT4D field, according to Walsham (2017)[vi].

Construction of autonomy of the Mumbuca CDB

Structured from local associative dynamics, CDBs rely on a series of tools to generate and expand income in the territory. With this purpose, four central action axes are articulated in its intervention process: (1) solidarity credit fund; (2) local current social currency; (3) fairs of local producers; and (4) training in solidarity economy. CDBs invention has gained relative scale since its first experience, the Banco Palmas (2000), and has been spread over more than one hundred of them in Brazil. It has achieved the status of a “social technology”, which may be replicated in different contexts (Brasil 2012), or which some call “frugal innovation” (Radojevic, Peerally 2016). More recently, especially since 2013, Brazilian CDBs have been promoting their community currencies digitalization, in a context particularly fostered by Brazilian legislation for electronic payments (eg. law 12865/2013 (Faria 2018)).

Mumbuca DCC was based on the Banco Palmas model (where one CC is worth one Real, Brazilian national currency) and was initially proposed by the local City Hall[vii]. It circulated around two million Reais per month (backed by Reais, the national currency) from 2015 until 2019 (Faria et al. 2020), which makes Mumbuca the Brazilian community currency with the greatest circulation volume. Mumbuca DCC has been implemented by different materiality forms: technological artifacts, at the first moment, which were like those usual electronic card networks, rather than paper money, and lately a digital application for mobile devices “E-dinheiro” - the platform currently under implementation by the CDBs Network community

banks. Through the “Mumbuca card”, from 2013 on, 14,000 low-income families in Maricá (RJ) started receiving monthly M$ 84.00 (eighty-four Mumbucas, eighty-four Reais, or around US$15, fifteen dollars) to be used at the local commerce, configuring the start of a minimum income program financed by the town government.

We propose the notion of discourse to deal with CCs materiality changes. In the historian Paul Edwards’ (1996, 31) perspective, a discourse is “a self-elaborating 'heterogeneous ensemble' that combines techniques and technologies, metaphors, language, practices, and fragments of other discourses around a support or supports”. This concept is useful to exam the extent to which changes in the support of a speech (in this case, the community currency on “paper-money”, on a magnetic card or on a mobile application) is also related to other characteristics of this speech. Faria (2018) highlights fundamental elements that constitute the community development banks discourse: autonomy, proximity, financial sustainability, economic democracies, community mobilizations and mediations. In this article we will focus on the first four practices, and in their reconfigurations observed on the transformation of the paper-money (as a CC) into other supports.

Consolidation traces of the proximity and autonomy notions are found in the 1st Brazilian Thematic Conference of Solidarity Finance, which formalized the “solidarity finance practices are distinguished from other economic organization forms by their initiatives self-managed character. It because the community is autonomously responsible for such practices management; […] Solidarity finance practices are distinguished from other economic organization forms, as they work according to a proximity finance logic. In it, human relations, personal contact, and social mediation (based on values such as trust, loyalty, and solidarity) are exchange relations structuring” (Brasil 2012, 180).

The initial umbilical relationship between the bank and the municipality of Maricá (which instituted its own legislation for BCD operation) constituted an important difference compared to the original proposal by Banco Palmas, especially concerning the population autonomy idea involved regarding governments. We are dealing with an experience that, on one hand, injects millions of Reais per month into the local economy using a local currency; but on the

other hand, it embodies the dependence of a partnership governed by a specific agreement between the Maricá government and Banco Palmas.

Over this period (from 2013 to 2017)[viii], Banco Mumbuca was not able to use some of the fundamental tools of CDBs due to a limit imposed by the local government: its DCC only circulated among grant beneficiaries. In that digital version, Mumbuca was limited to just “one spin”: after the beneficiary made his purchase at a local store, the bank deposited the corresponding amount, in Reais, into the merchant’s account. Hence, despite having a relatively high resources volume, the currency circulation was interrupted when the beneficiary shop.

This evident prominence of the City Hall (during that period) could also be noticed in the tasks division between the community bank and the government. Usually, the benefit candidates listened from the CDBs attendants: “do you know where the City Hall is?”, which indicates that the bank had no autonomy to solve that issue. However, the limited local autonomy was not only related to the link between the community bank and the local government. Paradoxically, it was possible to notice the constitution of a new center-periphery relationship: in Maricá, CDB members were then Banco Palmas employees. Despite the wish expressed by Banco Palmas coordinator for an autonomous local entity, what we experienced in Maricá's CDB first years daily life was a Banco Palmas centrality. This relative centrality could be noticed both in procedures terms - as research authorizations - and when someone mentioned the bank name: “you may go over there, at Banco Palmas”, or “good morning, Banco Palmas” were phases commonly heard in the period experienced in Maricá, either at the City Hall or at the community bank itself.

Thus, Brazilian CDBs practices, important references in the literature related to community management of a local currency and understood as common resources (commons) (Dissaux, Fare 2017; Hudon, Meyer 2016) faced challenges concerning autonomy and local management in Maricá. The complexity (and the delay) in consolidating a local entity was a key element for this CDB (lack of) autonomy. Mumbuca CDB team was not capable of managing completely the community bank, such as which projects conducting, which technologies adopting or when starting other CDBs practices, like microcredit. These seem

important effects, at least partially related to the scale involved, one of the main actors in the next section.

Scale and magnetic cards: challenges for autonomy and proximity

Maricá government secretary has decided to recommend a translation: according to him, after witnessing a Palmas paper-money theft during his visit to the pioneer CDB experience, he decided to recommend that CC should take a magnetic card form in Maricá, as a way to meet Mayor Quaquá's demand to implant a social currency in town (a much bigger territory when compared to Conjunto Palmeiras). Banco Palmas practices hired for the task were then faced with an artifact hitherto unknown: the magnetic card and the POS[ix]. They formed the main materiality of Mumbuca DCC from 2013 to 2017 and were provided by the ValeShop enterprise.

As can be seen, the scale required at the Mumbuca case for DCC implementation was inseparable from its materiality, a card inspired by the Federal Government Bolsa Família Program (PBF) – which provides financial aid to poor Brazilian families. A solution hybridized with community banks methodology: if local government drawn its attention to the fact that with PBF "unfortunately" the population could use the money for alcohol and drugs, Bolsa Mumbuca provided a control of the registered establishments. Furthermore, while the federal program beneficiaries had to use their cards to withdraw Reais into paper-money, with Maricá's DCC the paper-money materiality would never pass through the beneficiaries' hands: the currency was used exclusively in a debit card form.

In a larger scale reality (when comparing to other Brazilian CDBs), in addition to the local wealth maintenance, Mumbuca DCC promised more security and more control, important characteristics to consolidate the results obtained with Maricá public policy. During one of our interviews in 2015, the local government mentioned the “control” over currency data: seventy percent of Mumbuca's expenses would have been spent in grocery stores and twenty percent in pharmacies. In the light of a new scale and the presence of a state actor, a

proximity new idea was emerging among the community bank, residents, and traders, now mediated by artifacts such as beneficiary cards and merchants' machines.

As a strategy to follow the effects of this “controlled proximity”, we propose a (temporary) division among use, management, and production / maintenance of technologies. Starting with the use of technological devices dimension, rather than a possible expected variety of ways to appropriate the use of technological devices, we observed an absence of relevant difficulties evidence in Mumbuca cards usage. This absence dialogues more with an entity that emerged in the work field itself: a certain “card culture” that circulates in the population, pointed out by Banco Palmas. A culture that is certainly related to the Brazilian banking services digitalization process, accompanied by cards and POSs. Beneficiaries often revealed a preference for this digitalization type, rather than paper-money: some interviewees’ statements, such use seems associated with the possibility of controlling the spending type on the grant. Hereupon, the card would be better than paper-money because whoever receives the resource could only use them in registered places, “otherwise people would spend on anything”, according to Maricá inhabitants. With the card culture associated with a new control praise, barriers to this digitalization version of Brazilian social currencies seemed small regarding these artifacts usage.

Proceeding with the observation of the beneficiaries' data management, it was not difficult to notice the Mumbuca Card network complexification, at least in two directions. Firstly, documents profusion has increased as a requirement to enter the database. Hereupon, delay to analyze new beneficiaries’ applications (government responsibility) was not seldom questioned to the bank employees. Secondly, the registration process started including promises associated with its computerization, which faced obstacles in the beginning – e.g., during a beneficiaries’ update registration event, the system went down and there were delays in all service stations. Therefore, it seems clear that, considering these examples, a new kind of proximity, more mediated and controlled, enters the scene. This proximity is connected to not only a beneficiary and his/her card equipped with Mumbucas, but also to rules (including options concerning who were the beneficiaries and how could the

beneficiaries spend the Mumbucas), documents, registers in the databases and software used for the registration process, which were essential to Maricá currency infrastructure.

Finally, if when examining the card and the beneficiary we were led to the database registration and construction processes, when we listened to the merchants, we quickly arrived at the machines and the systems that communicate them with ValeShop computers. We arrive here at the third dimension that we proposed, namely the machines production and maintenance and their communication system, which are the ValeShop company responsibility. It is worth saying that Banco Palmas coordinator was uncomfortable with the fact that poor communities where BCDs are do not have another control type, the technology of producing machines. We understand this annoyance as a clue that Banco Palmas' practices faced artifacts relatively unknown to that community. Autonomy sense that circulates in the social currencies proposal of community banks is manifested here regarding the information technologies used, both in terms of knowing how to use them understanding and even being able to produce them as well.

Practices of autonomy and proximity were thus challenged from different angles during the program implementation, whose process was characterized "much more [by] a bank serving a city" than by a city meeting the demands of a community bank, as Banco Palmas coordinator admitted. The initial nuisance, "why can't we produce these little machines?" (the POS's), which embodies an autonomous approach, faced the possibilities of a "card culture" reasonably established among the population (and connected to a relatively desired sense of control), which paradoxically conferred a certain stability and trust in Mumbuca DCC.

E-dinheiro App and a new techno-legal financial sustainability

A new translation acted to stabilize the DCC network at Maricá, entangled by juridical entities: in addition to the municipal legislation created in Maricá (which regulates Mumbuca), the 2013 Brazilian electronic payments legislation entered the scene as an opportunity for CDBs to become "digital banks" and achieve a desired so-called financial sustainability. This legislation formed a new market of alternative electronic payment means, a market into which CDBs entered due to a 2014 proposal by the MoneyClip enterprise: digitalizing BCDs

Network social currencies using the E-dinheiro platform, whose most visible element is an application for cell phones. E-dinheiro gained centrality among CDBs as "[…] the first Social Electronic currency in Brazil, from the Brazilian Community Banks Network, which proposes to serve as the payment means for products and services sold in the solidarity economy" (Carta… 2015).

In Maricá, the proposal to switch from the ValeShop card to the MoneyClip App only took place in 2018, when the MoneyClip's proposal materiality (translated into a smartphone app associated with a card) replaced those operated by ValeShop, not without financial, technological and governance changes connected to the process. Infrastructure change was associated with negotiations with Maricá government, ValeShop and Banco Palmas, according to local governments representatives: in Latour's (1998) terms, technogram and sociogram were connected.

Furthermore, the material change of the payment method would bring a new actor to the BCD network, the cell phones. It should be noted here that Mumbuca Card easy using - "the card culture" - was not verified with a hypothetical scenario of an application with smartphones. When asked about the possibility of Mumbuca grant being paid only through cell phones, we collected expressions from beneficiaries such as "Oh, no…", "It is very complicated.", "I don't even like cell phones. (…) Leave it as it is". Although considering a more positive reception of the proposal by young people, it was clear that the promises of a mobile payment system would need to be situated.

Despite these obstacles, digital payment method became a central matter to the CDB Network, which was beginning to bet on the new legal framework for electronic payments and on the E-dinheiro application as inseparable from its future: "I think community banks either migrate to electronic currency or they will have problems", said a Banco Palmas coordinator. If in Maricá municipal legislation already strengthened its local currency network, the national picture was different. CDB Network and its paper-moneys, on one hand, relied only in BACEN's (Brazilian Central Bank) technical notes, which guaranteed the operations legality, but did not allow community banks being paid for the paper community currencies administration (Faria 2018). On the other hand, electronic payments legislation (law

12865/2013) allowed non-financial institutions to administer electronic payment systems with remuneration for that. As we can observe, legislation was a fundamental actor for the Brazilian community currencies framework to gain digital features.

Thus, from 2013 onwards, electronic payment legislation has been understood as an ally of Brazilian community banks, now candidates to be "payment institutions" whose low financial volumes operated left them relatively free from BACEN inspection (Ibid. 2018)[x]. Along with the new legislation, MoneyClip proposal came to the BCD Network: the small company from Brasília proposed sharing the fees (collected by the platform) with the Network, due to the currency circulation (2% of each trade sale, and 1% of each local currency exchange for Reais) – a more advantageous agreement to the BCD Network, if compared with ValeShop deal[xi].

An analysis of Banco Mumbuca data (Faria, Pupo, Braga, Silva, Severo 2019) revealed significant revenues for the bank, of approximately 2% of the amount allocated by the town to Maricá residents (between forty and fifty thousand Reais monthly, in 2018 second semester and in 2019 first one). This amount allowed the bank to launch an interest-free microcredit program, with its own resources, for the local population. Additionally, in parallel with E-dinheiro platform adoption (fully implemented in 2018 first semester), there was an "explosion" in the trades' adhesion: associated local producers/commerce number went from the magnitude of one hundred to one thousand trades in one year (Faria et al. 2019). Such a phenomenon met the demands of the own beneficiaries and traders, and it covered not only small businesses, but large businesses chains as well. As a result, while Mumbuca BCD's financial sustainability was increasing, a reorientation of beneficiaries' purchases towards large chains of enterprises was identified, causing a relative loss for small local businesses (Ibid. 2019).

Finally, in what someone could call "technical" new platform characteristics, it is worth mentioning two elements highlighted by Faria et al. (2019). From the DCC platform users' viewpoint, the field interviews pointed E-dinheiro application was hardly used by beneficiaries, among whom the use of the E-dinheiro card predominated, according to the interviewed merchants, reinforcing the "card culture" presence, already discussed here in this

text. Concerning the platform transparency and reliability: “[we] recommended ‘transparency panels’ for Mumbuca circulation in different levels [...]: to support the CDB Brazilian Network discussion with local governments and institutions; to increase community confidence where CDBs are situated, so that the [CDBs] Network itself could have a better data view and plan joint actions; every CDB could ascertain circulation in its own community” (Ibid. 2019). The research also recommended turning E-Dinheiro into an open-source software to facilitate security testing and possibly new software contributions. According to the authors, it would also enhance the dialogue among CDBs Network and other Brazilian collectives closer to solidarity-based economy and free software field.

Discussion: sociotechnical reconfigurations in discourse and governance

To illustrate the CDBs methodology translation into its Maricá’s version, we understand that Latour's approach (1998) is interesting. The author proposes that every change in the sociogram of an artifact, in our case Mumbuca DCC, may foster technogram tensions (and vice-versa). Figure 2 portrays these changes, which we propose (schematically) happen at least in four different moments in Maricá, based on descriptions in the previous sections. For each moment, there is a temporary stabilization of CDBs principles first examined here, namely, autonomy, proximity, and financial sustainability.

Taking Banco Palmas methodology as a starting point (T0), Mumbuca first moment (T1) represents this methodology translation for Maricá, with local government partnership, its social assistance program and local legislation. Here, a specific autonomy configuration of Banco Mumbuca was verified (symbolized in figure 2 with the word autonomy in bold and underlined), with challenges regarding the government (e.g., DCC initially only circulated among beneficiaries), also in relation to Banco Palmas. Due to a larger scale of this new network, magnetic card and ValeShop company entered the scene (second moment, T2 in figure 2). Proximity finance notion is then (T2) translated into what we called a controlled proximity scenario, where new mediations emerge (with artifacts like POSs, cards, and databases), as described.

Finally, in a third network stabilization investigated here (T3), migration aspects of the currency infrastructure were verified: smartphones, application and E-dinheiro card, as well as the MoneyClip company and its closed model of software development. Here, a greater financial sustainability perspective at Banco Mumbuca (and the CDBs Network) is central. The new stabilization also reconfigures the BCD autonomy, which started to implement a "zero interest" microcredit program in 2018. Indeed, it is worth mentioning the beginning of a T4 stabilization moment, as presented by Joaquim Melo during the Esocite.BR discussion: in this new configuration, which begun in 2021 first semester, CDB Network is no longer connected to Moneyclip, and software developers dialogue directly to the CDBs[xii].

This process allows us to affirm that different stabilizations of the discourse (Edwards 1996) of Banco Mumbuca are inseparable from its practices (from which were highlighted different practices of autonomy, proximity, financial sustainability arrangements) and its artifacts (paper-money, cards, applications). Hereupon, the case demonstrates that these elements are intertwined, a conclusion that remains far from the idea that changing the DCC materiality would not affect its principles and practices (or "the same idea, [only] in different ways", as verbalized by one of the Banco Palmas founders).

Alongside with these findings, Mumbuca DCC case allows us to discuss some aspects of what we call here DCC democratic governance. We propose connecting it to two works concerning DCCs and governance views. On one hand, Diniz, Siqueira and Heck (2019) framework proposes a DCCs taxonomy, including architecture, transactionality, virtuality, and finally governance. For the authors, governance dimension may be classified in "shared" or "centralized". On the other hand, Faria, Severo, Cukierman, Diniz (2020) discuss three sociotechnical dimensions, namely "requirements", "data" and "source code".

Faria et al. (2020) point the importance of what CDBs call "economic democracy": "[the] history of Brazilian Community Banks shows that democratic practices include not only disputing institutionalized politics power, but also community mobilization in the sense of currency management as common goods." The authors dialogue with Théret and Zanabria's (2007) classification, concerning the "states of a currency", namely, the "incorporated currency" (connected to the users' habits), the "objectified currency" (which serves as a

payment mean) and the “institutionalized currency” (which captures rules that unify a monetary space). Based on this classification, Dissaux and Fare (2017) understand that institutionalized currency dimension would be a preponderant state, insofar as a currency is abstract and immaterial: “it is first and foremost about the institution management at issue, much more than its objective expression in the payment means. [...]Social practices are built around it (self-organization, rules transparency, collective regulation, actors’ participation, individual non-appropriation of surplus, members cooperation, participatory and collective decision-making process, etc.) which should be analyzed and that allow considering the resource (the currency) to be instituted as a common good” (Dissaux, Fare 2017, 13, our translation).

Here, we share with Dissaux and Fare (2017) the attention to a democratic governance of community currencies, which is coherent to community banks and solidarity economy networks. However, when agreeing with Faria et al. (2020), we propose that materiality is connected to social practices, and therefore they should be placed in equal importance status. Thinking about democratic governances does involve considering social and technical (intertwined) dimensions, that is sociotechnical dimensions. We believe that dimensions proposed by Faria et al. (2020) (“requirements”, “data” and “source code” of a DCC) are connected to the CDBs practices examined here, as follows: the discussions around the CDB practices of autonomy are strongly connected both to the possibility of defining DCC requirements (with which rules and functions will be incorporated?) as well as with its source code (would who be able to access the “cake recipe”, the instructions executed by the software?). The proximity (and the discussions regarding the information control) is strongly connected to the data dimension (who does have access to it?).

When dialoguing with the authors, we propose to add two dimensions to their discussion, in addition to requirements, data and source code: DCC management dimension (would who take care of its functioning/availability?) and that of the economic appropriations involved (would who financially benefit from the activity?). Such dimensions may easily be coupled to the previous diagram, highlighting diverse sociotechnical governance configurations at different moments (figure 3).

The present research allows us to propose that Mumbuca DCC management (with ValeShop (T2), at the first moment, and after with Money Clip (T3)) is more centralized than “Palmas model” (T0). It is because, once the paper money was available to the community, it did not depend on an institution to manage the digital platform functionalities and its availability. Concerning the economic appropriation dimension, we may advocate that transition from ValeShop to MoneyClip allowed a more shared distribution of the financial benefits provided by DCC circulation (due to the interest-free microcredit program achievement).

Coming back to the categorization proposed by Diniz, Siqueira and Heck (2019) (governance dimension classified in “shared” or “centralized”), we consider this paper contributes with the authors’ discussion by emphasizing its inevitable “sociotechnical” aspect and by detailing this sociotechnical governance with the dimensions proposed (requirements, source code, data, management, and economic appropriation). We argue that each one of these dimensions may be categorized as “centralized” or “shared”. As a result, we propose a centralized/shared classification for the three moments of stabilization of different sociotechnical governances (T0, T2, T3), considering dimensions discussed here (table 1). “Centralized” means, for us, that there is a strong participation either by the state or by a private enterprise at this dimension; “shared” governance indicates a stronger self-management / community approach.

Then, we considered the platforms requirements are shared, from when it is decided with the CDBs Network - despite improving participation among CDBs might be interesting (Faria et al. 2020); CCs “source code” is centralized with capitalists enterprises (at any configuration, there are not “solidarity collectives” involved). T4 configuration points to a more shared stabilization, whether developers are directly connected to CDBs Network. Even so, both data and platform management dimension are more centralized with T2 and T3 CCs digitalized versions. We might say it considering that both all the network data and operating software are stored in centralized servers (computer), which are primarily administered by a capitalist enterprise – a different situation from T4, which could be even partially changed in the future, considering new technologies, such as blockchain (Diniz, Siqueira and Heck

2019). Finally, this framework makes more visible that transition from Mumbuca Card into Mumbuca E-dinheiro was an achievement in terms of a CDBs better financial appropriation.

The whole framework points to a centralization bias as a risk when information technologies come to the scene. However, it is possible to point out some paths to reverse this possible bias. In the code dimension, a more shared approach (which has already begun with the T4 configuration) could involve development models closer to the so-called free software. As for the data, for example, one can think in levels of aggregated data sharing (with communities involved and other CDBs) and in less centralized storage forms, as used in blockchain technology. Such technology could be promising even from the viewpoint of a more shared platform management, as well as used software improvements, towards more possibilities of local customization.

These assumptions dialogue with Diniz, Siqueira and Heck (2019) discussion, and makes sense to our case, as far as this categorization is a central issue to the idea of democratic governance in the solidarity economy proposition. It is aligned with the perception that state ("big government") and corporations ("big business") do not solve all the community problems (Craig 1993). One of the main Brazilian personalities concerning solidarity economy, Paul Singer (2002) calls attention to the fact that capitalism is a mode of production whose principles are the individual property rights applied to capital and the right to individual freedom. On the other hand, solidarity economy, as another mode of production, has as its basic principles the collective or associated property of capital and the right to individual freedom. Briefly speaking, in a capitalist company, a small and select group of owners is responsible by the main decisions on management processes, on the productive model adopted, on the profit allocation, and usually on tools used for the products / services provided[xiii]. Considering CDBs as participants of the solidarity economy movement, França Filho and Silva Júnior (2009) summarize the CDBs specificity as an experience of solidarity finance lying precisely in the fact that bank coordination and the resource management are carried out by a community organization. The authors also point out that, for a CDB to consolidate, among other aspects, it should establish a technological infrastructure that makes the community bank operations more efficient and effective.

What we argue here is the discussion of DCCs governance dimensions, as technological infrastructures of CDBs, is crucial for (and inseparable from) the “economic democracy” debate among community banks. This inseparability is anchored, for example, on STS field, and may be demonstrated by tools like Latour’s (1998) technogram and sociogram. Thus, our critical exercise here lies on the thought that, starting from the analysis of technology used in a determined way to manage work and production, there is a whole ideological and substantial model connected to it: schematically, more centralized systems, in the molds of traditional capitalist and state organizations (hetero management), or, furthermore, more shared systems, focused on principles of solidarity economy (self-managed).

Conclusions

This paper is situated in the context of monitoring and analyzing the Brazilian community currencies digitalization process, at the CDBs Network. In this community, the idea that this digitalization process would have occurred with “the same idea, [only] in different ways” was strong. At the same time, DCC governance used by the banks is considered a complex challenge to the Network. Drawing our attention to the study of one of the most relevant Brazilian DCCs, the Mumbuca, the paper demonstrates the digital community currency materiality is inseparable from the “social arrangement” around it.

Dialoguing to the ICT4Ds and STS fields, and especially with ANT, we used the concepts of translation, symmetry, networks, sociogram and technogram to describe different moments of Mumbuca. We showed interconnections between the sociogram and the technogram of Mumbuca DCC, emphasizing two approaches: first, discussing how some elements of the discourse of the community development banks (the practices of autonomy, proximity, and financial sustainability) were reconfigured to a certain extent (figure 2). Briefly, autonomy was challenged by dependencies of Mumbuca CDB regarding the local government, Banco Palmas and technology companies and its artifacts; the proximity notion faced the difficulties of the scale and the control possibilities, embedded in a more traceable network (a digital one); Banco Mumbuca financial sustainability was reinforced with the transition into E-dinheiro platform, increasing the bank financial autonomy.

Finally, we discussed a DCC democratic governance, linked to the economic democracy notion – another element of CDBs discourse. We propose that materiality is connected to social practices, and they should therefore be placed *a priori* in equal importance status, as intertwined dimensions: sociotechnical ones. The discussion was useful for us to evaluate each of DCC governance sociotechnical dimensions, namely, requirements, code, data, platform management, and economic appropriation. Dialoguing with Diniz, Siqueira and Heck (2019), we characterized these five dimensions as “centralized” or “shared”, according to each moment of Mumbuca DCC (table 1). Considering a desirable shared approach, in agreement with solidarity economy field, the framework proposed helps to highlight some of the greatest current governance challenges for Brazilian (CDBs) Network.

As future researches, we propose to advance on further discussions towards more shared approaches of code, data, and management dimensions; on the use and improvement of the framework with other DCCs analysis; on the connection of the framework with the discussion of the so-called platform capitalism; and on deepening the framework by analyzing complex governance cases, especially of new and promising technologies, such as blockchain.

Figure 1. Sociogram and technogram

(Latour 1998)

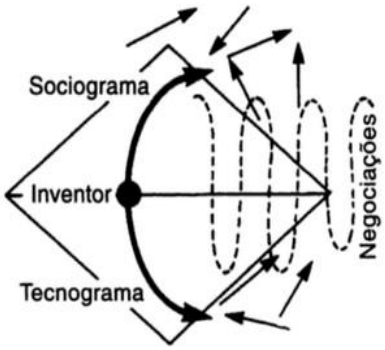


Figure 2. Sociogram and technogram (Latour 1998) adapted to the Mumbuca case. Successive translations lead to the network provisional stabilizations at different moments: different "social" and "technical" actors; in green, CDBs discourse, with relatively reconfigured CDBs practices.

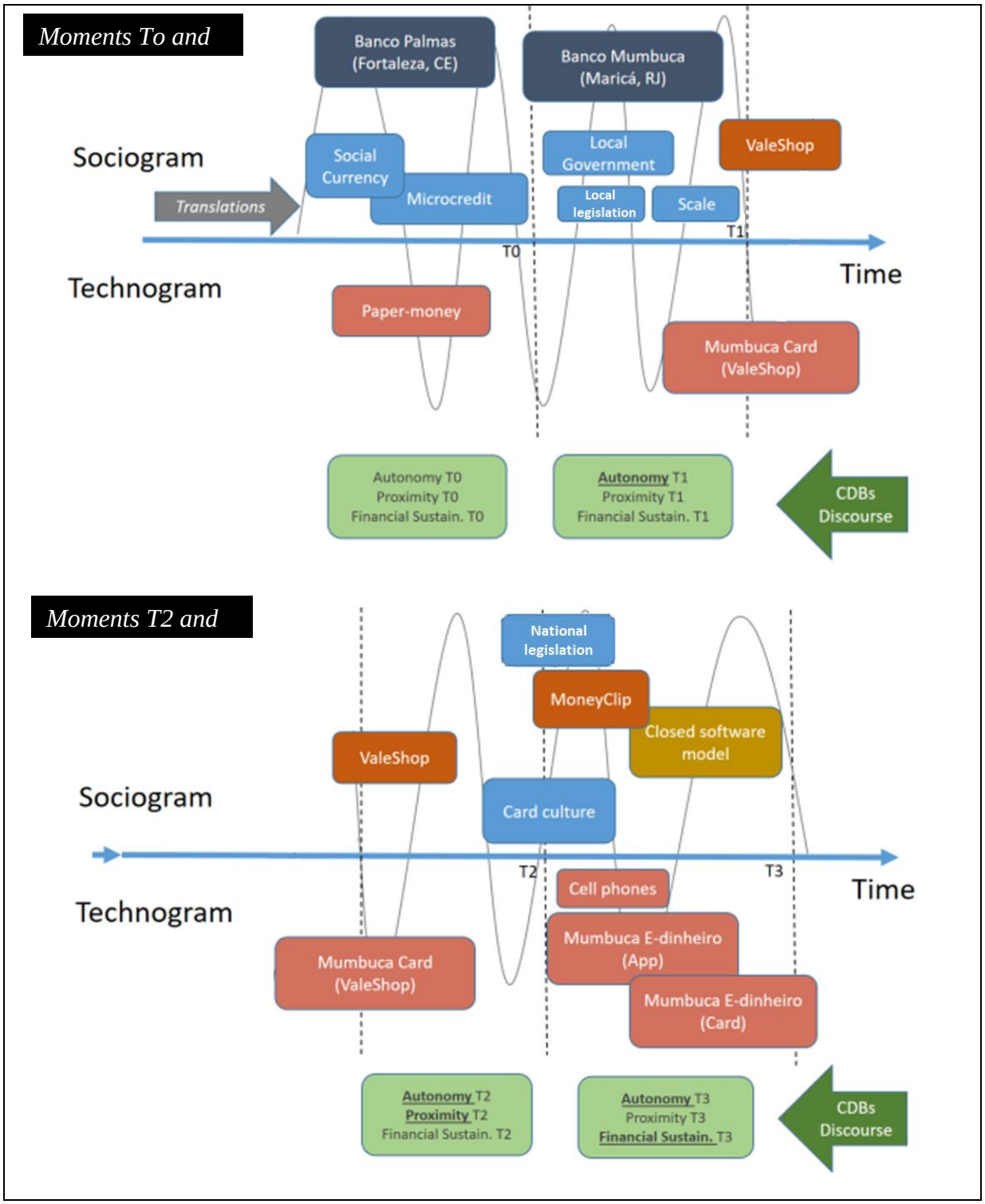
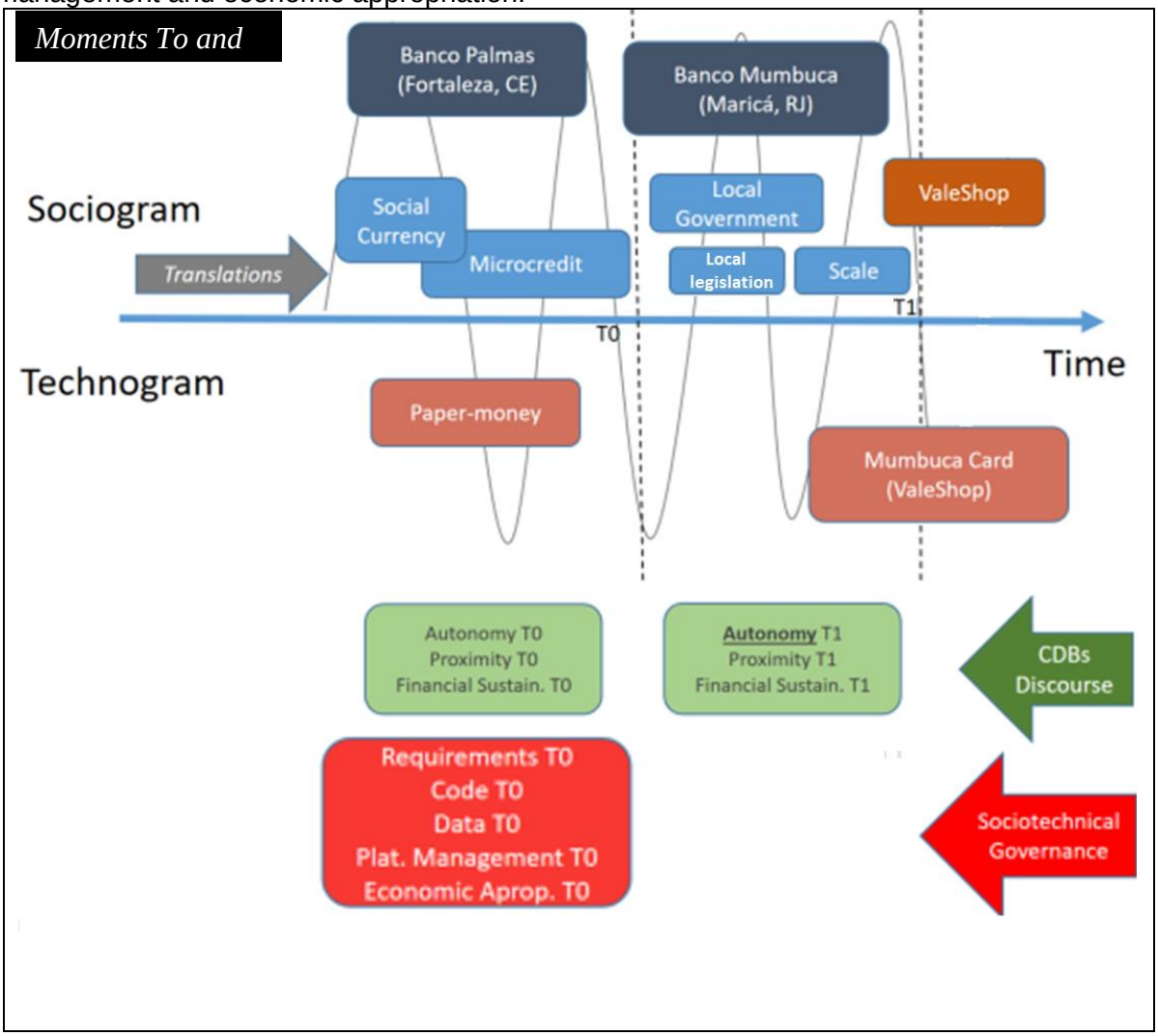


Figure 3. Sociogram and technogram (Latour 1998) adapted to the present case, including new governance sociotechnical configurations. Regarding the figure 2, we add (in red)

sociotechnical governance dimensions: requirements, source code, data, platform management and economic appropriation.



Moments T2 and

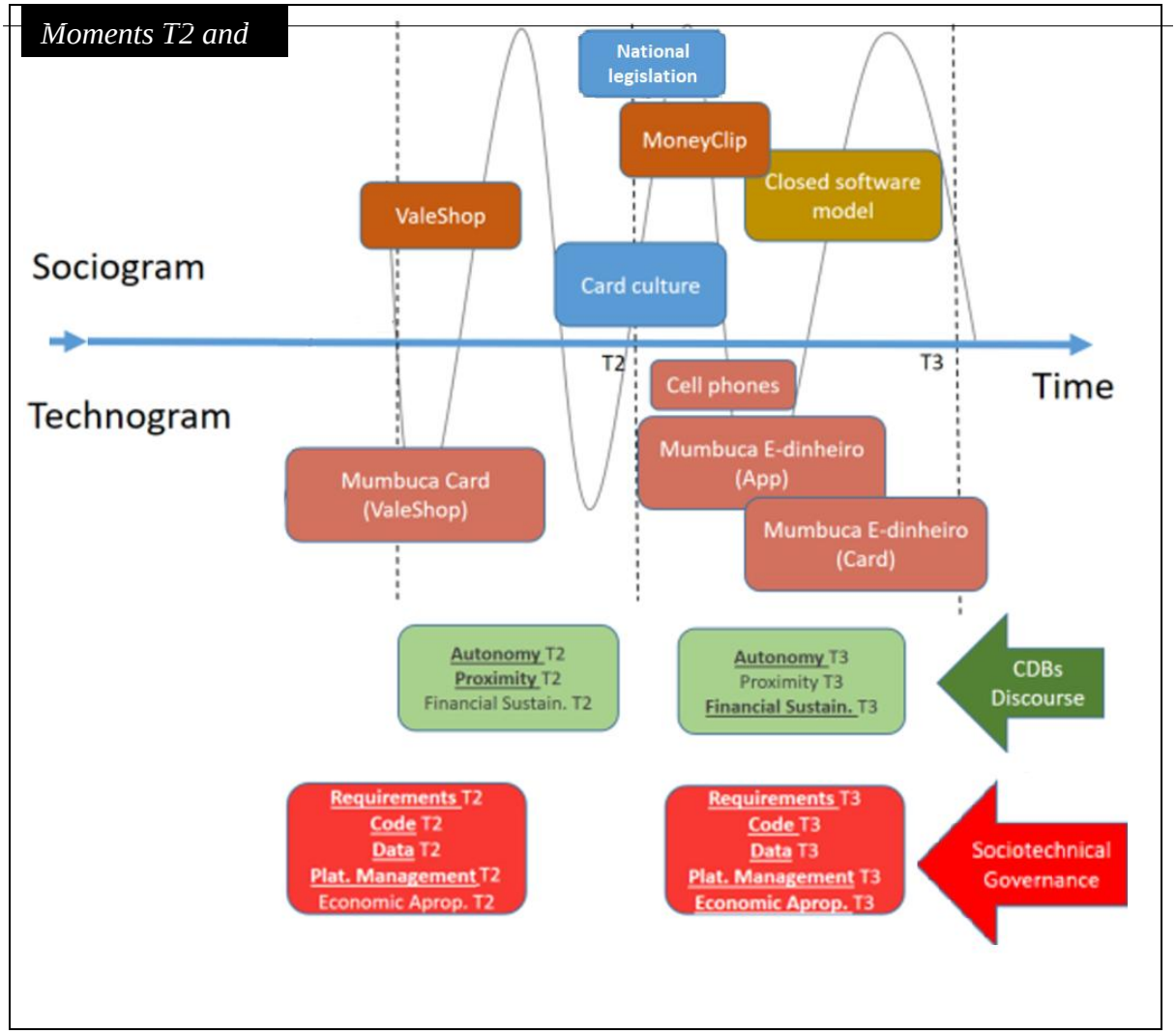


Table 1. Classification for each dimension of DCC sociotechnical governance: Centralized = strong state / private company presence; Shared = strong self-management / community approach

DCC Sociotechnical Governance *DCC Cases*	Requirements	Code	Data	Management	Economic Appropriation
Palma *(Paper-money, T0)*	**Shared** CDB	**Centralized** Printing enterprise	**Shared** CDB	**Shared** CDB	**Shared** CDB
Mumbuca Card *(ValeShop, T2)*	**Shared** CDB Network	**Centralized** ValeShop	**Centralized** ValeShop	**Centralized** ValeShop	**Centralized** ValeShop
Mumbuca E-dinheiro *(App + Card, T3)*	**Shared** CDB Network	**Centralized** MoneyClip	**Centralized** MoneyClip	**Centralized** MoneyClip	**Shared** Banco Mumbuca / CDB Network
E-dinheiro *(CDB Network developers, App + Card, T4)*	**Shared** CDB Network	**Shared** CDB Network	**Hybrid** CDB Network / Provider	**Hybrid** CDB Network / Provider	**Shared** Banco Mumbuca / CDB Network

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[i] Banco Mumbuca workers (3), Banco Palmas Coordinators (2), local commerce (1), Maricá inhabitants (2), local government (2) and MoneyClip enterprise (1) - the company was originally called MadeApp, which developed an application called MoneyClip (a software used to implement the electronic currency E-dinheiro). Subsequently, the partners opened a company called MoneyClip, a name adopted throughout the text, for simplification. The local commerce and inhabitants' interviews addressed aspects such as difficulties with technologies usage, mistrust in relation to the local currency, and changes in expectations regarding the project (at its beginning and by the interview time). The interviews with MoneyClip, Banco Mumbuca, Banco Palmas and local government addressed broader issues, related to mistrusts concerning Brazilian formal institutions (and their responses to local currencies), differences between paper and electronic currency, how users and

traders' data were recorded, and relationship with other parties (Banco Palmas, Banco Mumbuca, local government and ICT companies).

[ii] The materials: folders used by the bank to communicate with population, and spreadsheets with Mumbuca ValeShop Card circulation data. The system access allowed the elaboration of two reports about the Mumbuca currency circulation. More at https://is.cos.ufrj.br/producoes/. Access: 20 Jan 2021.

[iii] This approach also involved, during 2018, the organization of three "hackathons" (events that brought together software programmers and users): MumbucHackas I and II, which brought together software programmers, Banco Mumbuca and public managers in the municipality of Maricá-RJ; Hackathon at Solidários 2018, as one of the activities of a global meeting of development solidarity banks, organized by Banco Palmas, in Fortaleza-CE. More at https://www.marica.rj.gov.br/2018/01/10/desenvolvedores-discutem-nova-plataforma-do-cartao-mumbuca/, http://www.ofluminense.com.br/en/cidades/banco-mumbuca-no-2%C2%BA-distrito, http://bancossolidarios.global/ and https://is.cos.ufrj.br/producoes/. Access: 20 Jan 2021.

[iv] More at https://www.youtube.com/watch?v=wogq8WDKMYE. Access: 20 Jan 2021.

[v] Esocite.BR is the Associação Brasileira de Estudos Sociais das Ciências e das Tecnologias (Brazilian Association of Social Studies of Science and Technology). More at http://www.esocite.org.br/. Access: 20 Nov 2021.

[vi] According to the author, "[for] example, computer scientists tend to build ICT applications and then evaluate them in particular field contexts. [...] In contrast to computer scientists, sociologists and anthropologists normally address contextual issues in some depth but do not construct artefacts" (Walsham 2017).

[vii] Mumbuca DCC started its operation under the administration of the mayor of Maricá, Washington Luiz Cardoso Siqueira (Washington Quaquá), after a visit by its Municipal Human Rights Secretary to Banco Palmas, located in Fortaleza outskirts, in the State of Ceará, Brazil.

[viii] Banco Mumbuca was formally instituted (as an independent institution) in 2017 second semester.

[ix] "Little machines" ("maquininhas", in Portuguese) is the way a Banco Palmas Coordinator refers to POS (point of sale) machines.

[x] In practice, Brazilian State ended up favoring electronic currencies when designing a legislation that built a more advantageous market for arrangements that include ICTs.

[xi] 3% of merchants sales belonged to ValeShop.

[xii] In fact, CDB Network had already bought the E-dinheiro platform from MoneyClip in 2018, but CDBs were still depending on services concerning the platform maintenance.

[xiii] As a general rule, a profit portion is paid in cash to shareholders as dividends and the remaining goes to the investment fund. According to Lima (2009), in work cooperatives, the self-managing organization forms of production, the labor activity control, the product made by the own workers and leftovers have their destination decided by the partners collective. One

part is placed in an education fund of their own, other part divided between the use to expand the cooperative assets, another part to the cooperative, and finally the remaining is distributed in cash to the partners by some established pre-criteria.

Introducing Community (Crypto)currency in Sequential Fund Transfer Scheme

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1 Introduction

Against a backdrop of advances in information technology, a community currency can be issued as a digital currency, with which payments are made online. Notably, a cryptocurrency that bases on blockchain technology provides finality of the payments on its own system, not resorting to banking systems in the relevant domains. This property opens the way to issue a community currency for a community that is formed beyond a single monetary system.

A basic issue in introducing a community currency—whether it is in the form of cryptocurrency or not—is to provide sufficient monetary incentive to an issuer who has the technology of the issuance, while ensuring sufficient benefit for the part of the community members against the associated burden. One scheme for the implementation is a form of contract between an issuer and the representative of a community. This scheme could be a pertinent choice when a community is sufficiently organized, as would be often the case for a "traditional" community that is based on a geographical domain. However, for a community that is characterized with the individual connections between the members—as would be the case in many online-based communities—there would be difficulty in making a collective decision regarding how much monetary incentive to give to an issuer or how to bear the expense among the community members.

Bearing in mind the applications to the latter type of communities, this article conducts a theoretical analysis on decentralized scheme of a community currency, in which a community is not placed as a collective decision maker. Particularly, this study investigates situations in which an outside issuer offers the issuance of a community currency, and each community member independently decides whether to accept or not. On this

point, a scheme that has been recently adopted in Miamicoin[1] serves as a reference to our analysis. In the scheme, an applicant at one point of time not only receives issued coins in exchange of payments, but is also endowed the right to receive funds paid by later applicants. Thus, an applicant can receive additional funds when there comes a later applicant. This article frames such scheme as "sequential fund transfer scheme," and investigates the effectiveness and limitation of the scheme in introducing a community currency.

Sequential fund transfer scheme turns out as Ponzi scheme if there is no associated issuance of community currency or other potentially valuable material. Theoretically, a Ponzi scheme with finite offers tends to be fraudulent if it exists.[2] In this regard, our analysis begins with the settings of complete information and rational agents, ensuring that any fraudulent element or misconception has no essential role in the success of Sequential fund transfer scheme.

On this basis, a fundamental question for our investigation is what kind of merits a community currency could provide to the community members. This article grasps the merits of community currencies in the perspective of social value, which is separate from economic value that is gained through consumption. Particularly, we posit that trades among a community enhances social value through enlarging "social capital" that is maintained in the community. Our approach is motivated by a strand of literature that highlights merits of community currencies in view of social capital (Meyer and Hudon (2017); Seyfang and Longhurst (2013); Jacob, Brinkerhoff, Jovic, and Wheatley (2004); Seyfang (2002)). In conducting our analysis, the basic standpoint is to let social capital refer to "the additional productive benefits to the society or economy as a whole that result from the synergy of a set of mutually trusting social relationships" (Szreter (2000)). While consequences on both social and economic values are implied in the reference, this paper focuses on consequences solely on social value presuming its primary relevance to the whole consequences.

Given such potential merits of community currencies, a crucial question for our investigation is why the merits could not be realized without community currencies. The question is crucial in grasping the role of community currencies. For our analysis, the question can be rephrased as why trades within a community could not be realized without community currencies. On this point, we assume relative loss in economic value in engaging in "local" trades rather than "global" trades, where local and global trades respectively refer to trades within and outside of the corresponding community. The loss could be attributed to differences in quality or productivity of the goods. In this perspective, the article frames the key decision of a community member as the choice between engaging in local trades or global trades. In fact, a community member chooses to engage in global trades when the relative loss in social value exceeds the relative gain in economic

[1] Miamicoin https://www.citycoins.co/miamicoin (accessed: April 26, 2022).

[2] Maekawa (2017) examines a setting with complete information, finite offers and rational applicants to show that Ponzi scheme fails to exist.

value.

Here, another key assumption is myopia of community members particularly in evaluating social value. Contemplating the nature of social capital that would sustain to provide benefit in future, community members could be benefited also in future by contributing today. The assumption of myopia generates situations in which potential future benefit to the community is not necessarily considered in the decisions today. Particularly, this article demonstrates situations such that local trades are desirable for the corresponding community in long-run but never realized without introducing a community currency. In this perspective, the essential role of a community currency is grasped as enhancing inter-generation transfers that provide sufficient additional gain for current decision makers to let them engage in local trades.

Given this role of community currencies, the main issue in examining schemes for introducing a community currency is whether and how effectively appropriate inter-generation transfers could be realized. We begin by showing an impossibility result. It is shown that there are potentially desirable local trades in long-run that are never realized with a community currency. The result rests on our assumption that limits the circulation of a community currency within the corresponding community. Particularly, when a desirable set of trades includes not only local trades but also global trades, each flow of community currency may not be able to track the full sequence of the associated trades. In other words, a community currency is not able to realize a set of trades for which the associated monetary flow cannot be closed within the community.

Given the impossibility result, we proceed to discuss the effectiveness and limitation of sequential fund transfer scheme in realizing potentially desirable "fully" local trades in long-run. Concerning the limitation, observe that the incentive of applicants in choosing a slot to apply is possible to be a relevant issue. Apparently, the last entrant gains nothing except for community currency in participating the scheme. The last entrant might be inclined to switch to enter an earlier slot to gain some transfer payments from later entrants. Contrary to this observation, our analysis demonstrates that the incentive issue is not primary relevant to the limitation of sequential scheme as long as rational expectation is maintained. Formally, our analysis shows inevitable efficiency loss of sequential scheme in realizing inter-generation transfers. The result indicates that the loss is primarily associated with the restricted features inherent in sequential scheme. On this basis, the advantage of sequential scheme over simultaneous scheme is established.

In order to examine robustness of the results, we then analyze cases with optimistic applicants. There, optimism is introduced in a weak form so as to avoid any fraudulent element. The associated result confirms fragility of sequential scheme in that almost all applicants now choose to apply in the first slot when there is no restriction in application. Accordingly, the advantage over simultaneous scheme significantly shrinks. To this regard, we show that the advantage of sequential scheme could be recovered by introducing restriction on the number of the applicants for each slot. Overall, our analysis establishes potential effectiveness of sequential scheme, while pointing out that certain fine tuning

might be necessary in a realistic context.

2 Baseline setup

Time is discrete as $t = 1, 2, ...$ There are two domains as $D = \{H, F\}$, where H is for Home domain and F for Foreign domain. There are consumers living in the domains. Each consumer never moves to the other domain. There are $K \geq 3$ types for the consumers, and the lives of the consumers are structured as an overlapping generation such that n-th generation of type k consumer in each domain gets birth at the beginning of period $max(1, (n-2)K + k + 1)$ and dies at the end of period $(n-1)K + k$, for $n = 1, 2, ...$[3] For simplicity, this article examines the case of one consumer for n-the generation of type k consumer in each domain for every $n = 1, 2, ..$ and $k = 1, 2, ..., K$.

We assume that utility of a consumer is composed of economic benefit and social (i.e., non-economic) benefit. While economic benefit captures utilities in consuming goods, social benefit intends to capture utilities through engaging in a community. Concretely, let U_i denote the utility of consumer i, which we construct as

$$U_i = U_i^g + U_i^s, \tag{1}$$

where U_i^g and U_i^s show the utilities in the aspect of economic benefit and social benefit, respectively. Below, we proceed to introduce the setting for goods and the preferences for the part of U_i^g, which are followed by our formal construction of U_i^g, Afterwards, we elaborate the part of U_i^s. As for terminology, U_i^s is referred to as utility gains from community value for the rest of this article, in accordance with our limited focus.

There are commodity goods and luxury good to be consumed. There is an indivisible unit for the goods to be produced and traded. Every good depreciates within one period. Commodity goods are produced by consumers in both domains, while luxury good is elastically supplied from outside of the domains.[4] There are K types for commodity goods, for which the types correspond to those of the consumers in two respects; production and preference. With respect to production, type k consumer is endowed production technology of type k commodity good. The technology allows one unit of production only once in the lifetime of the consumer, for which we assume there is no production cost.[5] Regarding the aspect of preference, type k consumers gain positive utility in consuming type $k + 1$ commodity good while gain no utility for the other types, where type $K + 1$ indicates type 1.[6] These settings allow trades of commodity goods in a circular structure wherein type k consumers serve as buyers against type $k + 1$ consumers.

[3] Thus, each consumer of generation $n \geq 2$ lives for K periods.

[4]

[5] It could be thought that a type k consumer inherits a 'tree" from the consumer of the same type and domain in the previous generation.

[6] The reference of type 1 with type $K + 1$ is maintained throughout this article.

Concerning the preference on commodity goods, we add differences in "taste" for the same type commodity good, so that a consumer gains higher utility when consuming locally produced commodity goods than consuming those produced in the other domain. The setting of "taste" is to generate the merit of global trades (i.e., trades across the domains). On this basis, the structure of utility gains in consuming commodity goods and luxury good is composed as a hierarchical structure such that consuming luxury good leads to a utility gain only when the consumer is sated with commodity goods. The role of utility gains in consuming luxury good is to express seigniorage gains when introducing a community currency.

For our analytical purpose, a consumer gains utility from consumption only in the final period of the life. This setting in conjunction with the generation structure allows to demonstrate stable sequences of trades for commodity goods as well as non-trivial demand for money (i.e., sufficiently low velocity of money).[7]

For our formal construction of the utility function for the part of economic benefit, let $I_t^{d,k}$ denote the set of consumer of type k in domain d who dies in period t. Now, for consumer $i \in I_t^{d,k}$,

$$U_i^g = \begin{cases} (1-\theta)x_i^{k,d} + x_i^{k,d'} & \text{if } x_i^{k,d} + x_i^{k,d'} < 1 \\ (1-\theta)x_i^{k,d} + x_i^{k,d'} + \gamma x_i^L & \text{otherwise,} \end{cases} \tag{2}$$

where $x_i^{k,d}$ denotes i's consumption of type k commodity good produced in domain d, x_i^L shows i's consumption of luxury good, and only the consumptions in period t are counted in both terms. Here, $0 < \theta < 1$ shows the relative loss in consuming outside commodity goods over local commodity goods, and $0 < \gamma$ shows the relative size of utility gain from consuming luxury good that is measured in terms of the gain from consuming locally produced commodity goods. Throughout the analysis, we assume $\gamma > 1\theta$, which in effect ensures the use of Home currency whenever held as discussed in Section 4.

Concerning utility gains from community value, our focus is Home domain in the sense that only the consumers in Home domain are entitled to enjoy community value.[8] The source of community value is articulated by introducing the concept of "community capital," whose community nature is represented in two respects; it can be only locally accessible and formed only by local consumers. Consumers gain utility through accessing community capital.[9] In accordance with the setting of consumption, consumers gain utilities from community value only in the final period of their lives.

[7] If we alter settings so that type k consumers consume $k-1$ commodity goods (instead of $k+1$ commodity good) while the generation structure is unchanged, the initial holding money of the first generation type 1 consumers could eliminate the need of money for the rest of the consumers.

[8] Thus, Foreign domain is treated as an outside world which is not degenerated into a single community. In this respect, the setting would be more aligned when the relative size of the consumers in Foreign domain is much larger, such as $|I_t^{F,k}| = N|I_t^{H,k}|$ with large N for every $k = 1, 2, .., K$ and $t = 1, 2, ...$ Note that the analyses in this article trivially hold for such an extension.

[9] Community capital is implicitly captured as a collection of community relevant contents that can be valued and shared by the community members.

Our baseline assumption is that community capital is accumulated by the consumers who actively participate in community, for which active participation is indicated by purchases of locally produced goods.[10] This assumption is to demonstrate a potential merit of community currency in terms of community value. For our analytical purpose, we allow community capital to have a public good nature such that active participants (i.e., those who purchase local goods themselves) fully access to community capital, while non-active participants can still partially access to community capital, or free ride in enjoying community value.[11]

For our formal representation on utility gains from community value, let x_t^d denotes the aggregate locally consumed commodity goods of type k in domain d in period t. Now, for consumer $i \in I_t^{d,k}$ who dies in period t,

$$U_i^s = \begin{cases} \phi v\left(X_t^d\right) & \text{if } d = H \text{ and } x_i^{k+1,d} < 1 \\ v\left(X_t^d + x_i^{k+1,d}\right) & \text{if } d = H \text{ and } x_i^{k+1,d} \geq 1 \\ 0 & \text{if } d = F, \end{cases} \tag{3}$$

where $X_t^d := \sum_{k=1}^{K-1} x_{t-k}^d$ acts as the indicator of the formed community capital, function $v(.)$ brings community value, and $0 \leq \phi \leq 1$ indicates the easiness of free-riding in enjoying community value. We will specify the shape of $v(.)$ after presenting our base results in the next section. We assume that ϕ is known by all consumers and X_t^d is publicly observed within domain d.[12] Note that X_t^d is an aggregated consumption exactly over the past $K-1$ periods, which is primarily for our analytical purpose to discuss in terms of a steady state.[13]

As for trades of commodity goods, any bilateral exchange will not satisfy both sides of the counterparts given the circular preference structure. For trades to be made, we introduce durable assets that have no consumption or holding value, which we call currencies as they potentially serve as media of exchange. There are two types of currencies; Global and Home currency. Global currency is assumed as a standard payment method in trades of luxury goods, and can also be used for payments of commodity goods in both domains.

[10] In particular, we assume that community capital is enlarged via communication among the community members and active participation (i.e., engaging in local trades as a purchaser) opens or strengthens the communication channels with the other active participants, contributing to accumulate community capital. Note that it is assumed that consumers will not contribute to formation of community capital through selling local commodity goods to local consumers.

[11] The degree of public good nature of community capital could be related to the types of communities. For example, when we compare two conceptual communities: "traditional" communities that are based on physical domains and "virtual" communities that are based on online relationships, occasions for unintentional communication (i.e., accidental meetings) would be more frequent in the former type communities, and thus, one could posit that the community capital would be more prone to free riding in such communities.

[12] Note that there is no difference in the analysis even when X_t^d is observed also by the consumers in the other domain.

[13] A consistent interpretation is that once a consumer who has contributed to the accumulation of community capital dies, the contribution vanishes.

Home currency is examined as a potential community currency for Home domain. For the sake of our analysis, we assume that Home currency is accepted neither in trades of luxury good nor in any trades of commodity good produced in Foreign domain.[14] Thus, Home currency is possible to serve as a stable payment method only within Home domain. The ways of introducing Global and Home currencies are stated separately in corresponding sections.

2.1 Remarks

In our setting, observe that K represents the length of trades necessary to be closed itself, which coincides with the size of a community. This coincidence between economic and social unit is to provide a baseline analysis that could have implications also to non-coincided cases such as multiple economic units correspond to a social unit.

3 Case with Global currency

An economy is represented with $(K, \gamma, \theta, v(.), \phi)$. In this section, we examine economies to which Global currency is introduced as the sole choice of payment method. We let Global currency be simply endowed initially, in the way that every consumer of the first generation except type K is endowed one unit each.

We focus on the cases in which the prices of commodity goods and luxury good are equally one unit in terms of Global currency. Given that Global currency is believed to serve as the payment method in any future, a seller is always better to sell; however, indivisibility of goods bring an issue in cases of excess demand. We assume that local consumers have advantage in accessing to buy goods (e.g., physical closeness), and thus, goods are always sold to local consumers before outside consumers. In effect, buyer $i \in I_t^{d,k}$ faces the purchase availability $\{\bar{x}_t^{k+1,d'} \in \{0,1\}\}_{d' \in \{H,F\}}$ given the aggregate demands for the corresponding goods, where $\bar{x}_t^{k+1,d'} = 1$ only in the case of excess demand with $d \neq d'$ for $i \in I_t^{d,k}$.

In purchasing goods, each consumer maximizes consolidated utility shown in equation (1) given the budget constraint together with the purchase availability.[15] Formally, for consumer $i \in I_t^{d,k}$, let m_i shows the holding amount of global currency in period t, the budget constraint of the consumer becomes

$$x_i^{k+1,H} + x_i^{k+1,F} + x_i^L \leq m_i. \tag{4}$$

The purchase availability for the consumer becomes as follows: for $d \in \{D, H\}$,

$$x_i^{k+1,d} \leq \bar{x}_t^{k,d} \tag{5}$$

[14] Whether Home currency (issued as a community currency in Home domain) could be accepted in Foreign domain or not might be a relevant analytical issue not pursued in this article.

[15] We make realized purchase availabilities be consistent with those used in corresponding purchase decisions.

We define an equilibrium as below. Given an economy $(K, \gamma, \theta, v(.), \phi)$ with the endowments of Global currency in the specified manner, the consumptions, payments and participation history in local trades (i.e., $\{X_t^H, X_t^F\}$) for period $t = 1, 2...$ constitute an equilibrium if they are consistent with the determination of the purchase availabilities and the utility maximization as stated above.

We say that an equilibrium attains a steady state if there exists period T such that for every $t \geq T$ and every $d \in \{H, F\}$, $x_t^d = x_{t+K}^d$ and $x_t^L = x_{t+K}^L$. Specifically, we say a steady state with $k-$local trades for $k = 0, 1, 2, ..., K$ if $X_t^H = k$ for every $t + K - 1 \geq T$. Particularly, a steady state with $k = 0$ local trade is also referred to as a steady state with global trades.

We also introduce the concept of sustainability for a steady state. Suppose that each consumer of type $k' \in \{1, 2, ..., k\}$ of the first generation in Home domain choose to purchase Home goods.[16] Given this, consider an equilibrium that starts with period $k+1$. If it attains a steady state with $k-$local trades, then we say that a steady state with $k-$local trades is sustainable.

3.1 Preliminary results

Observe that Foreign consumers always choose to consume Home commodity goods when those purchases are available, as purchasing Foreign goods bring loss in the utility from consumption without gain in community value. Meanwhile, for Home consumers, purchasing Home commodity goods brings loss in the same manner, while they might generate gains in community value. Specifically, consumer $i \in I_t^{H,k}$ chooses to purchase local commodity goods only when

$$\theta \leq v(X_t^H + 1) - \phi v(X_t^H), \tag{6}$$

where the right hand side of the equation is interpreted as the effective marginal gain in community value.

We start by the following result.

Lemma 1. *(Equilibrium: steady state with global trades)*
There exists an equilibrium that realizes a steady state with global trades if and only if

$$\theta > v(1) - \phi v(0). \tag{7}$$

Proof. See Appendix A.1. □

The condition shown in Lemma 1 sets up the situation for our analysis on introducing community currency. In order to see the limitation of an equilibrium to attain a steady state, the next result prepares to show the conditions for an equilibrium to attain a steady state with $k-$local trades.

[16] Thus, the corresponding consumers in Foreign domain purchases Foreign goods.

Lemma 2. *(Equilibrium: steady state with $k-$local trades)*

There exists an equilibrium that realizes a steady state with $k-$local trades if and only if:

i) for $k = 1, 2, ..., K-1$,

$$\theta \leq v(k') - \phi v(k'-1) \text{ for every } k' = 1, 2, .., k \text{ and} \tag{8}$$

$$\theta > v(k+1) - \phi v(k). \tag{9}$$

ii) for $k = K$,

$$\theta \leq v(k') - \phi v(k'-1) \text{ for every } k' = 1, 2, .., K. \tag{10}$$

Proof. See Appendix A.2. □

The following result provides the sustainability conditions for a steady state with $k-$local trades.

Lemma 3. *(Sustainability of a steady state)*

A steady state with $k-$local trades in which $x_i^{k'+1,H} = 1$ for all consumers in Home domain of type $k' = 1, 2, ..., k$ is sustainable if and only if:

i) for $k = 1, 2, ..., K-1$,

$$\theta \leq v(k) - \phi v(k-1) \text{ and } \theta > v(k+1) - \phi v(k). \tag{11}$$

ii) for $k = K$,

$$\theta \leq v(K) - \phi v(K-1). \tag{12}$$

Proof. See Appendix A.3. □

The conditions of Lemmas 2 and 3 indicates that given an equilibrium with global trades, a steady state with $k-$local trades could be attained if type $k' = 1, 2, .., k-1$ Home consumer only in some generation are given sufficient incentive to make local consumptions. For our analysis, the way of providing incentive for those consumers is set as the central issue in introducing a community currency.

Here, we prepare to introduce the concept of welfare for a steady state in order to demonstrate the conditions for a community currency is better to be introduced. Let welfare be the summation of the utility levels of the consumers with respect to arbitrary one generation. Let W_k denote the welfare for a steady state with $k-$local trades. Then, the welfare becomes

$$W_k - W_0 = v(k)k + \phi v(k)(K-k) - 2\theta k, \tag{13}$$

where $v(k)k$ indicates the aggregated gains in community value for Home active participants (i.e., consuming local goods), $\phi v(k)(K-k)$ indicates the aggregated gains in community value for Home non-active participants (i.e., free riders) and $2\theta k$ is composed of the equal size of the aggregated loss in economic value in each domain.

The following proposition demonstrates the potential merit of a community currency for our analysis.

Proposition 1. *(Potential merit of a community currency)*

A sustainable steady state with $k-$local trades is not attained in an equilibrium with Global currency while it provides larger welfare compared with the steady state with global trades if:

i) for $k = 1, 2, .., K-1$,

$$\theta > v(1) - \phi v(0), \tag{14}$$
$$\theta \leq v(k) - \phi v(k-1), \tag{15}$$
$$\theta > v(k+1) - \phi v(k) \ \textit{and} \tag{16}$$
$$\theta < \frac{1}{2}v(k) + \frac{K-k}{2k}\phi v(k). \tag{17}$$

ii) for $k = K$,

$$\theta > v(1) - \phi v(0), \tag{18}$$
$$\theta \leq v(K) - \phi v(K) \ \textit{and} \tag{19}$$
$$\theta < \frac{1}{2}v(K). \tag{20}$$

Proof. It is immediate from Lemmas 1, 2 and 3, combining with the condition for welfare implied by equation 13. □

4 Introduction of a community currency

For our examination on the introduction of Home currency, we let the periods start by a steady state with global trades. Concretely, for a steady state that is sustainable under the setting of the previous section, take some period in which consumers of type 1 make their consumptions. We reframe the period as one, while the history of the local consumptions are maintained; thus we have $X_1^H = 0$, and $X_{k'}^H$ for $k' = 2, 3, ..K$ also reflects the history before period one.

In the face of potential circulation of Home currency, we need reexamine the sellers' behaviors. For a seller in Home domain, receiving Home currency means to restrict the own purchasing choice in the future, which was not so in the setting without Home currency. We assume rationality, or consistency of the seller's expectation such that $E_t^i[X_{t+K-1}^H] = X_{t+K-1}^H$, where $E_t^i[.]$ shows the expectation of Home consumer i in the selling phase and X_{t+K-1}^H in the right hand side is the realization in an equilibrium to examine.

Now, for consumer i who is a current seller in period t facing an excess demand, given that own future payment with Home currency is surely accepted, the consumer accepts Home currency if and only if; for given rationality on X_{t+K-1}^H,

$$\theta \leq v(X_{t+K-1}^H + 1) - \phi v(X_{t+K-1}^H). \tag{21}$$

Concerning the decisions in the phase of purchasing, suppose that a consumer holds one unit of Home currency without Global currency at the time of purchase, then there

is no choice but use the Home currency to purchase local goods. For a consumer who additionally holds several units of Global currency, a potential choice is not using Home currency but use Global currency to purchase outside goods. However, our maintained assumption of $\gamma > \theta$ ensures the use of Home currency also in these cases.[17] We now proceed to examine schemes for the introduction of Home currency.

4.1 Definition of scheme

We assume that the technology to issue Home currency is held outside of the domains. Particularly, there exists a risk-neutral issuer who can issue arbitrary size of Home currency with fixed cost $c \geq 0$. The cost is incurred at the initial issuance, which is made in period zero. The issuer gains utility only from consuming luxury good. Furthermore, the issuer is assumed sufficiently short-sighted so that only their consumptions in period 0 matter. Concretely, the issuer' utility is assumed as $r^0\gamma - c$, where r^0 is the receipts of global currency from the consumers in period zero, and γ is added to align the utility unit to that of consumers. We assume the issuer's opportunity cost is zero. To avoid notational cumbersome, let K^- imply the set $\{1, 2, .., K-1\}$.

For our analysis, we examine schemes that allocate either zero or one unit Home currency to each type $k \in K^-$ Home consumer in the first generation, and each allocation is made in exchange of a payment of Global currency. Concretely, let $(r^0, (m^k, r^k)_{k\in K^-})$ refer to a scheme, where m^k indicates the payment of consumer k to the scheme and r^k shows the transfer to consumer k for $k \geq 1$ while r^0 does to the issuer. The scheme is allowed to give probabilistic transfers, and we let r^k shows the expected value, thus $r^k \in R_{0+}$ for every $k \in 0 \cup K^-$. We proceed to discuss feasibility of the schemes.

4.2 Feasible scheme

In preparation to define a feasible scheme, let $L^k := \max\left(0, \frac{1}{\gamma}\left(\theta - (v(k) - \phi v(k-1))\right)\right)$, which indicates the necessary unit of local currency in expectation in order for consumer of type k in the first generation is willing to purchase local goods rather than outside goods.

[17] The net gain with respect to the part of U^g for the case of using Home currency against the case of not using becomes $(1 - \theta + \gamma) - 1$, where $(1 - \theta + \gamma)$ indicates the gain by purchasing one unit local commodity good with Home currency and one unit of luxury good, while the remaining term indicates the gain by purchasing one unit outside commodity good. This is always positive when $\gamma > \theta$.

Now, we say a scheme $(r^0, (m^k, r^k)_{k\in K^-})$ is feasible if; for every $k \in K^-$,

$$m^k \in \{0, 1\} \text{ and} \tag{22}$$

$$\sum_{k=0}^{K-1} r^k = \sum_{k=1}^{K-1} m^k, \tag{23}$$

$$r^0 \geq \frac{c}{\gamma} \text{ and} \tag{24}$$

$$r^k \geq L^k, \tag{25}$$

where equation (22) shows the constraint for the payment of each consumer, equation (23) shows the balance for the scheme, equation (24) is the incentive condition for the issuer to issue, and equation (25) serves as the incentive condition for a consumer to participate to the scheme.

Note that although a feasible scheme with probabilistic transfers is implicit about the underlying probability distribution on the realizations, we can always come up with a consistent distribution.[18]

Given a feasible scheme, the budget of type $k \in K^-$ consumer in the first generation is composed of r^k units of Global currency and either one or zero Home currency. Specifically, the consumer is allocated one unit Home currency only when $m^k > 0$. The budgets for the consumers in the following generations are formed only through their selling, as the same in the previous section. Now, given a steady state in the initial period, an equilibrium is defined in almost the same manner as in the previous section, when incorporating the selling decision shown with equation (21). We say that a feasible scheme successfully realizes a steady state with $k-$local trades when the steady state is attained in a corresponding equilibrium.

We start by the following impossibility result.

Proposition 2. *(Impossibility of partial local trades)*
Suppose that the conditions for the sustainability of a steady state with $k-$local trades shown in Lemma 3 are satisfied for some $k \in K^-$. Then, there exists no feasible scheme that successfully realizes a steady state with $k-$local trades.

Proof. See Appendix A.4. □

The next result shows the availability of steady states with $K-$local trades.

Proposition 3. *(Availability of full local trades)*
Suppose that the conditions for the sustainability of a steady state with $K-$local trades shown in Lemma 3 are satisfied. Then, there exists a feasible scheme that successfully

[18] Let $p^k = \frac{r^k}{\sum_{k=1}^{K-1} m^k}$ for $k \in 0 \cup K^-$. Then, take a set of realizations $\{R^k\}_{k\in 0\cup K^-}$, for which each R^k allocates $\sum_{k=1}^{K-1} m^k$ to agent k while 0 for the others. Take a probability distribution that endows probability p^k for realization R^k. Given the probability distribution which trivially equals to r^k.

realizes a steady state with $K-$local trades while allocating at least L^k unit of Global currency to each consumer $i \in \{I_1^{H,k}\}_{k \in K^-}$ if and only if

$$\sum_{k=1}^{K-1} L^k \leq K - 1 - \frac{c}{\gamma}, \tag{26}$$

Proof. See Appendix A.5. □

For a feasible scheme to realize a steady state with full local trades, equation (26) could be interpreted as the budget constraint. In this perspective, we proceed to analyze how the budget is efficiently used in decentralized settings where L^k cannot be directly used in the allocation.

4.3 Specifications on $v(.)$

Before proceeding to analyze schemes incorporating application decisions by consumers, we makes some specification on the structure of function $v(.)$ so as to endow certain monotonicity. Our baseline assumption behind the specification is that there is initially a strong synergy effect among the contributions in forming the community capital, while later the synergy effect wanes, as the consolidated effects emerge as a S-shape function. Specifically, we let $v : [0, \bar{K}] \to R_{0+}$, where $\bar{K}$ is the maximum possible K for our analysis. Our specification is interpreted as a truncated S-curve function, which consists of the following three parts:
i) (Increasing) $v'(.) > 0$.
ii) (S-shape) there exists y^* such that $v''(y^*) = 0$, $v''(y) > 0$ for $y < y^*$ and $v''(y) < 0$ for $y > y^*$.
iii) (Truncation) $v'''(y) < 0$ for $y^* \leq y \leq \bar{K}$.

Part i) and ii) in combination provides an increasing S-shape function. Part iii) is interpreted to add a truncation on the domain for a S-shape function such as Logistic function. We present a consistent model for the specification of function $v(.)$ as a truncated Logistic function in Appendix A.11.

Given the specifications, the representation of effective marginal gain in community value is endowed certain monotonicity. Prepare to define $mv(y) := v(y) - \phi v(y-1)$ for $y \geq 1$, We denote $mv(y;\phi)$ when mentioning $mv(y)$ for specific ϕ. Let $mv'(y;\phi)$ denote the first derivative with respect to y. Also, let $m''(y;\phi)$ and $m'''(y;\phi)$ denote the second and third derivative in the same manner, respectively. Now, we have the following results.

Lemma 4. *(Monotonicity on $mv(y;\phi)$)*
There exists $\tilde{\phi}$ such that:
i) (Monotonically increasing) For $\phi < \tilde{\phi}$, $mv'(y;\phi) > 0$ for $y \geq 1$.
ii) (Unique maximum point with monotonicity) For $\phi > \tilde{\phi}$, there exists y such that $mv'(y;\phi) = 0$, $mv'(y';\phi) > 0$ for $y' < y$ and $mv'(y;\phi) < 0$ for $y' > y$.

Proof. See Appendix A.6. □

The implications of Lemma 4 for our analysis are demonstrated in the following Lemma.

Lemma 5. *(Implications on L^k)*

Suppose that a steady state with $K-$local trade is sustainable, but it is not attained as an equilibrium with Global currency. Then, there exits $\hat{K} \in \{1, 2, .., K\}$ such that:
i) $L^k \geq 0$ for $1 \leq k \leq \hat{K}$ and $L^k = 0$ for $k > \hat{K}$.
ii) $L^k \geq L^{k+1}$ for every $1 \leq k \leq \hat{K}$.

Proof. See Appendix A.7. □

Lemma 5 indicates that the issue for our analysis is largely to incentivize consumers who decides their purchase in early periods.

5 Sequential scheme

We proceed to examine schemes by incorporating applications of consumers. This subsection examines applications made in a sequential manner. Concretely, let $(r^0, (q_t)_{t\in T}, (m_t^k, r_t^k)_{k\in K^-;t\in T})$ represent a sequential scheme, where $T = \{0, 1, .., K-1\}$ indicates the periods for applications, $q_t \in K^-$ shows the slot for applications in period $t \in T$, while $m_t^k \in \{0, 1\}$ and $r_t^k \in R_{0+}$ shows the payment and expected receipt of type k consumer in period $t \in T$, respectively. We focus on sequential schemes that are feasible, given the following relations of the relevant notations; $m^k = \sum_{t\in T} m_t^k$ and $r^k = \sum_{t\in T} r_t^k$. The procedure of a sequential scheme is as follows. Applications for each slot are all made in period 0. Application status (i.e., who applies to which slot) is public to the consumers in the first generation.[19] At the end of period 0, if there arises an excess application for a slot, the scheme is abandoned, that is, no transfer will be made. Thus, for a sequential scheme to work, slot q_t serves as restrictions for applications such that; for every $t \in T$,

$$\sum_{k\in K} m_t^k \leq q_t. \tag{27}$$

Given that a sequential scheme works, the transfers are realized in the way that

$$r^0 = m_0 \text{ and} \tag{28}$$
$$r_t = m_t, \text{ for every } t = 1, 2, .., K-1, \tag{29}$$

where $m_t := \sum_{k\in K^-} m_t^k$ and $r_t := \sum_{k\in K_t} r_{t+1}^k$ with $K_t := arg_{k\in K^-} m_t^k \geq 1$. Apparently, the last participants will receive no Global currency. Furthermore, given indivisibility of currency, we let the transfers among consumers with respect to each r_t are made randomly. Given this, r_t^k for $t1, 2, ..K-1$ becomes

$$r_t^k = \mathbb{1}_{\{m_{t-1}^k=1\}} \frac{m_t}{m_{t-1}}, \tag{30}$$

[19] Note that type K consumer in the first generation does not live in period 0, who is out of scope for a scheme.

Note that consumer of type $k \in K^-$ has no incentive in participating in period t for any $t \geq k$, that is, for every $k \in K^-$, $m_t^k = 0$ for $t \geq k$.

We first show the results concerning slot restrictions. We let non-restricted sequential scheme refer to a sequential scheme in which $q_t = K-1$ for every $t \in T$, while a sequential scheme with some restriction refers to that with $q_t < K-1$ for some $t \in T$. The following results indicates the advantage of non-restricted schemes.

Proposition 4. *(Advantage of non-restricted slots)*
If a steady state with $K-$local trades is successfully realized with a sequential scheme with some restriction, then it is also successfully realized with non-restricted sequential scheme.

Proof. See Appendix A.8. □

Note that the advantage of non-restricted schemes shown in Proposition 4 rests on the assumption of consumers' rational behavior in participating the scheme, as indicated by our proof. Specifically, a consumer who participates in the last period will not have incentive to participate in the first slot if it would collapse the scheme. There, the collapse of the scheme is rationally considered, which might be too strong assumption in reality. To this regard, Section 6 discusses robustness regarding the results shown in this section.

Sequential schemes have apparent limitations in the efficiency in using the budget. First, the receipt of the issuer must be discrete as

$$r^0 \in \{1, 2, .., K-1\}. \tag{31}$$

Second, consumers' receipts must be equal when the receipts come from the same slot, that is, for every $t = 1, 2, .., K-1$,

$$r_t^k = r_t^{k'} \text{ if } r_t^k > 0 \text{ and } r_t^{k'} > 0. \tag{32}$$

Thirdly, the formed tree structure regrading the participation is another source of limitation. To see this together with the former two sources, suppose that $\frac{c}{\gamma} \leq 1$ and that $L^k = 0$ for $k \geq \lceil L^1 \rceil + 2$, where $\lceil . \rceil$ denotes ceiling function. Furthermore, $K - 1 = 1 + \lceil L^1 \rceil + \lceil L^1 \rceil L^2$. Now, let n_t denote the number of applicants for period t under a non-restricted sequential scheme. Then, an equilibrium that successfully realizes a steady state with $K-$local trades is consistent with $n_1 = 1, n_2 = \lceil L^1 \rceil, n_3 = \lceil L^1 \rceil L^2$ with $m^k =_1= 1$ for $k = 2, 3, ..., n_1 + n_2$, where $\sum_{t=1}^{3} n_t = K - 1$. Suppose that there is no loss both concerning the issuer's receipt and the equality of consumers' receipts within each slot, that is, $\left\lceil \frac{c}{\gamma} \right\rceil = \frac{c}{\gamma}$ and $L^k = L^2$ for every $k = 3, 4, ..., \lceil L^1 \rceil + 1$. Then, $\sum_{k=1}^{K-1} L^k = K - 1 - \frac{c}{\gamma} - 1$, where the last term -1 corresponds to the efficiency loss brought by the third source. In general, the loss becomes greater in proportion to the required receipt of the issuer $\left\lceil \frac{c}{\gamma} \right\rceil$. The result on the decomposition of the source of inefficiency discussed above is formally stated for a slightly more general case below.

Proposition 5. *(Efficiency loss for non-restricted sequential schemes)*
Suppose that $K-1=\left\lceil\frac{c}{\gamma}\right\rceil+\left\lceil\frac{c}{\gamma}\right\rceil L^1+\left\lceil\frac{c}{\gamma}\right\rceil L^1 L^{\left\lceil\frac{c}{\gamma}\right\rceil+1}$, *and that* $L^k>0$ *for* $k<\bar{k}$ *and* $L^k=0$ *for* $k\geq\bar{k}$ *with* $\bar{k}:=\left\lceil\frac{c}{\gamma}\right\rceil+\left\lceil\frac{c}{\gamma}\right\rceil L^1+1$, *while letting* $\left\lceil\frac{c}{\gamma}\right\rceil L^1$ *be an integer. Then, non-restricted sequential scheme successfully realizes a steady state with* $K-$*local trades only if*

$$\sum_{k=1}^{K-1}L^k\leq\left(K-1-\left\lceil\frac{c}{\gamma}\right\rceil\right)-\left(\sum_{k=1}^{n_0}(L^k-L^1)+\sum_{k=n_0+1}^{n_0+n_1}(L^k-L^{1+\left\lceil\frac{c}{\gamma}\right\rceil})+\left\lceil\frac{c}{\gamma}\right\rceil\right) \tag{33}$$

with $n_0=\left\lceil\frac{c}{\gamma}\right\rceil$, $n_1=\left\lceil\frac{c}{\gamma}\right\rceil L^1$, $n_2=\left\lceil\frac{c}{\gamma}\right\rceil L^1 L^{\left\lceil\frac{c}{\gamma}\right\rceil+1}$.

Proof. See Appendix A.9. □

Equation (33) demonstrate the efficiency loss for non-restricted sequential schemes compared to a feasible scheme. In the first term of the right hand side of the equation, $\left\lceil\frac{c}{\gamma}\right\rceil$ indicates the loss of $\left\lceil\frac{c}{\gamma}\right\rceil-\frac{c}{\gamma}$. In the second term, $\sum_{k=1}^{\left\lceil\frac{c}{\gamma}\right\rceil}(L^k-L^1)$ shows the loss associated with the equality of the consumers' receipts within the first slot, while $\sum_{k=2+\left\lceil\frac{c}{\gamma}\right\rceil}^{K'}(L^k-L^2)$ shows the corresponding loss concerning the second slot. Finally, the last term $\left\lceil\frac{c}{\gamma}\right\rceil$ indicates the loss associated with the formed tree-structure regarding the numbers of applications across the slots.

5.1 Comparison with simultaneous scheme

We turn to shed a light on positive aspects of sequential schemes. For our purpose, we define a simultaneous scheme that is represented with $(r^0, q_0, (m_0^k, r_1^k)_{k\in K^-})$. As indicated with q_0, the slot for application is available only for period 0. Accordingly, consumers' payments and receipts are specified only for period 0 and 1, respectively. In the scheme, one unit of Home currency is allocated for consumer k with $m_0^k=1$. The issuer's receipt is restricted as $r^0=min(\sum_{k\in K^-}m_0^k,\left\lceil\frac{c}{\gamma}\right\rceil)$. Given the payments, receipts of the consumers are determined in a random manner, that is; for consumer k,

$$r_1^k=\mathbb{1}_{\{m_0^k=1\}}\frac{m_0-r^0}{m_0}. \tag{34}$$

The efficiency loss for simultaneous schemes are demonstrated below.

Proposition 6. *(Efficiency loss for simultaneous scheme)*
Simultaneous scheme successfully realizes a steady state with $K-$*local trades only if*

$$\sum_{k=1}^{K-1}L^k\leq(K-1-\left\lceil\frac{c}{\gamma}\right\rceil)-\sum_{k=1}^{K-1}(L^k-L^1). \tag{35}$$

Proof. See Appendix A.10. □

Comparison between Propositions 5 and 6 clarifies the advantage of non-restricted sequential scheme in bringing smaller loss regarding the differences on L^k through providing multiple timings for applications.

6 Robustness

This section examines the robustness of the results shown in Section 5. As already mentioned, successes of non-restricted scheme tends to depend on our strong rationality assumption on consumers' behavior. Particularly, a non-restricted sequential scheme might be no more successful when consumers no more rationally expect the collapse of the scheme when deviating.

To elaborate the fragile nature of the success of a non-restricted sequential scheme, we first define the concept of pivotal. If a sequential scheme successfully realizes a steady state with local trades, then a consumer in the sequence is said pivotal when there is no equilibrium in which the consumer applies in some earlier round to gain a larger receipt while the others' applications are unchanged.

We start by the following result.

Lemma 6. *(Pivotal)*

If a steady state with $K-$local trades is successfully realized with a non-restricted sequential scheme, then a consumer who applies in the last round is always pivotal

We discuss robustness by assuming certain optimism. For this purpose, suppose that given tentative applications for a sequential scheme, each consumer believes that existing applicant ions will be maintained even if the consumer changes the decision.[20] Still, the consumer rationally expects that the scheme will collapse when an excess number of applications occurs for arbitrary slot.

Given this optimism, the following result indicates that the pivotal consumers under the case of rationality would tend to change their applications, which makes the scheme hard to be successful.

Lemma 7. *(Applications under optimism)*

Under optimism, if a non-restricted scheme successfully realizes a steady state with $K-$local trades, then

$$n^0 = K - 2 \text{ and } n^1 = 1. \tag{36}$$

Lemma 7 indicates the following result.

[20]This way of introducing limitation of rationality resembles level k thinking in game theory, though the current model is not strictly framed as a game. For level k thinking, see, for example, Crawford, et al (2013).

Proposition 7. *(Efficiency loss under optimism)*

Under optimism, non-restricted scheme is not able to successfully realize a steady state with $K-$local trades if

$$\sum_{k=1}^{K-1} L^k \leq (K-1-\left\lceil \frac{c}{\gamma} \right\rceil) - (K-\left\lceil \frac{c}{\gamma} \right\rceil + \sum_{k=1}^{n_0} L_1 - L^k). \tag{37}$$

In equation (37), $K-\left\lceil \frac{c}{\gamma} \right\rceil$ in the second term shows the loss associated with the early applications, while $\sum_{k=1}^{n_0} L_1 - L^k$ corresponds to the loss associated with diversity of L^k among applications in the first slot.

In the face of the indicated stark fragility of non-restricted sequential scheme, we turn to examine fragility of restricted sequential schemes. The following result indicates a robust feature of restricted schemes.

Proposition 8. *(Robustness of restricted schemes)*

Suppose that under rationality, there exists a non-restricted sequential scheme that successfully realizes a steady state with $K-$local trades. Then, under optimism, there exists a restricted sequential scheme that successfully realizes a steady state with $K-$local trades.

Thus, the nature of efficiency loss discussed under rationality is maintained under optimism when we take an appropriate restricted sequential scheme.

7 Concluding remarks

This article investigates decentralized scheme in introducing a community currency. Particularly, the effectiveness and limitation of sequential fund transfer scheme is examined. The analysis establishes potential effectiveness of sequential fund transfer scheme under a stylized setting. The robustness analysis indicates that certain fine tuning might be necessary in realizing the effectiveness. There is limitation in the generality of our results considering our limited focus on the role of community currency. This line of investigation is a remaining task for future works.

A Appendix

A.1 Proof of Lemma 1

Suppose that the condition shown in the lemma is satisfied. We focus on an equilibrium in which Global currency is used as the payment method, Note that every seller has an incentive to receive global currency given the belief that Global currency is used as the payment method in any future. Now, given the condition, consumer $i \in I_1^{H,1}$ chooses

to buy type K outside good rather than the corresponding local good. Since consumer $i \in I_1^{F,1}$ also chooses to buy type K outside good, their choices are consistent with the relevant purchase availabilities. In the same logic, every consumer of type $k = 2, 3, .., K-1$ in the first generation buys type $k-1$ outside good. Also, given the purchases of type 1 consumers in the first generation, it is true for type K consumers in the first generation.

Now, take some integer n. Suppose that for some k, each consumer $i \in I_{nK+k}^{d,k}$ for $d \in \{H, F\}$ holds one unit Global currency and buys type $k-1$ outside good. Then, each consumer $i \in I_{(n+1)K+k-1}^{d,k-1}$ holds one unit of Global currency. Each consumer chooses to buy type $k-2$ outside commodity good, which are consistent with the purchase availabilities. For the same n, this is true for every $k = 1, 2, .., K$. This prove the existence of an equilibrium that realizes a steady state with global trades.

For the revere direction, suppose that $\theta \leq v(1) - \phi v(0)$. Now, suppose that for some t, $X_t^H = 0$. Take k such that type k consumer dies in period t. Then, consumer $i \in I_t^{H,k}$ always choose to buy type K local good. Given that the seller sells to local purchasers before outside purchasers, this is consistent with the purchase availability. Thus, there is no steady state with global trades that is attained by an equilibrium. This concludes our proof.

A.2 Proof of Lemma 2

We maintain to focus on an equilibrium in which Global currency is used as the payment method, Suppose that the conditions in the lemma are satisfied. For each type $k \leq k$ Home consumers in the first generation, the consumer faces the condition $\theta \leq v(k') - \phi v(k'-1)$, and thus, chooses to buy local commodity good of the corresponding type, which is consistent with the purchase availability. For each type $k' > k$ Home consumer in the first generation purchases outside commodity good since each consumer faces the same condition $v(k'+1) - \phi v(k') < \theta$.

For type $k' \leq k$ Home consumers in the second and later generation, each face the condition $\theta \leq v(k') - \phi v(k'-1)$, and thus, chooses to buy local commodity good. Meanwhile, each type $k' > k$ Home consumer faces the same condition as that in the first generation. Thus, an equilibrium realizes a steady state with $k-$local trades.

For the reverse direction, first for some type $k' \leq k$, suppose that $\theta > v(k'+1) - \phi v(k')$. Then, $X_t^H < k'$ for every $t = 1, 2, ..$ since any Home consumer who faces $X_{t-1}^H = k' - 1$ chooses to buy outside good. Next, suppose that $\theta \leq v(k+1) - \phi v(k)$. Also, suppose that a steady state is attained in some period t in which type $k' > k$ dies. Note that if an equilibrium attains a steady state with $k-$local trades, then $x_i^{k+1,H} = 1$ for every consumer i in Home domain of type $k' = 1, 2, .., k$ for every period. Then, type k' Home consumer in the period always choose to buy local good, which breaks down the steady state. This completes our proof.

A.3 Proof of Lemma 3

From the definition of a steady state, we are suffice to examine the consumers' choices from period $t = 2$ on. Suppose that the conditions shown in the lemma are satisfied. Then, type $k' \leq k$ Home consumer in the second generation faces the condition of $\theta \leq v(k) - \phi v(k-1)$. Given the condition, each consumer always choose to purchase local good. Meanwhile, type $k' > k$ Home consumer in the second generation faces the condition $\theta > v(k+1) - \phi v(k)$, and thus, chooses to buy outside good. The situation is the same for Home consumers in the third generation and later.

For the reverse direction, suppose that a steady state is maintained until period t in which type k' consumers die. First suppose that $k' \leq k$ and $\theta > v(k) - \phi v(k-1)$. Then, type k' Home consumer faces $X_t^H = k-1$, and thus, the consumer no more purchases local good, which collapses the steady state. Next, suppose that $k' > k$ and $\theta \leq v(k+1) - \phi v(k)$. Then, type k' Home consumer faces $X_t^H = k$, and thus, the consumer no more purchases outside good, which collapses the steady state. This completes our proof.

A.4 Proof of Proposition 2

For some $1 \leq k \leq K-1$, suppose that some feasible scheme realizes an equilibrium that attains a steady state with $k-$local trade. Observe that the consumers in the second and the following generations hold either one unit Global or Home currency, since each consumer in the first generation is to pay one unit of either currency to buy commodity goods and use the remaining amount to buy luxury goods. Now, in the steady state, at least 1 unit of Home currency is circulated within a generation, since otherwise there is no way to start a consumption of local goods and once started, Home currency will continue to circulate. In the steady state, let type k' Home consumer uses Home currency in period t. Then, the type $k'-1$ consumer who receives the Home currency will purchase goods in period $t+K-1$. The consumer will face $X_t^H = k$ from the definition of a steady state. Here, the conditions for the sustainability of a steady state shown in Lemma 3 indicate that the consumer will choose to purchase outside goods. This contradicts with the receipt of Home currency in period t. This indicates that any use of Home currency in the first generation had not been realized.

A.5 Proof of Proposition 3

Suppose that equation (26) is satisfied. Then, we can take a feasible scheme such that $r^0 = \frac{c}{\gamma}$ and $r^k \geq L^k$ for every $1 \leq k \leq K-1$ by letting $m^k = 1$ for every $1 \leq k \leq K-1$. It is because $\sum_{k=1}^{K-1} m^k = K-1$. Here, take such a feasible scheme. From the definition of L^k, the incentive condition for the sellers shown with equation (21) is satisfied. Given the currency allocation brought by the scheme, each consumer of type $k \in K^-$ purchases local goods, as already discussed. Given these purchases, type K consumer of the first generation faces the history of $K-1$ local trades. Since a steady state with $K-$local trades is assumed to be sustainable, the consumer also purchases local goods. Since every

following Home consumer faces the same history, a steady state with $K-$local trades is actually realized in an equilibrium.

For the reverse direction, suppose that equation (26) is not satisfied. Then, there must exist $k \in 0 \cup K^-$ such that $r^k < L^k$. If $k = 0$, then the issuer will not issue. if $k \in K^-$, the consumer k will not participate to the scheme and purchases outside commodity goods. Thus, $H_t^H < k$ for every $t \geq 1$, which contradicts with a steady state with $K-$local trades. This completes our proof.

A.6 Proof of Lemma 4

i) We first show for given arbitrary $0 \leq \phi \leq 1$, $mv(,)$ is either monotonically increasing or has a unique local maximum with monotonicity. From our assumption of S-shape of $v(.)$, we can take y^* such that $v''(y^*) = 0$ with $v''(y < y^*) > 0$ and $v''(y > y^*) < 0$.
i-1) First, for the case of $y < y^*$, we have $mv'(y) > 0$. Now, $mv'(y) = v'(y) - \phi v'(y-1) \geq v'(y) - v'(y-1)$ since $v'(y < y^*) > 0$. Since $v''(y < y^*) > 0$, we have $v'(y) - v'(y-1) > 0$. Thus, $mv'(y) > 0$.
i-2) For the case of $y^* \leq y \leq \bar{K}$, we proceed to show $mv''(y) < 0$. Observe that $mv''(y) = v''(y) - \phi v''(y-1)$. Since $v''(y) \leq 0$ for $y^* \leq y \leq \bar{K}$, $mv''(y) \leq v''(y) - v''(y-1)$ for $y^* \leq y \leq \bar{K}$. For $y = y^*$, $mv''(y) < 0$ since $v''(y) = 0$ and $v''(y-1) > 0$. For $y^* < y < y^* + 1$, $mv''(y) < 0$ since $v''(y) < 0$ and $v''(y-1) > 0$. For $y = y^* + 1$, $mv''(y) < 0$ since $v''(y) < 0$ and $v''(y-1) = 0$. For $y^* + 1 < y \leq \bar{K}$, we have $v''(y) < 0$ and $v''(y-1) < 0$. Here, $v''(y) < v''(y-1)$ since $v'''(\tilde{y}) < 0$ for $y^* < \tilde{y} \leq \bar{K}$. Thus, $m''(y) < 0$ for the case of $y^* \leq y \leq \bar{K}$.

The parts of i-1) and i-2) above proves that there exists at most one maximum point. If it exists as $mv'(y = \hat{y}) = 0$, then $y > y^*$. Furthermore, $mv'(y < \hat{y}) > 0$ and $mv'(y > \hat{y}) < 0$.

ii) We proceed to show that there exists $\tilde{\phi}$ such that $mv(y; \phi)$ is monotonically increasing with respect to y for $\phi < \tilde{\phi}$ and has unique maximum for $\phi \geq \tilde{\phi}$.
ii-1) For $\phi = 1$, $mv'(y; \phi = 1) = v'(y) - v'(y-1)$. Observe that $mv'(y = y^* + 1; \phi = 1) < 0$ since $v'(y^* + 1) < v'(y^*)$. Thus, there exists some $y^* \leq y < y^* + 1$ such that $mv'(y; \phi = 1) = 0$.
ii-2) For $\phi = 0$, $mv'(y; \phi = 0) = v'(y)$. Since $v'(y) > 0$, $mv'(y; \phi = 0) > 0$.
ii-3) Here, we prove the existence of $\tilde{\phi}$. Take some ϕ such that $mv'(y; \phi) > 0$ for every y. Then, for arbitrary $\phi' < \phi$, $mv'(y; \phi) > 0$ for every y since $mv'(y; \phi)$ is decreasing with respect to ϕ for each y. Conversely, take some ϕ such that there exists $\hat{y}(\phi)$ such that $mv'(\hat{y}(\phi); \phi) = 0$. Then, for arbitrary $\phi' > \phi$, there exists some $\hat{y}(\phi')$ such that $mv'(\hat{y}(\phi'); \phi') = 0$. It is because $mv'(y = y^*; \phi') > 0$ and $mv'(y; \phi')$ is decreasing with respect to ϕ' for each y, and $mv'(y; \phi')$ is decreasing with respect to y for each ϕ'.

A.7 Proof of Lemma 5

Lemma 4 indicates that L^k is decreasing or there exists k^* such that $L^{k-1} > L^k$ for $k \leq k^*$ while $L^k < L^{k+1}$ for $k \geq k^*$. When a steady state with $K-$local trade is sustainable, we have $L^K < 0$. This indicates that there exists $\hat{K}$ such that $L^k > 0$ for $k \leq \hat{K}$ and $L^k = 0$ for $k > \hat{K}$.

A.8 Proof of Proposition 4

Suppose that a steady state with $K-$local trades is successfully realized with a sequential scheme with some restriction. Then, Lemma 5 indicates that each consumer of type k in the first generation who participates the scheme receives at least L^k units of global currency together with one unit of Home currency, while $L^k = 0$ for those who does not participate. Observe that each consumer in the first generation is better off under the successful scheme compared to an equilibrium under no existence of the scheme. Now, suppose we remove any restriction on the slots. Since any consumer has no incentive to make an alternative decision regarding the participation and slot selection that leads to collapse the scheme, the same steady state is always realized with non-restricted sequential scheme.

A.9 Proof of Proposition 5

Given a candidate $\{n_t\}_{t=0,1,...,T}$, let $k_t := \max_{k \in K'} L^k$, where $K' = arg_{k'}(m_t^{k'} = 1)$. Then, $n_k \geq n_{k-1} L^{k_{k-1}}$ for $k \geq 1$. Given that type $k = 1$ dies in period 1, $k_1 = 1$. Then, $n_1 \geq n_0 L^1$ and $n_2 \geq n_1 L^{k_1}$. If $n_0 > \left\lceil \frac{c}{\gamma} \right\rceil$, then $n_0 + n_1 > \left\lceil \frac{c}{\gamma} \right\rceil + \left\lceil \frac{c}{\gamma} \right\rceil L^1$. Thus, $n_0 = \left\lceil \frac{c}{\gamma} \right\rceil$. Then, $k_1 = L^{\lceil \frac{c}{\gamma} \rceil + 1}$. If $L^k = L^1$ for $k \leq n_0$ and $L^k = L^2$ for $n_0 < k \leq n_0 + n_1$, then, Efficiency loss is demonstrated as $\sum_{k=1}^{K-1} = K - 1 - \left\lceil \frac{c}{\gamma} \right\rceil - \left\lceil \frac{c}{\gamma} \right\rceil$, where the last term $\left\lceil \frac{c}{\gamma} \right\rceil$ shows the loss associated with the tree structure of the corresponding application. Equation (33) is brought immediately when the losses associated with respect to the difference of L^k among the applications within the same slot are incorporated.

A.10 Proof of Proposition 6

Given our maintained assumption on $v(.)$, $L^k \leq L^1$ for every $k \in K^-$. Then, simultaneous scheme is successful only in $L^1 \leq \frac{K-1-\left\lceil \frac{c}{\gamma} \right\rceil}{K-1}$ Thus, $\sum_{k=1}^{K-1} L^k \leq (K-1)L^1 - \sum_{k=1}^{K-1}(L^k - L^1) = (K - 1 - \left\lceil \frac{c}{\gamma} \right\rceil) - \sum_{k=1}^{K-1}(L^k - L^1)$.

A.11 Model for the specifications of $v(.)$

We have assumed that $v(.)$ represents community value that is experienced through accessing to community capital. We can interchangeably regard $v(.)$ as the size of community capital. Now, we capture the formation of community capital with the following

$$\frac{dV}{dn} = rV(1 - \frac{V}{\bar{V}}), \tag{38}$$

where V corresponds to the formed community capita, $0 < r < 1$ indicates synergy effect and $\bar{V} > 0$ sets the maximum possible community capital. While the synergy effect is captured with r, the term $(1 - \frac{V}{\bar{V}})$ indicates the countereffect that could be referred to as the duplication effect. Remember that we regard community capital as the community relevant contents. As the accumulation of community capital goes on, duplication would occur more frequent in forming community capital, for which any duplication does not contribute to the accumulation.

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Abstracts need to be written in English, the length of the abstract needs to be between 170 and 500 words. Keywords must be included.

Critical issues in the institutional design of digital community currencies: A comparative analysis

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Keywords *community currencies; digitalisation; institutional design; local stakeholders; stability; sustainability*

Abstract:
The increasing shift towards digitalisation in providing social benefits and welfare aid is reflected in literature and emphasises the catalyst role of G2P-payments and digital vouchers to increase the outreach of social transfers to entitled households in remote areas in general and mitigate detrimental effects in times of crises as for instance during the recent pandemic (Gentilini et al., 2021; Sahay et al., 2021). In contrast, there is little discussion on digital community currencies, yet. The aim of this paper is to identify success factors and stumbling blocks in the design of digital community currencies. First, we provide an overview of existing digital community currency systems, distinguishing them from other notions in the field (e.g. money, social currency, voucher), which are often erroneously used interchangeably. Second, based on the existing literature for both analogue and digital community currencies (for instance Blanc, 2011; Diniz et al., 2019), we identify institutional features crucial for the stability and sustainability of community currencies. To those features belong issues of convertibility, lasting acceptance of community currencies by local traders, SMEs and municipal public institutions, the governance of the system and the involvement of local stakeholders. Digital community currencies can be challenging from a regulatory point of view in case of e-wallets or from a technical point of view in case of blockchain-based versions. Thus, in contrast to analogue community currencies, capacity building to empower local stakeholders is an additional requirement. Furthermore, we suggest community-related benefits as seignorage and automatic contributions to community funds as means of redistribution and outreach to those who abstain from the system. Finally, we offer insights how selected digital community currency systems addressed these features to ensure their operation. The paper uses a comparative analysis with five still existing community currency systems of which four belong to the Global South as MonedaPar from Argentina, Mumbuca E-dinheiro from Brazil, Sarafu credit from Kenya

and Sikka in Nepal. Besides supplementary discussing WIR from Switzerland, we also portray the institutional features of the brand-new digital community currency in the North-West Region of Cameroon; the latter is only introduced in summer 2022 and thus not discussed at all in literature, yet (GIZ 2022). Our findings have important policy implications, particularly for communities intending to introduce their own digital community currency.

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Municipal currencies in Brazil: potentialities and limits beyond the case of Banco Mumbuca (RJ)

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ABSTRACT:

Community banks in Brazil are solidarity practices which started with the Banco Palmas experience. This first bank establishes its own methodology for organization and local development based on the solidarity economy (SINGER, 2004). In this context, the bank must be managed by its own community and must support local enterprises with little or no technical organization and capital, called by Santos ([1975] 2008) as a lower circuit, to generate local development. They usually operate with credit for consumption (with interest-free local community currencies at parity with the national currency) and credit for local production.

Community bank experiences have reached the number of 147 initiatives in Brazil, based on this methodology presented, which have spread throughout the Brazilian territory supported by federal public policies, called solidarity finance (2006 and 2015). Without the support of the federal government, the Brazilian Community Banks Network (BCBN), the main articulator of these local solidarity experiences, has sought alternatives for financial self-sustainability. With the regulation of electronic money use in Brazil (federal law 12.865/2013), BCBN started considering the possibility of maintaining community banks with revenues coming from a digital platform (E-dinheiro).

In 2013, BCBN made its first public partnership with the municipality of Maricá (RJ), using a digital currency as a basic income program and creating a municipal community bank. We propose to discuss the recent movement that is underway in Brazil, which expands experiences of digital municipal currencies managed by BCBN, based on the case of Banco Mumbuca (RJ), the first and most consolidated experience in Brazil. The data presented was collected between 2018 and 2022, resulting from participant observations, semi-structured

interviews with actors involved in the implementation and management of community banks, analysis of public documentation and literature review.

As theoretical assumptions, we start from the contributions that observe the solidarity economy as democratic and cooperative processes built from the decisions and needs of communities (SINGER, 2004; GAIGER, 2000; CORAGGIO, 2007). Public policies in this field can present broad local development results if they obtain co-production effects between communities and municipal governments. The concept of translation, based on Actor Network Theory (or Sociology of Translation), will be the basis for narrating the shifts in legislation and methodologies (of coins and community banks) between different territories.

In this process of expansion of municipal digital currencies by BCBN, tensions between governments and fundamental solidarity economy principles of community banks can be noticed. The Mumbuca case is paradigmatic because it brought about a coexistence between solidarity economy, local development and public policy. The 10 new Brazilian experiences analyzed - notably the Arariboia case, in the municipality of Niterói (RJ) - indicate that the municipal government may not be attentive to the needs of the communities or taking advantage of synergies that already exist in the municipalities, distancing itself from the guiding principle of the solidarity economy. Therefore, it is necessary to create an agenda so that the co-participation between community actors and public authorities is effective, contributing for the expansion of the methodology of existing community banks.

Keywords (*Community Development Banks; Public Policy; Solidarity Economy; Digital currencies* **)**

1. Introduction

Community Development Banks, in Brazil, are solidarity finance institutions, traditionally managed by communities through a self-management approach, with the objective of financial inclusion, enabling socioeconomic development in peripheral areas. Its performance generally unfolds on two fronts: i) provision of microcredit at low interest rates for small producers and local traders (production) and for families (consumption); ii) issuance of social currencies (backed in reais) whose circulation is restricted to the region where the bank operates, strengthening local consumption and enabling development.

Such organizations may be supported by NGOs, companies and local governments, being mostly community associative entities, located in impoverished peripheries of Brazilian cities (FRANÇA FILHO, SILVA JR, RIGO, 2012, p. 504). It is worth emphasizing, therefore, that community banks, in general, are institutions embedded in the economy and sociability of the places where they operate, with a democratic management and social activism characteristic that goes beyond finance - although these are an important pillar. These solidary finance institutions are spread across the national territory in all five Brazilian regions, where there are currently approximately 150 community bank initiatives, part of BCBN (PUPO, 2022).

In 2013, Brazilian Community Banks Network (BCBN) made its first municipal partnership with the municipality of Maricá (RJ), using a digital currency as a basic income program and creating a municipal community bank. We propose to discuss the recent movement that is underway in Brazil, which expands experiences of digital municipal currencies managed by BCBN, based on the case of Banco Mumbuca (Maricá, RJ) - the first and most consolidated experience in Brazil.

The community banks methodology is based on the premise that no territory is poor *a priori*, but becomes impoverished because it loses its local savings, as stated by one of its founders, Joaquim Melo (QUEM..., 2014). In the early 2000s, local paper currencies went through a legal process, being allowed to circulate in the neighborhoods where community banks are located, since they were “parallel currencies” and could incite a decrease in national sovereignty (CAMINHA E FIGUEIREDO, 2011). However, there was an understanding of these local currencies as a promotion bonus and not as a promise of payment, allowing their existence, even though there was no specific legal framework for their regulation.

With the political instability that Brazil experienced and that culminated in the impeachment of President Dilma Roussef, the Solidarity Economy Secretariat (SENAES) - responsible for operating and increasing the number of community banks in the country - began to stop

supporting CDBs initiatives, In this way, the CDBs members felt the effects of the lack of federal support: the BCBN, the main articulator of these local solidarity experiences, has then sought alternatives for financial self-sustainability. With the regulation of electronic money use in Brazil (federal law 12.865/2013), BCBN started considering the possibility of maintaining community banks with revenues coming from a digital payment platform (E-dinheiro). This system allows the survival of dozens of CDBs by transferring 1% of the taxes charged when a client makes a payment.

Figure 1 - E-dinheiro card. Source: Carolina G. de Paula Pupo, 11/7/2018. . For the customer to purchase it, it is necessary to pay the amount of R$8.00. Note the "Near Field Communication" system in the lower right corner.

The Institute integrates the coordination of BCBN and represents at the Central Bank of Brazil (BACEN) for the purposes of law 12.865/2013. Such digitization was seen as an opportunity for the sustainability of CDBs, as it was anchored in legislation that allowed institutions not participating in the Brazilian Payment System (SPB) to manage means of payment (as long as they were electronic and backed in Real), guaranteeing a previously non-existent legal stability (FARIA, 2018) (PUPO, 2022)[1].

The ways in which social currencies are put into circulation have taken different forms in the history of community banks CDBs. In addition to the productive and consumption microcredit,

[1] It is worth mentioning that BNCB is also supported by the microcredit legislation: Banco Palmas has a legal entity (Instituto Palmas) which allows it to operate microcredit, and is also registered with the PNMPO (National Program for Oriented Productive Microcredit), enabling the institution to operate public resources for microcredit (MELO, 2018) - the PNMPO "was established by Law No. 11,110, of April 25, 2005". More at <http://portalfat.mte.gov.br/programas-e-acoes-2/programa-nacional-do-microcredito-produtivo-orientado pnmpo/>. Accessed on 16 Aug. 2018. It should also be noted that in other countries there are laws that explicitly support "social" currencies, even if not electronic, as in the French case.

the social currency has allowed the payment for repairing Banco Palmas building (Fortaleza CE), the purchase of waste from collectors/carriers by Fortaleza municipality (CE) and the management of the payment of a social benefit from a city hall (Banco Mumbuca, Maricá, RJ), all of them being ways of bringing social currencies into circulation.

Banco Mumbuca - located in Maricá (RJ) - has so far had the most impact among BCBN, from the point of view of resources involved in the circulation of community banks' social currencies. It inaugurates the recent process of expansion of municipal digital currencies by BCBN, where tensions between governments and fundamental solidarity economy principles of community banks can be noticed. The Mumbuca case is paradigmatic because it brought about a coexistence between solidarity economy, local development and public policy - we will go through this case in section three of this paper.

Also, the Banco Araribóia case must be highlighted. Created by the municipality of Niterói (RJ), its social currency circulates on a territory where another CDB has already worked for more than ten years (Banco Preventório) – we will describe this case in section four. Subsequently, we will discuss initial lessons learned from the collected data, which briefly indicates that the municipal governments may not be attentive to the needs of the communities or taking advantage of synergies that already exist in the municipalities, distancing itself from the guiding principle of the solidarity economy. We will begin this journey by describing methodological aspects of this research, in the next section.

2. Community banks and social currencies: theoretical debates about their territorial and solidarity meanings

As theoretical assumptions, we start from the contributions that observe the **solidarity economy** as democratic and cooperative processes built from the decisions and needs of communities (SINGER, 2004; GAIGER, 2000; CORAGGIO, 2007). In other words, the solidarity economy must value socially excluded populations, emphasizing cooperation, the establishment of new production relations, environmental concerns and the social sharing of the means of production. In this way, opportunities for equal participation would be created for all those involved and the logic of cooperation would override the logic of competition (SINGER, 2004). In this sense, we consider the social currencies analyzed here to be part of the solidarity economy field.

According to Soares (2009), social currencies are a set of alternative monetary means that originate from the economic and social needs of certain communities and that, for this very reason, do not necessarily require the issuance and state regulation, being the mutual trust between its users its organizational substrate (SOARES, 2009). Additionally, they can be analyzed as local devices oriented towards the socio-environmental sustainability of the

territories involved. For this, such networks reinvent features of modern money, such as its issuing entities and interest associated with them, seeing it as a common resource (OSTROM, 2011). In addition, we consider that currency and markets are institutions that exist in an embedded way in society (POLANYI, 2012). In this way, the construction of local currency systems by the agents involved gives them a purposeful character, that is, to establish a market - and its corresponding monetary environment - aimed at achieving social, cultural, environmental and economic objectives of the locality in question.

There is a relative consensus among social currencies researchers that they partly represent responses to the advent of globalization (PACIONE, 1999; BÚRIGO, 2011, PUPO, 2022). In this sense, they constitute not only an appeal for communities to recover over their territories (FARE, FREITAS and MEYER, 2015) but also a symbolic way of contesting the power of the financial market and the control of money by banks (INGHAM, 2002). In other words, the globalization of markets removes the protection and interdependence that small producers had in relation to their small economic spaces. The geographic position no longer guarantees markets for local producers who now compete with global transport and information networks and which therefore allow the arrival of products from other corners. This is why, thinking about social currencies - and, perhaps, about solidarity economy in a comprehensive way - demands a new concept of local development, which must encompass the mobilization of different resources coming from the public, private and civil society sectors. In other words, the construction of local solidarity networks can be allied to public policies as long as they guarantee co-production between community agents, companies, local governments and public-private structures on a national or even global scale (EVANS, 2008; OSTROM et al. , 2001).

Hart (2006) follows a similar reasoning when defending that the social currency is a device that can precede a truly democratic society. As money is one of the most important economic institutions in society, its control by communities deepens democracy, by increasing the access of the poorest people and regions to this instrument.

Thus, democracy would be achieved not only through political formalities, but through access to the market and actual consumption. More than that, via a decentralization of monetary power and of the decision-making process for the production and circulation of goods and services. In this sense, social currencies are also under the concept of solidarity finance, a term that roots the granting and management of microcredit in values such as trust, solidarity and proximity. In this sense, Community Development Banks (CDBs) - so typical of Brazil - are hybrid institutions in which the issuance of social currencies coexists with the granting of credits in official money. Well then: the economic logic in creating a bank of this type, therefore, bows to the imperatives of such solidary values. This means that proximity and a

sense of community are issues that define the issuance of credit, since the purpose is financial inclusion and appreciation of the local economy and territory. In other words,

> (…) the bank must be created in response to an intrinsic desire of the community, even when external agents contribute to this by motivating and mobilizing this community. The process of implementing a CDB [Community Development Bank] must begin with a genuine community desire. In any event, some requirements must be met, such as financial capital for a credit fund; financial resources to cover the bank's operating expenses; a community organization (association, board, council, etc.) that can manage the bank; people trained for the roles of loan officer and credit manager; and support for the assimilation of the new technology by the community. These steps describe how many CDBs have been created: through a process of institutional partnerships involving supportive organizations (such as university incubators and Non-Governmental Organizations - NGOs - specialized in this field) and funding institutions (municipalities, state governments, government departments, foundations, etc.) (FRANÇA FILHO, SILVA JR, RIGO, 2012, p. 504).

Local currencies are a key CDBs characteristic. Concerning them, August Corrons (2017, p. 71) adopts the terminology "complementary currencies", whose main objective would be to "improve the social well-being of communities", and lists what the four types of complementary currencies would be: time banks, mutual credit systems, local currencies and barter markets (trueque). Time banks would be the most common form of complementary currency for Corrons (2017, p. 70), gathering 50.2% of the experiences. The second most numerous typology today would aggregate mutual credit systems, where members of a community disclose their offers and demands (with an accounting system that records transactions), with 41.3% of the total. For Jerome Blanc (2013), both systems would compose a generation of social and complementary currencies with significant growth in the 1980s.

Added to these is a "Latin American translation" (BLANC, 2013), especially in Argentina in the 1990s, the barter markets: "aimed at overcoming the scarcity of money and facilitating exchanges in a group of users, generally in a regular market", less frequent (1.4%) worldwide. The social currencies of Brazilian CDBs would be located in the field of local currencies, "monetary systems geographically delimited to a region" - the third most frequent typology, with 7% of the total. It is worth mentioning that, if we follow the classification "by generations", proposed by Jérôme Blanc, they would be part of a generation, born in the nineties, with an "economic ambition" different from those of the eighties (BLANC, 2013).

CDBs and their social currencies characteristics, described above, have undergone significant changes, both in their digitization process (FARIA, 2018) and in the experiences promoted by local governments, generally for the payment of social benefits, such as we will see in the next two sections with Banco Mumbuca and Banco Araribóia. Thus, as Brazilian social currencies become instruments of public policies, we perceive significant changes in

the networks of actors connected to them. We were inspired by findings from Actor Network Theory (ANT, or Sociology of Translation) as tools to map these differences. Briefly, its perspective is to make visible

> (...) a network of entities of different types, heterogeneous, like a seamless tissue constituted by actors that can themselves be seen as networks – hence, the term actor-network. The usefulness of this approach is shown, for example, when we verify that an a priori technological infrastructure can influence the so-called social relations between the people who manage or use them (directly, the technical influences the social); or when CTS Studies also show us that artifacts have politics (WINNER, 1986), in the sense of incorporating the worldviews of their builders (the social influences the technical); or even when we realize that the materialities of the artifacts make difference, insofar as they do not translate only and exactly into those values and worldviews incorporated therein (the materialities are surprising). (FARIA, 2018, p.131 our translation)

We adopt here Bruno Latour's (1998) terminology of sociogram (sociogram) and technogram (technical characteristics), to describe (provisionally) the digital social currency networks analyzed here, bearing in mind that the analysis of the technogram of an artifact would provide clues to the sociogram that makes up its network (FARIA, 2010), and vice versa (figure 2).

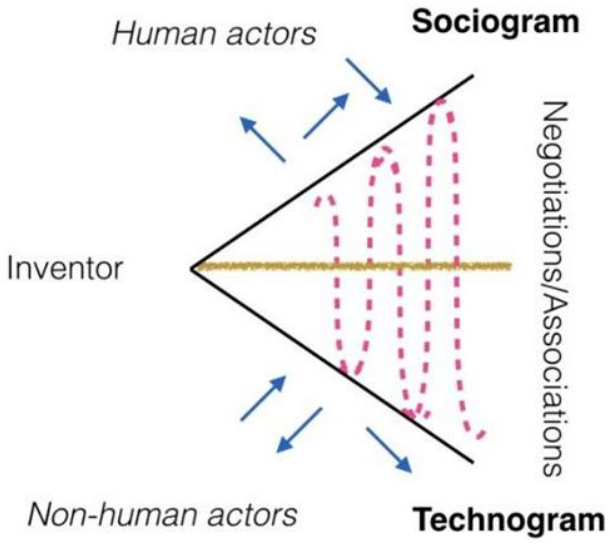

Figure 2 – Socialgram and Tecnogram (adaptation from Latour, 1987)

The concept of **symmetry** is important in this approach: for ANT not only people do act (in the sense of making difference), but also cards, smartphones, paper-money, computers and other artifacts. Also, we dialogue with the ideia of **translation**, when describing the shifts in legislation and methodologies (of currencies and community banks) from one territory to

another - for example, the displacement of facts (such as the CDBs methodology) and artifacts (such as the digital community currency), from what we can call its origin (Banco Palmas) to the different stabilizations of Mumbuca and Araribóia networks.

Finally, the data presented here was collected between 2018 and 2022, resulting from participant observations, semi-structured interviews with actors involved in the implementation and management of community banks, analysis of public documentation and literature review. Among the experiences and materials collected by the authors, the following stand out: organization of the 1st Seminar on Community Public Emergencies and their Citizen Technologies held on March 21[2] and 29[3] 2022, with the Secretariat of Social Assistance and Solidarity Economy of the City of Niterói (responsible for the Araribóia currency), which took part in the discussions "Strengthening community dreams: the microcredit" and "Circulating Local Riches: social currencies", as well as in the opening and closing sessions of the event; participation in the URBE Latin America (Urbe LatAm) project (described in section four), especially in the initiatives to discuss and implement the new microcredit methodology with Banco Preventório, as well as in the "Solidarity course on social currency and microcredit with Preventório", discussing the arrival the Araribóia municipal currency with the bank's members and different associated projects; visits to Banco Mumbuca and Banco Araribóia, participating in semi-structured interviews with six members of the banks; participation in debates during the implementation of Banco Araribóia, with emphasis on a public hearing and a meeting between the local solidarity economy forum and the municipal government.

3. The Mumbuca case: a public policy in dialog with a communitarian approach

In Brazil, the most paradigmatic case of public support for a social currency occurs in the city of Maricá (RJ). There, the municipal government - anchored in revenues from oil exploration - created a legislation that provided the basis for a social assistance program in local currency, known as Mumbuca. Initially, it was a benefit intended for low-income families, in the amount of 85 mumbucas (= R$ 85.00)[4]. According to Souza (2018), until May 2018, the program had a budget of around R$24,000,000.00 per year, which were turned into mumbucas as soon as the municipal government deposited this amount in the users' accounts.

As a result, the impacts on the economy and social life of the city of Maricá were considerable. Also according to Souza (ibid.), there was a significant reduction in poverty

[2] https://www.youtube.com/watch?v=ZW1vm6Du5Qc. Acess on 14 Set. 2022.
[3] https://www.youtube.com/watch?v=RqHAzKpCzEs. Acess on 14 Set. 2022.
[4] Law Nº 2.448, de 26 de junho de 2013. More at http://www.institutobancopalmas.org/wp-content/uploads/lei-moeda-social-mumbuca.pdf

accompanied by an increase in the revenue of local companies which, in turn, were able to hire workers, increasing the level of employment - something difficult to verify in smaller circuits of social currencies.

That is to say, the Mumbuca assistencial program was progressively gaining new modalities, supporting pregnant women and students, and being a minimum income experiment. According to Faria (2018), after initial reports of distrust from merchants, CDB managed to establish a local payment infrastructure. In 2018, the currency materiality was migrated from a magnetic card based platform to the digital platform E-dinheiro (accessible by card, smartphones and web), a change that allowed part of the administrative fees to remain with Banco Mumbuca[5] (figures 3 and 4). This migration was concomitant with the increase in the number of beneficiaries and traders, from just over 100 to over 1000 during 2018[6]. The scenario allowed the CDB to finally start its interest-free microcredit program in electronic social currency.

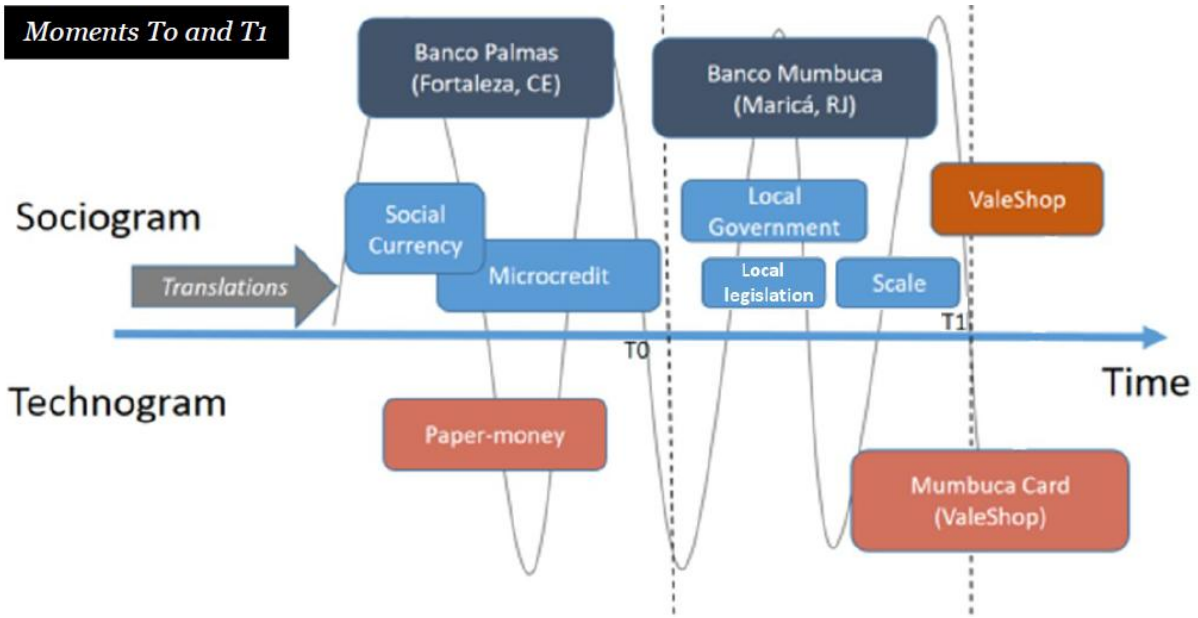

Figure 3 – Represents temporary stabilizations: of the socio-technical network of Banco Palmas (Fortaleza-CE) and of its translation for the first phase of Banco Mumbuca (Maricá-RJ)

[5] The BCBN model generally charges from the merchant 2% of the payment value, on each sale, and 1% on redemption (exchange of local currency for Reais): this revenue is divided between the local CDB and BCBN. In Maricá case, where the municipality pays for expenses such as the rent for the CDB, all revenue remains with CDB Mumbuca.

[6] It is important to point out that, given the extension of the territory, Banco Mumbuca currently has 4 bank branches in the city, in addition to the central one. More in the reports on the circulation of Mumbuca produced by LabIS/UFRJ, at https://is.cos.ufrj.br/producoes/. Accessed on Aug 21, 2020.

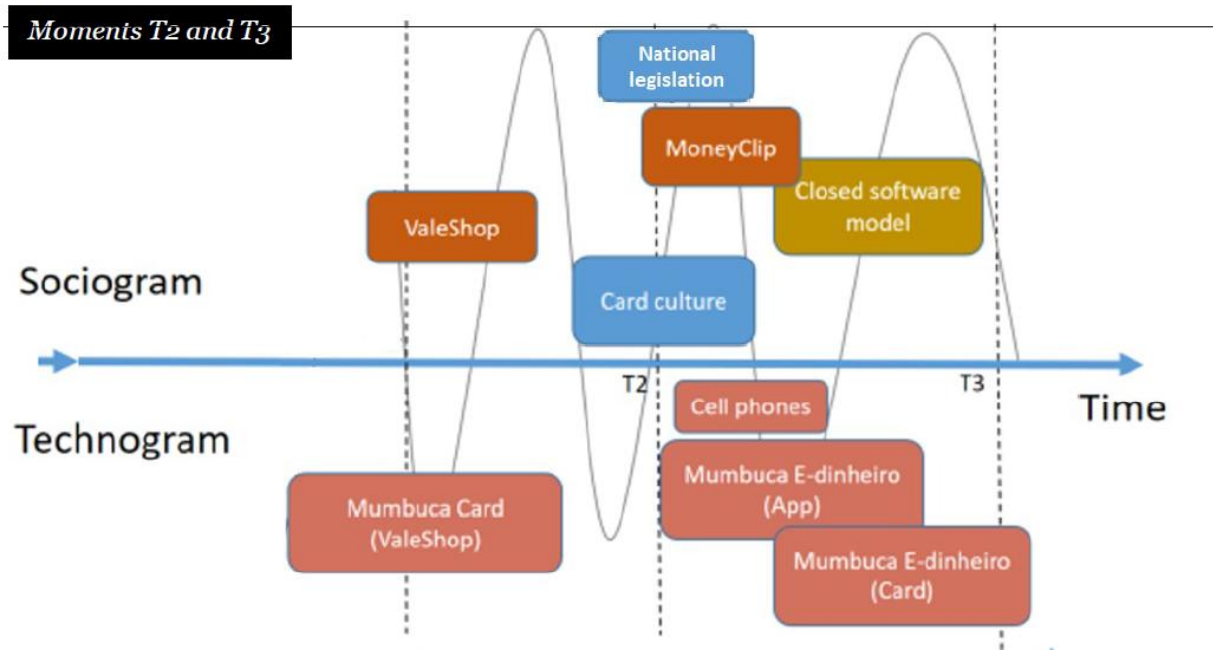

Figure 4 – Represents temporary stabilizations: the change of the technological provider of the digital platform (from ValeShop to MoneyClip). Anchored at the national legislation and at a partnership with MoneyClip, Banco Mumbuca benefited with more resources, enabling a local microcredit program.

Currently, the program has an annual budget of R$ 62 million and covers families that earn up to 3 minimum wages, constituting the main laboratory for the implementation of a basic income plan in the national territory. Its effects so far are remarkable: in addition to the expected reduction in poverty, there is also growth in economic activity, which is expressed in an increase in ICMS and ISS collection of around 15%, while in the rest of the state there was an average drop of 30%[7].

Additionally, there are effects that are manifested in the social and political life of the municipality. Souza (2018) points out that the beneficiaries began to have more confidence in the government and to participate more in the political life of the city. The creation of local institutions, with the strengthening of community ties and the creation of social capital are effects that are largely verified in experiences of social currencies and contribute, to a great extent, to the resilience of territories.

From an organizational point of view, the Mumbuca system proved to be innovative. The origin of social benefits paid in local currency results from public resources collected by the

[7] The spending multiplier effect can result in increased government revenue. If the income received by beneficiaries manages to boost local economic activity, there will be higher tax payments. More information at: BETIM, Felipe. Maricá, no Rio, preserva empregos e negócios na pandemia e coloca a renda básica no centro do debate. **El País.** Maricá, p. 1-2. July 19 2020. Available at: https://brasil.elpais.com/sociedade/2020-07-19/marica-no-rio-preserva-empregos-e-negocios-na-pandemi a-e-coloca-a-renda-basica-no-centro-do -debate.html. Accessed on: 21 Aug. 2020

municipality, mostly from oil royalties. Therefore, it is up to the local government to determine the budget and allocation of resources. At the same time, the Banco Mumbuca is an institution managed by community members and is part of the Brazilian Network of Community Banks. Its performance is based on the promotion of technical expertise and social relations that disseminate knowledge for the construction of new banks, guaranteeing technical and human support. It is therefore a social network that promotes the dissemination of knowledge and the emergence of social innovations (GRANOVETTER, 2007).

The role of the community bank at Maricá is to operationalize the payment of resources to beneficiaries selected by the city government. In other words, it is at the forefront of local currency management, dealing directly with the realities of the territory. In addition to receiving public funds, the bank finances itself through fees generated in the digital social currency payment system itself. That is, most beneficiaries use a mobile phone application to make payments at registered establishments. In short, the local government provides budget resources, while the community bank manages the social currency circuit.

Additionally, it is worth mentioning that the CDB was initially implemented by the Banco Palmas team, a period in which many of the bank customers and employees confused the very identity of Banco Mumbuca with that of Banco Palmas (FARIA, 2018). Currently, we could see that Banco Mumbuca is not only formally an association located in Maricá, but has gained autonomy to analyze strategies, its own lines of microcredit and support for social projects.

4. Arariboia case and new BCBN categories: a municipal bank with a social municipal currency

Perhaps the authors' first approach to Banco Araribóia was through the URBE Latin America project (Urbe LatAm) and Banco Preventório. The project (started in 2020) and community resilience as its main theme and the Preventório community bank (located in Niterói city), as long as its microcredit and social currency iniciatives, as community potentialities. The social currency Prevê was inaugurated with Banco Preventório in 2011, but from 2016 on has barely circulated in the community (FARIA et. al, forthcoming). At the end of 2021, after the most difficult phase of the COVID-19 pandemic, the Preventório community and the project understood that it was time to resume strengthening the circulation of its social currency.

Banco Preventório, unlike Banco Mumbuca and Araribóia, is an experience that did not have significant support from the municipal authorities. As shown in figure 5, its network points to a variety of partnerships (with universities, volunteers, and donors) and actions (such as recycling and cultural projects) that currently help keeping the Bank alive and the microcredit

operation active. This one, it is worth mentioning, was specially remodeled in partnership with the Urbe LatAm project, through online regular discussions during the COVID-19 pandemic.

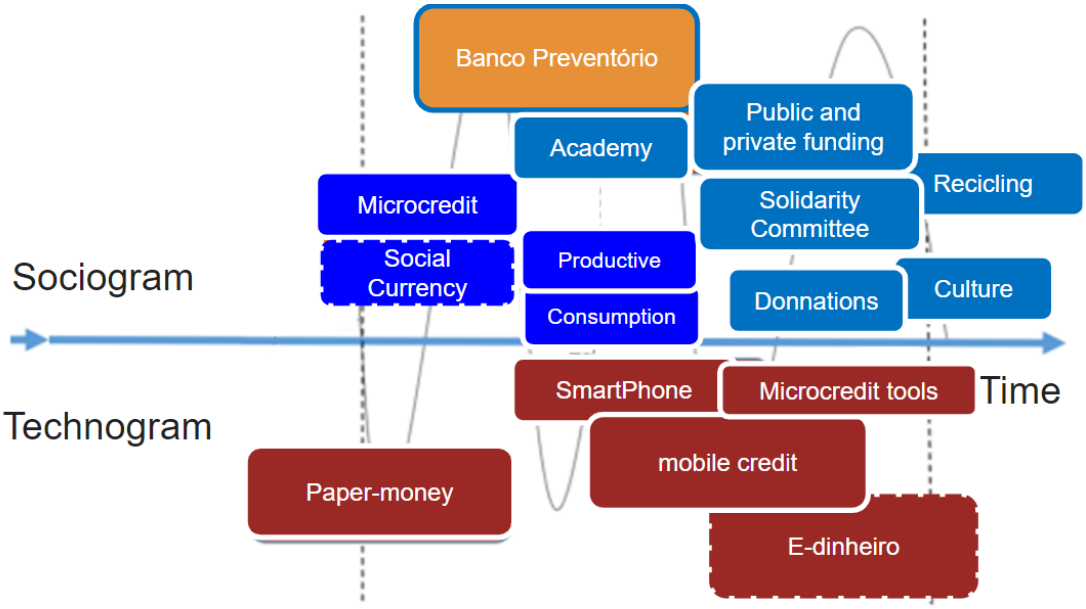

Figure 5 - Provisional stabilization of the socio-technical network of Banco Preventório

In the second half of 2021, the weekly planning online discussions for Preventório microcredit and social currencies continued. On that occasion, the emergence of other complementary currency experiences in the city was identified, notably the municipal social currency Araribóia and the NITE currency (CityCoin project). Regarding the resumption of circulation of Prevê, some steps were defined in the discussions, among them the establishment of a partnership with the Araribóia currency (which would start circulating in January 2022) and training sessions in order to re-discuss social currencies concepts and practices with new and old bank members (FARIA et. al, forthcoming).

The project organized the 1st Seminar on Community Public Emergencies and their Citizen Technologies, held on March 21[8] and 29[9], 2022, motivated by the necessity of dialoguing with the local government. The government Social Assistance and Solidarity Economy Secretariat (responsible for the Araribóia currency) took part in the discussions

[8] https://www.youtube.com/watch?v=ZW1vm6Du5Qc. Accessed on 14 set. 2022.

[9] The Seminar's discussions pointed to extremely interesting opportunities in the sense of articulating the experiences of the Prevê community social currency, the Araribóia municipal social currency and the NITE municipal digital reward currency. As an example, the possibility that citizens who consume products and services from small producers and traders of the solidarity economy, with Araribóias or Prevês, are awarded with NITEs. Another possibility was the partnership between the currency Araribóia and Prevê in the territory where Banco Preventório operates, ensuring that the community identity of Prevê is maintained and strengthened (FARIA et. al, forthcoming). https://www.youtube.com/watch?v=RqHAzKpCzEs. Accessed on 14 set. 2022.

“Strengthening community dreams: the microcredit” and “Circulating Local Riches: social currencies”, as well as in the opening and closing sessions of the event.

The Seminar's discussions pointed to extremely interesting opportunities in the sense of articulating the experiences of the Prevê community social currency, the Araribóia municipal social currency and the NITE municipal digital reward currency. As an example, the possibility that citizens who consume products and services from small producers and traders of the solidarity economy, with Araribóias or Prevês, could be awarded with NITEs. Another possibility was the partnership between the currency Araribóia and Prevê in the territory where Banco Preventório operates, ensuring that the community identity of Prevê is maintained and strengthened (FARIA et. al, forthcoming).

During the event, it became clear that the Arariboia currency, on the one hand, was the result of the articulation of community banks (as stated by Joaquim Melo himself, one of the founders of the pioneer Banco Palmas) and their “community social currencies” around the BCBN. On the other hand, Arariboia was also the result of BCBN’s move to approach local governments in order to compete in the electronic payment market forged by Law 12865/2013 (FARIA, 2018), in the digitization process of their currencies through the E-dinheiro platform (which would also support Arariboia currency). In the State of Rio de Janeiro, in addition to Banco Mumbuca (initiated in 2013), from 2019 on five other municipalities articulated what came to be classified as Municipal Social Currencies by Instituto E-dinheiro Brasil (IEB): Niterói, Itaboraí, Quissamã, Saquarema and Porciúncula.

It is worth mentioning that the history of the Araribóia currency was controversial since its beginning, since no action was made aiming to dialogue or even strengthen Banco Preventório Bank and the solidarity economy in the municipality. It is important to point out that the city of Niterói already had articulated solidarity economy actions, such as small producers' fairs, a local solidarity economy forum, in addition to the Preventório Bank itself. A different scenario from the one found for example in Maricá at the beginning of Banco Mumbuca. The municipal law project in Niterói that gave rise to Banco Araribóia, for example, was the subject of many amendments, promoted especially by actors from the local solidarity economy forum, including Banco do Preventório. In a public hearing on the subject, the bank articulated with different actors, including researchers from the Observatory of Community Banks and Social Currencies (OBM, in which the authors participate), represented - at the time - by the geographer Carolina Pupo. At that moment, little or no articulation of the actors involved in the consolidation of the Moeda Araribóia with the actors of the solidarity economy of the municipality was perceived. A certain concern was then built in the creation of a digital social currency without local roots, which could even become an obstacle to the activities of existing community banks, in this case Banco Preventório.

Thus, from the point of view of Banco do Preventório, the paths towards the desired partnership with Arariboia around social currencies took longer to take shape than those discussed in the Preventório circle at the end of 2021. Even after the seminar, the mediations continued: in May 2021, Banco Preventório sends proposals to Instituto Edinheiro Brasil, requesting

> 1 - formalize a partnership with Banco Preventório, to carry out the microcredit actions corresponding to the revenues generated by the Araribóia currency and others from the municipal program;
>
> 2 - formalize a partnership for the management of Araribóia currency in the communities of Cavalão, Grota, Preventorio and Jurujuba, areas close to Banco Preventório; and
>
> 3 - stablish periodic meetings (between the IEB and Banco Preventório) to coordinate the Prevê community social currency and the Araribóia municipal social currency.

The agendas between Prevê and Araribóia were accepted by the Local Forum of Solidarity Economy of Niterói, and later taken to the local government. Within the scope of BCBN, Joaquim Melo signaled positively about the proposals, however pointing out a dependence on the local government to implement them. However, until the writing of this paper, there was no decision by the local government on the subject, and the Araribóia network did not include Banco do Preventório, Prevê Card, the social paper-money currency, and also did not provide microcredit to the local population (figure 6).

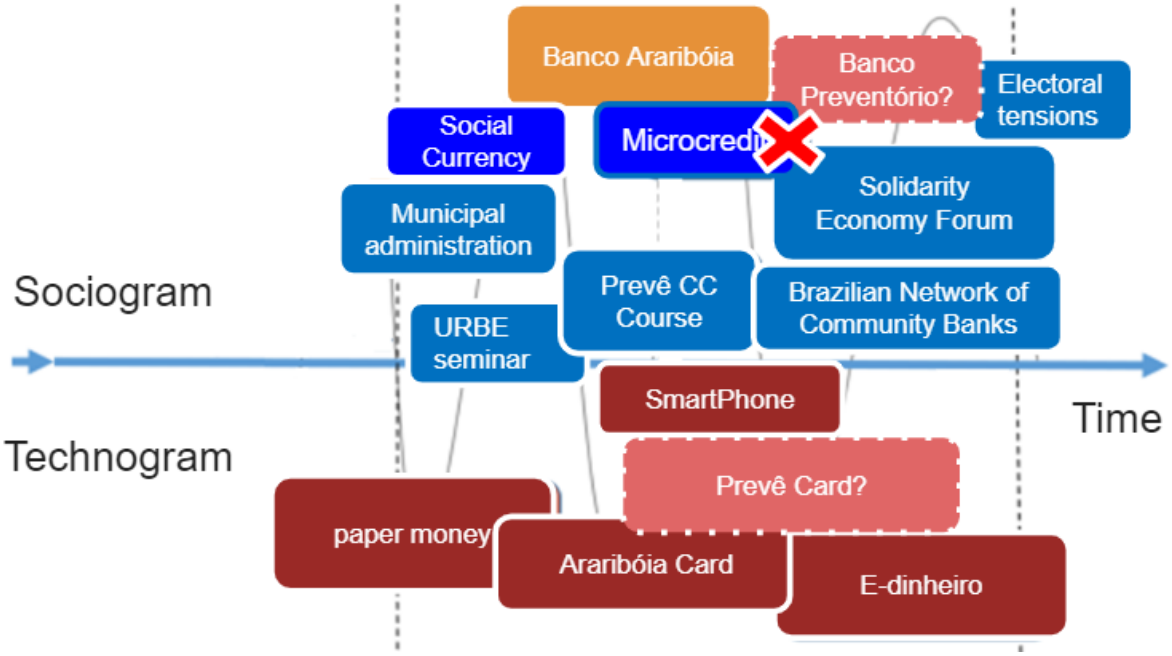

Figure 6 - Provisional stabilization of the socio-technical network of Banco Araribóia

If, from the point of view of Banco Preventório, the frustration with the process of implantation of Araribóia is notorious, it can be said that from the point of view of the city hall, BCBN and Instituto Edinheiro Brasil (IEB), the case is perceived with enthusiasm. In February 2022, the IEB released a public document (https://bancomunicipal.org/) in which they differentiate "Municipal Social Currencies" from "Community Social Currencies", assuming important differences between the methodologies, among which we can highlight:

"A social currency 'created' by a municipal law, there is no doubt that the municipality belongs to its governance. Just as a currency created by a community, under the aegis of a Civil Society Organization, to which its governance belongs. This is not about measuring which model is more popular, participatory, democratic; both can create a form of shared governance and democratic forms of decision-making."

The same document[10] points out the relevance of the numbers of the new experiences: community social currencies add up to approximately 23,000 accounts (2021), while municipal social currencies add up to 8 experiences, with 113,000 accounts (2021), with the following amounts (Dec 2021): Maricá (Mumbuca) BRL 26,000,000.00; Niterói (Araribóia) BRL 6,000,000.00; Cabo Frio (Itajuru) BRL 1,000,000; Itaboraí (Pedra Bonita) BRL606,750.00.

Another important epistemological landmark for the knowledge community of Brazilian CBDs, identified in the data of this research, was collected in social networks. The profile of @edinheirobrasil on the Instagram network (on 08/31/2022) starts to differentiate "community banks" from "municipal banks" (figure 7).

[10] Link direto: https://drive.google.com/file/d/1_tWY8qg39u2Xa2k0CxCSz_vYPG3Mhtpb/view. Accessed on 14 set. 2022.

Figura 7: IEB differentiates community banks and municipal banks

The post establishes the common goals of the two models,

> Both models use the E-Dinheiro platform; They promote the development of territories; They encourage social currency; They promote a network of contacts between customers and local merchants.

They also point out their differences:

> Community banks are banks built on the basis of popular organization, with projects and benefits organized by the people, in partnership with popular associations and cooperatives. Their projects are supported by the local community organization. Municipal banks are banks managed in partnership with municipalities based on municipal laws, generally they work by helping to deliver social and financial benefits to the population, contributing to the distribution of income through the public authoritie.

It is also worth noting that, as we pointed out above, each municipal law defines the (important) details of each experience. For example, Araribóia foresees seven branches spread across the city of Niterói (by the way, including a branch very close to Banco Preventório), and the constitution of a fund for local solidarity economy initiatives (partially formed by the fees charged on the E-dinheiro platform). However, it is not clear how (and if) the effective constitution of a bank (whether community or municipal) will be carried out independently of the City Hall (as is the case of Banco Mumbuca, in Maricá). Finally, as a last relevant data collected until the writing of this paper, an important difference in the methodology of the municipal bank of the city of Cabo Frio indicates the payment of social benefits with a “regionalized” currency, that is, the beneficiary can only use it in its region of

the municipality (a format that points to a greater similarity with the more traditional model of community banks).

5. Discussion

Initially, it is important to point out that the "Mumbuca model" (in short, started with the payment of a monthly income to a population through social currency), despite its relevance, does not summarize the history of partnerships involving CDBs and public policies. A noteworthy case is the purchase of waste with social currency, currently carried out by the Fortaleza cleaning company, in partnership with Banco Palmas (E-carroceiro)[11]. In this experience, the company's employees buy waste, according to a price list, from the "carroceiros" of Fortaleza, paying in Palmas E-dinheiro. The project is related to other experiences, such as "Pago em lixo", developed by the local government of Campolide (Lisbon region, Portugal): in that initiative, the local public power organized monthly events in which citizens took their recyclable waste, exchanging it as "Lixo" (local currency with Euro parity) accepted by small businesses. In both cases, the central issues are the correct destination of the waste, urban cleaning, protection for small businesses and, in the Brazilian case, the social inclusion of carters.

Historically, other modalities of public power support to CDBs have proved to be important: resources that support funds intended for community microcredit (whether reimbursable or not) were fundamental, for example, in the BNDES' (Banco Nacional de Desenvolvimento Econômico e Social) support for the expansion of the Brazilian Network of CDBs (FARIA , 2018). There are also important resources to support the implementation of new CDBs, involving, for example, networks of incubators linked to the solidarity economy, as well as other advisory structures (in Universities and Institutes) – for Banco Preventório, for example, the Incubator of Solidarity Enterprises of the local University was a fundamental agent. Training support, either from microcredit agents (historically quite relevant) or from agents supporting the use of electronic social currency (a topic with increasing importance), enter the list of possibilities for promoting CDB s by the public authorities. Assistance in renting or granting physical space is also an important condition for the sustainability of CDBs: experiences where such support is obtained are not uncommon internationally - as in the cases of LaTuruta (Vilanova i la Geltrú, Spain) and lÉlef (Chambéry, France) -, and constitute an important advantage for the financial sustainability of CDBs, as pointed out by Faria (2018) in the experience of CDB Preventório.

[11] More at http://edinheirobrasil.org/prefeituras-fortaleza/ and https://diariodonordeste.verdesmares.com.br/metro/mais-100-trabalhadores-sao-recebidos-no-e-carroceir o-1.1984447 . Acess on 19 Aug. 2020.

Other forms of action by the public power can be mentioned, which, while promoting social currency systems, end up bringing tangible benefits to the territories. In Santa Catarina, the NecDindin project was developed by teachers from the public school network in the city of Itajaí city (SC)[12]. It is an action that aims to circulate a social currency within schools in order to encourage students to reflect on the currency and the economic system in general. Furthermore, the Palminha currency - a project by Banco Palmas de Fortaleza - fulfills similar functions and objectives.

The educational potential of such experiences highlights the centrality of public power as a policymaker in this direction. Extending the discussion to “non-monetized community banks” (or local monetary systems not backed by official currency), there are various types of local monetary experiences worldwide that exert positive externalities on society. There are projects that pay people who engage in community gardens, in solidarity activities, in urban revitalization projects, support for neighbors with low mobility - the elderly, the sick, etc. (SEYFANG and LONGHURST, 2013; BLANC, 2013).

Such incentives, although they could be in official currency, play a greater role when paid in currencies that circulate only in the localities in question (even when the currencies are not convertible into “official currency”). Even for systems with such characteristics, several of the aforementioned support from the public authorities are valid (such as technical support, physical space, etc.). With these social currencies, it is possible to fulfill a dual function: to stimulate the engagement and improvement of communities through the actions mentioned above, while creating a circulating medium that retains resources and values local economies.

There is, therefore, a variety of articulations that the public power can exercise in order to promote practices with social currencies. From financing to purely organizational support - providing consultancy, dissemination, technical support, mapping local offers and demands - the possibilities are fruitful and depend on the scale at which the social currency system(s) is intended to be built.

The examples examined more closely in this research point to the implementation of public policies for basic income by community banks, an agenda of this movement that is able to enhance the generation of local income, as it was possible to observe in the municipality of Maricá (RJ) with the Banco Mumbuca. Additionally, we saw that the current legislation for electronic payment arrangements started, as of 2013, allows community funds to be generated, constituting relevant legacies for the populations involved. Organized in a network, community banks have a unique digital platform, the E-Dinheiro platform. Some

[12] More at: https://www.facebook.com/moedasocialnecdindin/

operations on the platform, such as payment or withdrawal, generate small fees that feed the community funds of each of these solidarity organizations.

Such a “techno-legal” arrangement seems to have contributed to the recent strategy of the Brazilian Network of Community Banks, in which the E-dinheiro platform is seen by municipalities as a means of payment for grants and basic income programs, which brings new connections and challenges. Among the concerns perceived is the possible appropriation of financial inclusion policies by local governments and companies. If, on the one hand, basic income policies can provide virtuous effects in various spheres of economic and social life, on the other hand, municipal (community?) banks, conceived and managed by actors potentially not involved in the community, can build a dynamic that ignores the needs of the small local merchants and undermines pillars of solidarity finance, supported by local development.

In this sense, it is important to draw attention to issues such as the autonomy of the community banks involved, in relation to the municipalities that implemented such policies. Such autonomy allows, on the one hand, the continuity of these currencies and banks over time (less dependent on the governments in charge), and, on the other hand, it opens up more concrete possibilities for the participation of the local population in the decisions of the banks through, for example, advice for formulating and evaluating microcredit lines (as we could see at the Mumbuca case).

Another relevant point that the data collected in Niterói points out refers to the territories that bring together municipal and community Banks (using here the new nomenclature promoted by the Instituto E-dinheiro Brasil). We bring up the need for dialogue between existing local community banks with the new municipal “community” banks, which are being implemented, as is the case of the local community bank of Preventório and the municipal bank Araribóia, both in the municipality of Niterói (RJ).

In the Araribóia case, the data shows that the municipal bank has been built without dialogue with the existing CDB. There, evidence indicates that the reason for the difficulty in dialogue may be related to different political parties affiliations - when we compare, on the one hand, the municipal secretariat responsible for Araribóia and, on the other hand, some of the builders of Banco Preventório - despite the fact that definitive evidence in this regard were not found.

It is worth noting that efforts were made to build bridges between the CDBs at Niterói, specially those initiated by the Urbe LatAm project, such as the participation of the municipality in the 'I Seminar on Community Public Emergencies and their Citizen

~~Technologies', the invitation to the local government to participate in the 'Solidarity course on~~ social currency and microcredit with Preventório' and a letter from the Urbe LatAm Project addressed to the city hall, as a feedback on the seminar and an invitation to dialogue. This experience points to the need for reflections within the BCBN in the sense of mechanisms to strengthen community banks without partnership with local governments, reducing the asymmetry between these and the so-called municipal banks.

We start from the assumption that the resources from IEB's contracts with municipal governments and, especially, the fees collected through the E-dinheiro platform, are potential sources of extremely relevant financial resources for the BCBN as a whole, and not only for municipal banks. Joaquim Melo himself points in this direction when he states that both Banco Araribóia and the E-dinheiro platform are collective constructions resulting from the work of many community banks, such as Preventório. One option that seems viable and not subject to interference from municipal managers would be that a part of the resources collected by IEB (with the contracts and fees of municipal banks) were destined to a fund to support other community banks (figure 8).

Figura 8 – Possibility of funding for community banks

We represent in the figure some of the BCBN community banks, as well as the Instituto E-dinheiro Brasil (IEB, registered with BACEN and which provides the platform for CDBs). That is to say, Banco Mumbuca and Banco Araribóia appear within the BCBN, insofar as, on the one hand, we did not find any evidence that municipal banks will not participate in the network, and, on the other hand, we identified the new nomenclature 'municipal bank '. The Community Banking Fund (FCB - Fundo para Bancos Comunitários) would thus be fed by a portion of the fees and contracts between IEB and municipalities (such fee should be agreed between BCBN and IEB). The other community banks (non-municipal) could access the fund

~~according to rules defined by the BCBN. As possible rules for the FBC, we can imagine: that~~ a CDB that is located in the territory where there is a municipal bank (case of Banco Preventório) would have access to a greater portion of the resources coming from that municipal bank assigned to the FBC; that the fund could be accessed in a loan modality (where the CDB would use the resource for local microcredit) or in a non-refundable transfer modality (in which the CDB could use it for its infrastructure or local projects).

A socio-technical arrangement like that could reduce some of the risks examined here (such as the increase in asymmetry between municipal and community banks) and would enhance the historical experiences of CDBs, community participation and solidarity economy. Here, it is worth dialoguing very briefly with the article by Milton Santos, published in the Brazilian newspaper Folha de São Paulo (late 1990s), in which the Brazilian geographer pointed out to us that crises and tremors established by finance are capable of creating awareness of the problems local and national. Santos proposes that it is the place and its dynamics that builds other financial forms. It seems to us, therefore, that community banks, their social currencies and the E-dinheiro digital platform are expressions of this “chão contra o cifrão” (“ground against the money sign $”), as Santos proposes, giving strength to territories.

6. Conclusion

The paper shows the Banco Mumbuca case, a paradigmatic one because of the amount of resources involved as well as the coexistence between solidarity economy, local development and public policy. Another case discussed was the recent Banco Araribóia case, in the municipality of Niterói (RJ), on a territory where another CDB has already worked for more than ten years (Banco Preventório). We discussed different modalities of public support for local banks and currencies, and specially the issues brought by the examination of Mumbuca and Araribóia experiences. In addition to understanding that the characteristics of community banks can also permeate the new municipal banks (as the history of Banco Mumbuca has shown), the paper advances proposing a possibility framework in which the municipal banks model (already explicitly admitted by the IEB) encourages the existing community banks.

Here, the action of community development banks is advocated in synergy with local governments with regard to the implementation of basic income policies. Although it is widely known that such policies have beneficial effects in reducing poverty and other deprivations, improvements in their applicability can be suggested, providing them with the necessary democratic decentralization, something that community banks have to offer.

By operating in a way that is rooted in the places where they are located, community banks have the ability to map local needs, as they are in close contact with the surrounding citizens. This brings about a desired approximation between public policies and communities through community banks. This integration allows its credit agents, as well as the families and companies involved in the locality, to act in co-participation with public policies, improving their control, their implementation and their results. There is, in the literature on the subject, a series of evidence that points to the positive aspects of this interaction, since the appropriation of community resources empowers and feeds back governmental action in the territory, perpetuating its benefits.

In this sense, although the creation of community banks encouraged by the municipalities is a promising practice, we reinforce that there is in this process a great opportunity for valuing the existing practices and initiatives of the community banks experiences in Brazil, with their social currencies connected to the local populations. Here, therefore, we draw attention to the power of gathering the benefits of inclusive public policies, such as basic income, with the virtues of community resource management, in this case a social currency. The engagement of local populations in maintaining common resources (whether they are water, forests or currencies) strengthens and roots solidary and democratic management practices in the territories, something necessary and especially relevant in Brazil nowadays.

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Data Utilization of Digital Community Currency for regional economic policy: Case of TARCA in Otaru, Hokkaido

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Keywords

Digital Community Currency (DCC), Regional Economic Circulation, Network Analysis, Regional Economic Society Analyzing System (RESAS)

Abstract

There has been an increased interest in digital currencies (DC) worldwide, including in Japan, affecting the economic activities of various agents. This interest has spread to urban areas and rural areas, and digital community currency (DCC), that circulate within specific areas as a tool for revitalizing the local economy, were introduced in quick succession. Japanese pioneering DCC, "Sarubobo Coin (Hida Takayama Area in Gifu)," was launched by the Hida Credit Union in December 2017 and has reached a cumulative settlement amount of approximately 5.1 billion yen as of the end of January 2022. The number of users has reached approximately 24,600, and the number of member stores has reached approximately 1,700. Multiple agents, mainly credit unions and local governments, such as "Aqua Coin (Kisarazu City in Chiba)," and "Setagaya Pay (Setagaya Ward, Tokyo)," that use the same DCC platform "Money Easy" as Sarubobo Coin. These projects are focusing on stimulating consumption in the region while simultaneously achieving regional economic revitalization and community formation (Yoshida et al., 2021). In addition, as DCC use blockchain, "Byacco" operated at the University of Aizu and "Kintetsu Harukasu Coin / Shimakaze Coin" experimentally operated in the Kansai Area have appeared.

The purpose of this study is to consider how regional economic policy can contribute to Fin Tech and regional revitalization, by examining the methods of analysis and utilization of macro data, such as regional economic circulation rate and interregional balance, and micro data, such as user trends obtained through social experiments of DCC. With macro data, it is possible to grasp the structural characteristics of the regional economy, mainly focusing on the "Regional Economic Circulation Map," which can be obtained

from the Regional Economic Analysis System provided free of charge online by Japanese government. In addition, regarding micro data, we analyze transaction data between users obtained in the social experiment of DCC "TARCA," which was introduced in Otaru, Hokkaido, to promote volunteer activities and regional economic circulation.

TARCA employs an online account-type system that enables electronic payments through smartphones and tablets to be made within the community. It is easy to send and receive information about events and stores, and messages are sent on the completion of every transaction. Miyazaki has been involved in research and management as a secretariat since considering the first introduction of TARCA in Otaru and has supported its efforts. We started the DCC social experiment for approximately two years beginning 2012 and achieved some results (See Miyazaki 2019 for details). Subsequently, in collaboration with Kobayashi, we examined a circulation design utilizing transaction network analysis that visualizes the behavior of participants using transaction data from TARCA (Kobayashi and Miyazaki, 2021). Through these analyzes, we will clarify the vision of regional economic policies and the possibility of data utilization that contributes to the formation of local communities while stimulating consumption in the region.

Introduction

In this study, we propose a regional economic policy based on regional data by utilizing a circulation experiment of digital community currency (DCC) and its circulation data. Regional policy in Japan needs to shift from the traditional "opinion-based policy-making (OBPM)" to "evidence-based policy making (EBPM)" in recent years (Hayashi et al., 2021). Regional data analysis and its use are essential for promoting evidence-based regional economic (or community) policies.

Evaluating business promotion and regional revitalization based on evidence has been challenging. A typical case study is a stamp business, in which a store or shopping street aims at a customer retention strategy and sales promotion. In the traditional stump business, it is difficult for shopkeepers to take much trouble and accumulate business data for analysis to verify user information. Consequently, subjective satisfaction of customers and shopkeepers is often the key to business continuity. Furthermore, data analysis and its outcomes have not been returned to the regional community, and data utilization has not progressed well in the local loyalty program and some of the Community Currencies (CCs) provided by local governments in Japan.

This study focuses on DCC transaction data as complementary to existing regional data and examines its applicability to evidence-based regional economic or community policy based on the analysis of connections.

1. Regional economic or community policy based on regional data analysis

Since the 2000s, interest in "evidence-based policy-making (EBPM)" has surged worldwide. Although there is no clear definition of evidence in EBPM among experts, the US government report describes it as follows:

> "Evidence" can be defined broadly as information that aids the generation of a conclusion. Throughout this report, the Commission uses the term more specifically. This report uses the shorthand "evidence" to refer to information produced by "statistical activities" with a "statistical purpose" that is potentially useful when evaluating government programs and policies.
>
> Commission on Evidence-Based Policy-making (2017)

In other words, "evidence" can be considered as material (data) to clarify the degree to which a policy contributes to its objectives and effects based on causal relationships or inferences. Until now, policy-making and the evaluation of policy effects have been mainly based on subjective factors such as intuition,

experience, and assumptions of policymakers and residents (local actors). However, since an accurate understanding of policy effects makes verifying their effectiveness and determining appropriate budget allocation by national and local governments, more objective evidence and data-based verification of cause-and-effect relationships are becoming essential.

This trend began in the 2000s, mainly in Europe and the United States, and is now becoming a common goal worldwide. On the other hand, the areas in which practical EBPM efforts are progressing and the status of progress differ significantly from country to country (Baron 2018). For example, circulation experiments and program evaluations, such as randomized controlled trials (RCTs) preceded by EBPM, have been conducted since the 1960s in the United States. Subsequently, the formation of organizations leading EBPM in a wide range of fields, from poverty and education to health and welfare, and the development of laws, have been promoted. In the UK, the What Works Centre (WWC) has been established as an intermediary organization that links academic research and policy-making in each policy field, such as health care and education. It collects and organizes evidence for each field and supports its utilization. In addition, the What Works Centre for Local Economic Growth (WWCLEG) has been established to conduct impact evaluations of local economic growth, examining whether policy interventions lead to increases in employment, wages, and added value (WWCLEG website).

Japan tends to be a backward country regarding EBPM, and most discussions are based on subjective evaluations by national or local governments and residents. According to trends in other countries, the e-Stat (Portal Site of Official Statistics of Japan), which releases statistical data held by the central and local governments, began to be built and disclosed to the public in 2008. Furthermore, to make statistical data easily accessible to local government officials and the public, open data utilization platforms for understanding regional economies, such as the Regional Economic Analysis System (RESAS) and regional economic circulation, have been established. The Cabinet Office and other ministries and agencies are accelerating the promotion of EBPM. There is an emerging movement to understand local (community) economic data and apply them to economic (community) policies.

However, some aspects of data collection and their effective use by local governments and residents have not been found. One reason for this is the problem of personal information protection and security related to data collection and use. Recently, there have been discussions and initiatives such as decentralized Parsonal Data Store (PDS) and information banks in Japan, where companies or governments do not hold data but are managed by individuals and opened to companies and other entities as needed (Hashida 2017). In addition, it is pointed out that there is a shortage of professional human resources responsible for data analysis.

This study, considering these circumstances, examines evidence-based analysis and policy-making for local economic policies using the DCC. The question is, how far have empirical studies on CC progressed in previous studies? Representative examples include a questionnaire and interview-based surveys, input-output analysis, transaction network analysis, simulation analysis, and circulation experiments (e.g., Kichiji and Nishibe 2008, Nakazato and Hiramoto 2012, Kurita et al. 2012). They all show subjective values and satisfaction levels, such as user awareness and behavior changes, and visualize objective behaviors from transaction data to clarify their impact on the local economy and society. Prior studies have often shown the use of CC and its impact on subjective data, and few attempts have been made to move toward subsequent policy-making.

On a practical level, the Community Currencies in Action project, conducted from 2012 to 2015 by a cooperative organization in the UK, France, the Netherlands, and Belgium, can be positioned as an essential activity. This project provides various tools to verify complementary currencies' institutional design, effectiveness, and evaluation methods. For example, the handbook "People-powered Money- Designing, Developing and Delivering Community Currencies" for introducing complementary currencies provides the following information. (1) The potential benefits of CC projects and considerations for implementing them, and (2) specific issues, prospects, and case studies regarding the design, supply, and implementation of currencies. It states that the best way to collect data is through electronic payment instruments, and it is envisaged that the process of currency use and how it is used will be clarified and the project's impact evaluated based on this information.

Furthermore, while building on the results of Place et al. (2015), "No Small Change- How to evaluate your community currency, with accompanying work materials," explains the procedures and methods for analyzing the impact of CC projects from a theory of change perspective explicitly. It is useful because methods can be designed to measure user changes over time and evaluate projects effectively. Thus, empirical studies and practices have been attempted using various approaches; however, as mentioned earlier, only a few studies worldwide have attempted to utilize data analysis from the viewpoint of policy-making and evaluation. One example is the Community Dock developed by Kusago and Nishibe (2018). Community Dock is a practical policy instrument that enhances the effectiveness and validity of a given set of external institutions through spontaneous changes in internal institutions by self-evaluation and self-correction of community members. This study is constructive in considering EBPM using CC.

Based on previous empirical studies and recent trends in digitization, we examine the data analysis in detail and its application possibility of policy in the case of TARCA. The purpose of this experiment was to revitalize local communities by utilizing Information and Communication Technology and CC.

Specifically, the experiment aimed to simultaneously promote volunteer and regional economic circulation by exchanging value and disseminating information using DCC. One of the authors of this paper, Miyazaki, has been involved in the planning and operation of the TARCA project. He is working as a secretariat member and researcher since its inception. This study is the first attempt to link regional strategies and policy proposals through data analysis and DCC utilization in Japan.

2. The circulation experiment of TARCA in OTARU

2.1 What is TARCA?

DCC' TARCA' is an online account-type system employing technology that enables electronic payment for smartphones and tablets (**Figure1**). After registering as a member and logging in, four functions can be used: (1) exchange from cash to TARCA, (2) person-to-person transactions, (3) transactions at stores, and (4) display of the history of transactions (**Figure2**). Individual members obtain TARCA in return for volunteers at events and use it for mutual aid among members and to exchange local food, drinks, and merchandise sales at stores. TARCA can also be exchanged (recharged) for cash if necessary (1 TARCA = 1 yen).

Figure 1 Main Screen of TARCA application

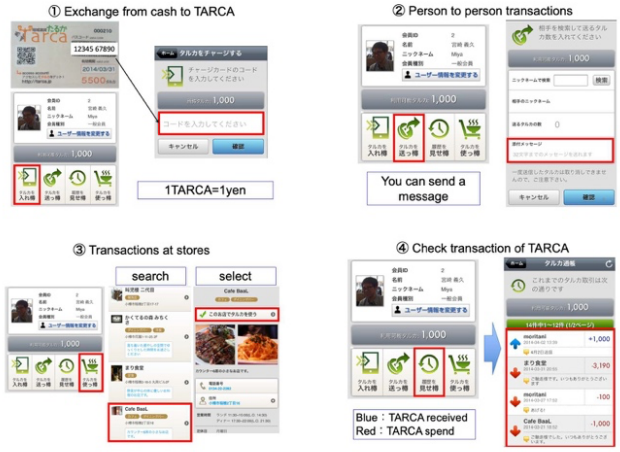

Figure 2　Four functions

2.2　Experiment overview and analysis method

This experiment targeted citizens and college students involved in volunteer and community development in Otaru. The organizer distributes TARCA as a reward for participating in activities and community contributions, and the recipients can use the DCC at local shops or restaurants (**Figure3**). For example, TARCA was circulated as an appreciation to the city's participants in canal clean-up groups and volunteers for various local events. Then, all information on volunteers and stores that accept CC was collected, recruited, and disseminated through the social networking service (Facebook).

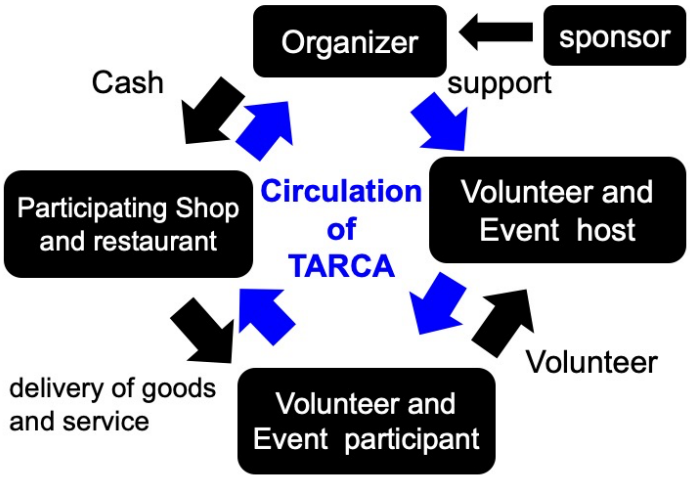

Figure 3　Circulation scheme of TARCA

The analysis was based on the transaction data of the DCC TARCA used from November 30, 2012, to February 28, 2013 (the first circulation experiment). The transaction data mainly included the settlement date and time, settlement amount, and counterparty (attribute information). Real-time transaction information can be downloaded in CSV format. In this study, we attempted several regional data analyses using this data.

2.3 Result of circulation experiment

In analyzing the data, we overview the outline and result of the circulation experiment TARCA, based on the policy-making process and evidence from Hayashi et al (2021). In the first phase, it is essential to indicate the vision and the goal that the project intends to achieve. Otaru once prospered as an industrial port city, but due to its declining population, falling birth rate, and aging population, the city has lost its former momentum and is in severe decline today. On the other hand, this city is well known as a tourist destination, and its events and community development are thriving. Therefore, the city faces the challenge of forming an intra-regional economic cycle that supports the daily lives of its citizens while simultaneously building a network with tourists and residents. It is considered that the discovery, transmission, and improvement of the city's attractiveness based on history and culture, or tourism, will lead to the sustainable development of the local economy. This project aims to support local revitalization and tourism community development by introducing the DCC.

The next important step is discovering the core problems and formulating policy objectives in Phase 2. In this study, a primary survey based on statistical data and a preliminary survey using questionnaires were conducted to understand the current situation in Otaru, the target area of the experiment. Miyazaki (2019) described the experimental background and outcomes in detail and identified two significant points. First, an examination of the regional economic circulation in Otaru reveals that the regional economy depends on funds from outside the region and that funds are flowing out of the region, using a regional economic analysis system called RESAS. Therefore, the reinvestment capacity in this city should be strengthened to prevent the leakage of funds and to promote intra-regional circulation.

Second, the outcomes of the questionnaire survey targeting the three entities of residents, NPOs, volunteer groups, and self-employed shopkeepers who are members of the shopping street revealed the following points. Although the self-employed are dissatisfied with the commercial district and business conditions and the residents are dissatisfied with economic aspects such as employment opportunities, income, and earnings, the outcomes show a somewhat high level of satisfaction with life in Otaru.

Based on these outcomes, we considered the introduction of DCC as a policy objective, and a citizen's group took the lead in planning and managing the introduction of TARCA. In the policy-making phase, the members of the TARCA Steering Committee, a citizens' group, and the author were also involved in the institutional design and circulation experiments while developing the strategy. This experiment was based on the circulation scheme described in **Figure3** and was expected to have three significant effects.

The first is to improve the convenience of payment using the DCC. Considering the spread and development of smartphones and the emergence and rise of electronic payments, we thought the DCC would facilitate payments and promote local consumption in the community. Second, along with DCC, one of the regular activities is to guide citizens by disseminating local information on stores and recruiting volunteers. While it is essential to increase consumption within the community, we believe that combining local information with a medium such as a DCC is an even better match and can effectively promote and guide people to stores and events. Finally, the message function promotes communication. Payment is not just an exchange of cash for goods and services but also a part of communication that connects people and stores and can be a trigger for new interactions. We believe that the message function has many possibilities for creating new connections beyond exchanges.

Based on these expectations, a circulation experiment was conducted, and in the final phase, the implementation of policy measures and evaluation of the project were discussed. The experiment was repeated for a period based on the expiration date. The outcomes of the first circulation experiment are shown in **Table1**, while the circulation transition is shown in **Figure 4**. The final issuance amounted to 355,300TARCA, although it was not large enough to boost the local economy.

Table1　Results of the first circulation experiment

1. Period	2012.11.30～2013.2.28（91day）
2. Participants	117 people
3. Participating shops	22 shops
4. Total amount of issue	355,300TARCA（About 3,000TARCA per person）
5. Total amount of transaction	798,470TARCA
6. Total amount of cashing	315,020TARCA（cashing rate：88.4％）
7. Velocity of circulation	About 9.0（time／year） ※method of calculation：（Total amount of transaction÷ Total amount of issue）÷0.2493（annualized）

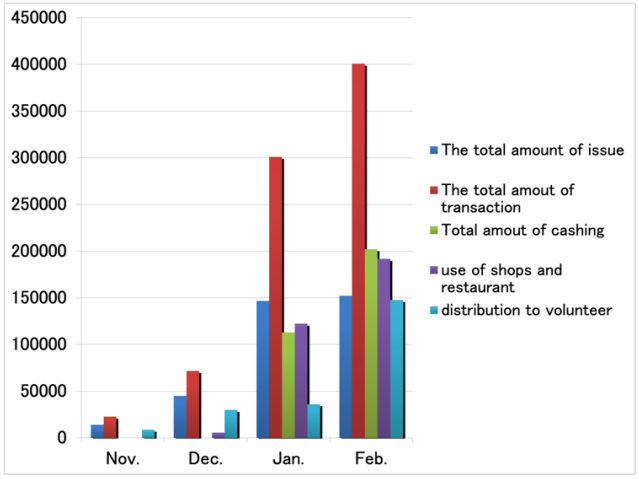

Figure4　Circulation trend（Unit: TARCA）

In addition to these outcomes, we analyzed the velocity and route of CC circulation. The velocity of circulation is calculated as the number of times money (or CC) passes from one person to another during a specific period. As shown in **Table 2**, none of the other regions exhibited such a high value, indicating a significant ripple effect. In addition, the circulation channels showed that approximately 70% of the volunteers and event participants received CC and used it at local stores and restaurants, and approximately 30% of the participants exchanged the currency with other individuals (**Figure 5**).

Table2　Issuance and redemption amount and velocity of CC circulation in Japan

Name	P		Genki	Aqua	TARCA
Place	Tomamae, Hokkaido		Neyagawa, Osaka	Nirasaki/Hokuto, Yamanashi	Otaru, Hokkaido
Period	91day（first）	173day（second）	153day	181day	91day
Total amount of issue	1,096,000	1,485,000	N/A	854,175	355,300
Total amount of transaction	1,385,500	2,458,500	381,300	1,210,650	798,470
Total amount of cashing	1,096,000	1,483,500	137,000	751,275	315,020
Velocity of circulation	5.0708	3.4948	6.6397	2.85816	9.0

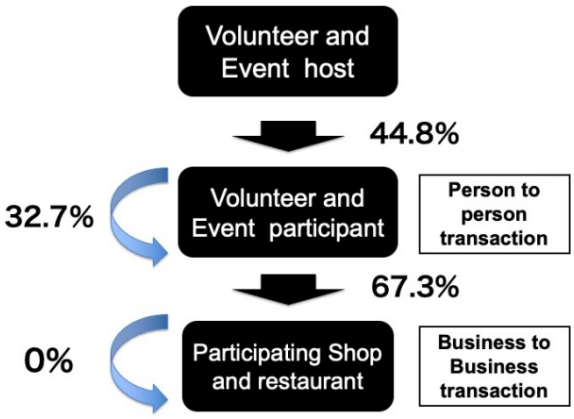

Figure5 Circulation route of TARCA

Although the data could not provide evidence, the steering committee found that the local currency, TARCA, became available at various events in Otaru, and a new network was established with DCC TARCA. For example, the participants were able to experience connections with people in the city through collaborations with local festivals and events, such as the "Moonlight Shops Tour" event in which they visited restaurants in the city at night to discover their charms and volunteer activities to distribute "Tarupon," a local information magazine in Otaru. This experiment's total number of participants was approximately 600 people, 60 stores, and ten events related to CC. Through involvement in various events linked to CC, a network of people, including the steering committee, gradually formed and played a role in building new relationships.

2.4 Discussion from basic data

The reasons for these results can be summarized as follows: First, the target audience, concept, and goal-setting for introducing the DCC are unclear. This is not necessarily limited to DCC, but one reason was that the members could not share why they were introducing CC in the first place, whose issues would be solved by using CC, and what kind of effects they expected from the digitalization of CC. In this experiment, few citizens and tourists used the system, as expected by the management, along with college students who were able to participate as volunteers. In the future, it will be necessary to clarify the purpose of the experiment, establish a system that allows the intended participants, and provide sufficient explanations to users.

Second, activities to promote and educate the public about the DCC system and the dissemination of information were weak. Several procedures (downloading the application and member registration) must

be followed to use the newly developed system. In addition, the penetration rate of smartphones and other devices was lower than expected, and we had to quickly prepare the necessary devices for payment. Consequently, it took time to set up and publicize these devices, and it was challenging to increase the number of users and sponsors who could use TARCA. Many of the users who obtained CC kept it until just before the expiration date because they "did not know how to use it" or "could not find a store where they wanted to use it," and finally used it at a convenient location. This was also evident from the distribution trends shown in **Figure4**.

Another reason for the failure to increase the number of users is the lack of information dissemination to those unfamiliar with CCs or electronic payment systems. It takes a considerable amount of time to explain the purpose and significance of CC and how to use DCC and TARCA to everyone, and it is difficult for users to understand. It is desirable to start with familiar types of currency, such as paper money and bank books, and then gradually shift to electronic currencies. Another strategy would be to increase the number of people interested in CCs by using them as a tool for financial education at events for schools and children, such as game experiences with CCs.

Finally, differences in attitudes toward volunteer activities may have affected CC circulation. TARCA was paid mainly as a reward for volunteer activities, and most of the people who could obtain it were college students. The fact that CC was given in exchange for activities that were essentially free of charge made people who were not accustomed to such activities uncomfortable to use and, as a result, did not lead to active use of CC. This is also clear from several other studies. Whether or not to accept CC as compensation for volunteer activities is related to whether people have a paid orientation, that is, they do not mind receiving a reward, or a gratuitous orientation, that is, they do not mind receiving a reward (Kurita et al. 2015). In the future, based on the results of the circulation experiment, it will be necessary to improve the DCC system further while also considering mechanisms to promote changes in the attitudes and behavior of people who use CC.

On the other hand, however, the limitations of this experiment were also observed. Although the steering committee played a central role in establishing the direction of the CC circulation scheme (institutional design), the smooth circulation of CC was not easy. Contrary to our expectations, we had to constantly monitor the situation, acquire new individual members and TARCA member stores, and deliberately create opportunities for TARCA to be obtained and used. It is necessary to deliberately create opportunities to obtain and use TARCA while constantly monitoring the situation. Consequently, it was difficult to derive an optimal strategy for the distribution scheme even before the initiative began, and the ability to understand the situation and respond to issues simultaneously was required. Furthermore, it was

impossible to sufficiently follow the logic and procedures of the verification process to verify the effectiveness of policies such as EBPM; as a result, time passed without achieving satisfactory results.

At the current stage, continuing to consider the best measures for CC circulation while repeating trial and error through demonstration experiments is essential. At the same time, it is important to consider what needs to be verified and how to do so. In addition, there is a lack of methods to acquire and analyze the circulation status in real-time and to utilize the data for policy purposes. Although it was possible to track the transaction history of CCs and measure the volume and speed of transactions after the demonstration experiment, no measures were found to objectively grasp the situation at the distribution stage, evaluate the situation, and consider and prescribe measures to deal with the situation. This is a significant bottleneck when considering the policy applicability of CCs and requires a solution.

In the next section, we investigate the possibilities and issues in verifying new effects using transaction network analysis based on transaction history information. In addition to the previous analysis, we conducted a transaction network analysis of TARCA to visualize participants' behavior according to their attributes and clarify the factors that promote or hinder the circulation of TARCA.

3. Evaluation and Issues of transaction network analysis

We analyzed transaction data from a demonstration experiment conducted between November 30, 2012, and February 28, 2013. We analyzed all transaction data, including TARCA issuances and redemptions. We categorized users into two demographic groups, "college students" and "others," and used network analysis to determine how they used TARCA. Gephi 0.9.2 was used for analysis and visualization.

3.1 Result of transaction network analysis

Figure6 shows a transaction network created from TARCA transaction data. Each node represents a user, and the nodes' edges indicate that transactions are made between users. The arrows on the edges represent the flow of TARCA in the direction of the arrow. TARCA was issued by three entities, represented by green, red, and orange nodes, respectively. User nodes are represented in purple for college students, yellow-green for others, and blue for stores.

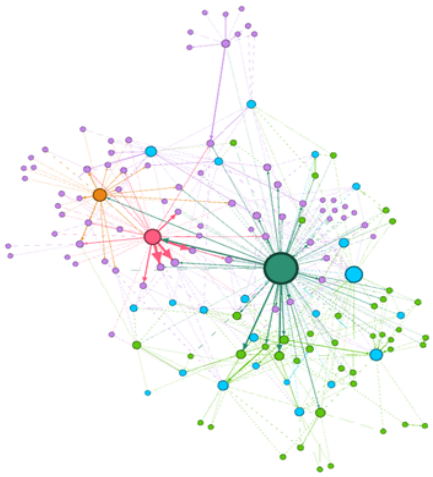

Figure6　Transaction network of TARCA

：The size of the node represents the size of the degree.

The average degree, which indicates the number of transactional relationships a user has, was 2.84, and the average path length was 3.256. The average path length of the random graph calculated using the same number of nodes and average degree was 2.572, which is similar to the average path length of the random graph. The average clustering coefficient is 0.325, an order of magnitude larger than that of 0.042 on the random graph, indicating that this transaction network has a cluster structure.

Figure7 shows that the attributes of the users receiving TARCA differ depending on the issuer (red, orange, or green). The red and orange issuers transfer TARCA mainly to college student nodes (purple), whereas the green issuer transfers TARCA to college students (purple) or others (yellow-green). The reason for this depends on whether the publisher is a volunteer organization with strong ties to college students or a publisher with ties to people other than college students. Focusing on stores where users use TARCA, there is a difference in the main destinations of TARCA use between college students and others.

The percentage of store usage attributes can be divided into three main categories, as shown in **Table3**. Calculating the average distance of each group of stores from the college, we found that the group with a more significant percentage of students using TARCA was closer to the college, while the group with a smaller percentage of students using TARCA was farther away from the college. It can also be seen that store groups with large percentages of other payments have locations scattered in the suburbs of Otaru.

Table3 Average distance from the store to college

according to the percentage of user attributes: Parentheses indicate standard deviation

Percentage of stores used by each attribute	Number of stores	Average distance from college
Group of stores with more than 80% of student user	4	0.81km（0.93）
Group of stores with more than 80% of others user	11	2.70km（1.43）
Group of stores other than the above	7	1.69km（0.25）

In addition to the regular demonstration experiment, a one-day store tour event using TARCA was held to promote its use. On the day, 107 TARCA transactions were conducted (556 during the demonstration period). **Figure7** shows the transaction network for that day.

Figure7 Transaction network of the event day

In this event, all participants gathered at a particular store and were then grouped to visit several stores. In **Figure7**, the node with the highest degree that appears in the center represents the store where they first gathered, and the blue nodes in the surrounding area represent the stores they visited afterward. Some groups consisted only of others, while others were a mix of others and college students. This event has created new encounters between people and stores through TARCA and new encounters between people.

3.2 Discussion of transaction data

Because there are differences in the stores used by different user attributes, we believe that expanding the number of stores where TARCA can be used based on the orientation of user attributes will improve user convenience. However, because most students used stores near their college, increasing the number of

student volunteers too much could lead to a concentration of transactions at certain stores. On the other hand, increasing the number of citizen volunteers is more complex than increasing the number of students; however, if we can increase the number of other users, there is a strong possibility that we can expand the distribution range of TARCA within Otaru.

However, simply having users use TARCA at stores where they use legal tenders is unlikely to discover new attractions and values in the community. The event analyzed in this study effectively used TARCA in the city and made them aware of new stores. The transaction network for this event (**Figure7**) was independent of the overall network, and "other" users who rarely participated in this event used TARCA in other stores during the demonstration. Although some user-to-user TARCA transfers were observed during the event, these were transfers for batch settlement at the store and were only practical transactions. In other words, "others' users who participated in the event did not use TARCA afterward. Unless a way to obtain TARCA outside the event is provided, transactions with TARCA will likely become transient and limited to the event. Providing users with information that encourages them to use TARCA will be the key to continued TARCA use.

Our analysis shows that there were almost no transactions between stores and users. We believe that one of the reasons for this is that TARCA was not sufficiently explained to users, including stores. The TARCA was perceived as a coupon that could be redeemed for cash. This is also an issue in other DCC.

4. Toward EBPM utilizing transaction data of DCC

In this section, we summarize the implications and considerations for EBPM using DCC transaction data based on a circulation experiment and its analysis. The following three points became apparent once we looked back at the experiment.

First, more accurate and objective data can be obtained in real-time. Until now, analysis has been conducted based on questionnaires and interviews with the concerned entities. However, conventional data collection and analysis are time-consuming and costly, and they take a lot of time and money before they are reflected in the subsequent measures. Therefore, collecting and analyzing new DCC transaction data will enable immediate, accurate, and objective evaluation. Furthermore, future technological developments will enable real-time data collection, analysis, and visualization, facilitating new policies and feedback to residents. The transition to new policy planning and implementation will be smoother and more accurate in the future, based on data analysis and policy evaluation.

Second, local information from the micro level (each actor in the community) to the macro level (the entire community) with CC transaction data can be grasped and analyzed in a complementary manner. Until

now, micro-level data for each actor and macro-level data for the community have been obtained and analyzed separately. The micro- and macro-structures can be supplemented mutually with trancaction network analysis, although the scope of users and communities is limited. Although the community of users and stores was limited in this experiment, we may be able to analyze spillover effects with objectivity and high accuracy of behavioral data in the future. Furthermore, it is possible to compare the results with those of users and communities that do not use CCs.

Third, by complementing the subjective information from questionnaires, interviews, and analysis results and understanding the community situation from various aspects, we can verify the hypotheses from new perspectives. In policy-making, it is possible to test meaningful hypotheses based on the actual conditions of the community rather than setting hypotheses based on conventional intuition, experience, and assumptions. For example, starting from an understanding of trends such as pay time, user attributes, and location of use through network analysis, residents, can formulate hypotheses on why these behaviors are adopted and develop an environment that is easy for users or stores to use, and incorporate innovations to promote intra-regional circulation and communication. It may be possible to develop an environment that is easy for users or stores to use or to incorporate devices to promote intra-regional circulation and communication. Thus, further verification is needed to determine how these barriers can be overcome through transaction data or network analysis and how they can be reflected in EBPM.

Despite these advantages, several issues remain to be addressed. Although transaction network analysis can grasp the history of behavior, it cannot grasp the reasons behind such behavior. In this respect, additional questionnaires and interview surveys should be conducted to supplement previous data analyses. There is no other best way to explore the combination of more sophisticated data analysis and policy-making through repeated hypotheses and verification.

In addition, the issue of handling regional data has always been an obstacle in discussions on EBPM. From the viewpoint of personal information protection and security, it is essential to establish strict rules on handling data for acquisition and analysis and to use the data safely and appropriately. In addition, establishing cooperation between the public sector, such as local governments, and the private sector and how to build a cooperative relationship with citizens will be an issue to be addressed in the future. Since overseas initiatives have not progressed and systems such as information banks are still in the exploratory stage, the future utilization of regional data and the diffusion and promotion of DCC will have a close relationship.

Lastly, there is concern that collecting local data will make analysis and feedback methods more complicated and complex. In addition to conventional data on economic and community conditions, using

data on CC transactions and their analysis as a basis for making decisions on the appropriateness and rationale of policy interventions or policy-making may confuse local governments and residents. Other studies have pointed out that experts tend to take the lead in policy-making and emphasize their professional skills and knowledge, which may cause difficulties in understanding, sharing, and utilizing data with the concerned parties (Colette Einfeld et al., 2021). Appropriate analysis and feedback are required for self-adjusting modifications with the intervention and support of researchers while keeping the residents as the main actors, as in the case of the community dock shown in the previous study.

Conclusion

In this study, we clarify the results and issues of the circulation experiment of DCC TARCA from the perspective of regional economic policy. We examined measures to further develop and elaborate regional economic policies from the traditional OBPM to the EBPM. The most crucial point is that transaction network analysis with CC transaction data can play a complementary role in regional information and simultaneously help establish a method for hypothesis testing based on more accurate and objective data.

Although this study was not able to develop deeply into causal relationships and causal inferences, which can be said to be the basis of EBPM in a strict sense, it would be desirable to be able to discuss these issues with citizens and local governments from the stage of designing circulation experiments in future studies, with the verification and policy-making of these issues in mind. In considering EBPM with transaction data of DCC, there is much work to be done. However, if we can accumulate hypotheses and verifications individually and use our past experiences, we can conduct experiments and formulate policies more precisely.

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Impact of digitalization of money on people's perceptions of community currencies: A gaming simulation analysis

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Abstract

The digitalization of community currencies (CCs) in Japan has progressed rapidly since 2016. The "Sarubobo Coin," used in the Hida region of the Gifu Prefecture, had approximately 24,600 users (including approximately 18,000 Japanese residents), approximately 1,700 member stores, and a cumulative value of approximately 5.1 billion yen by the end of 2021. There are more than 10 "sibling coins" in Japan that use a common format "*Money Eas*y" as the Sarubobo Coin. Therefore, digital CCs continue to attract increasing attention in Japan.

In Japan, digital CC issuers have an issuance philosophy that emphasizes the enrichment of the economic environment as compared to analog CC issuers. Furthermore, digital CC issuers evaluate their currency issuance as having resulted in fair and efficient transactions. Consequently, digital CCs have been found to operate more efficient payment systems.

We examined the transformation of perceptions regarding CC due to digitalization from the users' perspectives. Through an analysis using gaming simulation, we examined the changes in users' awareness and behavior in response to different forms of CCs, as well as their evaluation of different CCs.

The findings reveal that the introduction of a CC increases the ratio of purchases made within the community and the ratio of volunteering to provide the requested help in both analog and digital CCs. However, digital CCs were evaluated as stimulating the local economy whereas analog CCs were evaluated as strengthening the local community. Nevertheless, there are several types of analog CCs in Japan, including Banknote type and LETS type and users' evaluations of analog CCs differ between the two types. Therefore, this study examines the extent to which the characteristics of analog CCs impact the transformation of perceptions regarding CCs through digitalization by analyzing the relative evaluation of analog banknotes with digital charge type and analog with digital LETS-type.

Keywords

community currency, currency issuance form, digitalization of money, gaming simulation

1. Introduction

Since 2016, various digital community currencies (CCs) have rapidly emerged in Japan. The Sarubobo Coin, a representative example, is widely used in the Hida region of the Gifu Prefecture of Japan. By 2021, it had 24,600 users (18,000 residents), 1,700 merchants, and a cumulative total transaction value of 5.1 billion yen. Similar "sibling coins," based on the *Money Easy* platform, have been introduced in more than 10 regions of Japan.

In a questionnaire survey of CC-issuing organizations in Japan, Yoshida, Kobayashi, and Miyazaki (2021) found that organizations issuing digital CCs were more likely to have an enhanced economic environment than those issuing analog CCs. They found that organizations issuing digital CCs emphasized on the enhancement of the economic environment and rated their CC as promoting fair and efficient transactions than those issuing analog CCs.

From the user perspective, Kobayashi and Yoshida (2021) found that one of the reasons for evaluating digital CCs as a form of issuance that promotes local economic activity is the advantage of digitalization, such as the ability to view usage history and the fact that no calculations are required. However, the respondents also appreciated the manual work involved in analog payments, based on responses such as "transactions can be carried out based on mutual confirmation through communication" and "I would be happier if there were manual procedures," as factors that strengthen ties between communities. Therefore, analog-type CCs are highly valued as a form of issuance that strengthens local community ties.

The digitalization of CCs in Japan is expected to evolve into a more fulfilling economic environment that is more convenient for users. However, it can be inferred that the positive impacts of analog CCs provided in the past, such as the formation of communities and new connections, will possibly become more tenuous. While residents and local governments have traditionally been the main issuers of these currencies, as they go digital, private companies will be able to determine the distribution design and other aspects of these currencies, and more emphasis will be placed on enhancing the economic environment. So how can we create a digital CC that activates economic activities based on ties among communities that share common ideals and values?

There are several ways to consider this issue. The first direction investigated by Satoh et al. (2020) and Moriki et al. (2020) is to form social capital by improving the interface of the application used for CC payments. According to this approach, the use of digital CC applications can lead to forming new communities and ties. However, this approach raises the challenge of utilizing the research results accumulated on analog CCs.

The second possible approach is to focus on the variations in the issuance of analog CCs. Yoshida and

Kobayashi (2016) suggest that, even for analog CCs, Banknote type and LETS type currencies have different effects on user behavior and attitudes. Specifically, the paper currency type tends to increase the transaction amount of CC compared to the LETS type, while users are less likely to accept monetary diversity or change their attitudes toward community orientation. Conversely, although the LETS type currency is less likely to increase the transaction amount compared to the Banknote type, it is known to influence a greater degree of change in users' attitudes. This study examines the impact of these differences in the issuance of analog CCs in the backdrop of digitalization.

2. Materials and methods

In this study, the following hypotheses have been formulated and examined using gaming simulation:

Hypothesis 1: Digitalization of a Banknote-type currency strengthens its perception as a currency with local economic effects.

Hypothesis 2: Digitalization of a LETS-type currency weakens its perception as a currency with community-building and expansion effects.

The digitalization of CCs is expected to increase their convenience (Kobayashi and Yoshida 2021). The two hypotheses in this study examine how digitalization improves the convenience of two different forms of CCs: banknotes and LETS. Hypothesis 1 is based on the premise that the digitalization of the banknote-type currency, which has been effective in stimulating the local economy among analog CCs, will improve user convenience, promote transactions within the local community, further enhance the local economy, and be recognized by users as a currency with a positive effect on the local economy. Hypothesis 2 is based on the premise that the LETS-type currency, which has fostered a change in consciousness toward community orientation among analog currencies, will be recognized for its convenience more than for its community activation function when digitalized, and will no longer be recognized by users as a currency with a community formation and expansion function.

To test the above hypotheses, we used the gaming simulation method. Gaming simulation is a method used to promote participants' understanding of a specific social situation or to reveal the characteristics of a specific social situation itself. Its most distinctive feature is the formation of dynamic interactions from the real world (Yoshida and Kobayashi 2014).

Considering the case of a specific analog CC going digital, as examined in this study, the case of a real CC lacks robust examples and surveying actual users of the currency is difficult. In addition, it is necessary to conduct a controlled experiment on the experience of using the currency to investigate changes in the awareness and behavior of users because of changing the form of issuance from analog to

digital. A previous study that compared analog forms of issuance (Yoshida and Kobayashi 2016) employed a similar methodology, allowing for a comparative analysis with existing findings.

The gaming simulation used in this study is the "Community Currency Game" (Yoshida and Kobayashi 2014, 2016, 2018), a multi-player face-to-face analog game developed specifically for this study. The game was originally developed to examine the structure and concept of CCs and has been practiced in a workshop format for residents and stakeholders who intend to introduce CCs (Yoshida and Kobayashi 2018). In recent years, however, the gaming simulation has been used to identify how the use of CCs can transform the behavior and attitudes of people who have no experience in using them (Yoshida and Kobayashi 2014; 2016, Kobayashi and Yoshida 2021).

In this game, subjects take on one of five roles (businessman, student, restaurant employee, pottery studio employee, or hotel employee) as residents of a virtual community in groups of two or three, repeatedly buy and sell goods and services, and request and perform volunteer work using legal tender (unit: yen) and CC (unit: J).

The role of the dice determines the goods and services purchased for each role and the salary received. The game ends when the player receives a specified salary according to the roll of the dice, purchases the specified goods and services, and decides whether to perform the requested volunteer service. In the first two turns of the game, only the legal tender is used, and in the last three turns, both legal tender and CC are used. The legal tender can be used both inside and outside the region, whereas CC can only be used within the region.

The participants in the game are required to make three primary decisions: (1) whether to purchase goods and services inside or outside the region[1], (2) what percentage of the price of the goods and services to be sold should be in the CC[2], and (3) whether to accept volunteer work requested by other roles[3].

In addition to the analog Banknote-type and analog LETS-type CCs, which are the most common types of CCs issued as observed in previous studies, the current experimental design also includes new digital charge-and LETS-type CCs. Only one of these four types of CCs is employed in each game for a total of four games. The characteristics of the four adopted CCs are as follows:

[1] The game comprises items sold only within the region, items sold only outside the region, and items sold both inside and outside the region. Items sold both inside and outside the region are set so that the price is higher inside the region than outside the region. Prices are not negotiable in the game.
[2] In the turn after the introduction of CC, each turn determines how much CC will be received in exchange for items sold or services provided.
[3] Volunteering in this game takes the form of deciding whether other players who can solve a problem faced by one player will solve that problem.

- Analog banknote (Banknote) type: CC made of paper and issued by the CC issuing organization with a 10% premium and converted into yen for a 10% fee.
- Analog LETS (A-LETS) type: Everyone owns a paper passbook. The amount paid (negative) or received (positive) for each transaction is entered into the bankbook. Since there is no upper limit to the amount of deficit and surplus, the total balance in everyone's passbook is zero.
- Digital charge (D-Charge) type: CC that can be settled using a tablet and QR code. It can be used by charging the remaining balance to the tablet at the CC-issuing organization. Premium and redemption conditions are the same as those for the analog banknote type.
- Digital LETS (D-LETS): LETS-type CC using tablets and QR codes. Similar to the analog LETS-type, there is no upper limit to the amount of deficit and surplus, and the sum of everyone's balances is zero-sum.

This study developed a D-Charge type and D-LETS CC as a web application corresponding to the games implemented. *Com-Pay* was named after the first three letters of "community," as it is a payment method for communities (Fujiwara and Kobayashi 2019). This system is expected to be implemented the next fiscal year (February 2021) since the major electronic CCs in operation as of February 2021 (Sarubobo Coin, Aqua Coin, etc.) have adopted QR code payments to reduce implementation costs and fees on the store side, and it is expected that QR codes will continue to be used as a payment method for electronic CCs

All entities appearing in the "community currency game" used in the gaming experiment had a unique QR code, and the system automatically transitioned to the payment screen when the QR code of the payment partner was captured by the camera built into the tablet device during payment. By entering the amount to be paid and clicking the "Pay" button, a final confirmation screen appears, and the payment is completed by accepting the payment (clicking the OK button). (Figure 1).

Figure 1. Payment screen in Com-Pay

To ensure mutual recognition of the correct payment, the payer presents the authorization screen to the payee who updates the balance screen immediately to confirm that the correct amount has been credited to the app. All transactions settled with digital CC can be viewed at any time on the account history screen within the application.

Since charge-type CC cannot be paid without a balance in the app, it is necessary to pay a legal tender to charge the electronic CC to the app at the "community development organization" that issues electronic CC in the game to increase the balance of the electronic CC. Conversely, D-LETS-type digital CC can be paid even if the balance is zero or negative, and therefore, it can be paid without charging the electronic CC to the application at the "community development organization."

Only college students were included as participants to observe the interaction among relatively homogeneous participants who had never used a CC before. Therefore, no knowledge of CC was provided to the participants prior to the gaming. The games analyzed were CC games conducted in 2018 and 2019 using CCs with four different forms of issuance (analog banknote type, digital charge type, analog LETS type, and digital LETS type) with first-year students of the Joetsu University of Education[4] (Table 1).

Table 1. Status of game implementation

Game	Date	First Session	Second Session	Questionnaire
Ⅰ	2018.12.01	Banknote	D-Charge	Worksheet Ⅰ
Ⅱ	2018.12.02	A-LETS	D-LETS	Worksheet Ⅱ
Ⅲ	2019.12.21	D-Charge	Banknote	Worksheet Ⅲ
Ⅳ	2019.12.22	D-LETS	A-LETS	Worksheet Ⅳ

[4] There were 14 participants in 2018 and 17 in 2019.

Games I and II, conducted in 2018, included the same participants; Game I was conducted in the order of Banknote type in the first session and D-Charge type in the second session and Worksheet I was filled out for the participants after the completion of the two sessions. Game II was conducted in the order of A-LETS type and D-LETS type and Worksheet II was completed after all the sessions were over. Games III and IV, conducted in 2019, included the same participants; Game III was conducted with the D-Charge type in the first session and the Banknote type in the second. Game IV was conducted in the order of D-LETS type and A-LETS type and Worksheet IV was completed after all the sessions were completed.

Worksheets I and III consisted of (1) questions to rate the convenience of the CC, its contribution to the local economy, its contribution to volunteer activities, and its contribution to town activities on a 4-point scale for the two CCs used in the game that day, (2) a question to freely describe the characteristics of each CC used in the game that day, and (3) a question to be answered in the section asking the participants to select one of the two currencies they used that day to revitalize the local economy, form connections in the local community, or the currency they would like to use, and to describe the reasons for their choice.

In addition to the above questions, for Worksheets II and IV, respondents were asked to rank the four CCs with respect to each of the following three areas: revitalization of the local economy, formation of community ties, and the CC they would like to use, and to fill in a question section describing the reasons for their choices.

This study examined two hypotheses by comparing the Banknote type and D-Charge type (Games I and III) and the A-LETS and D-LETS (Games II and IV) types of CCs.

3. Results

3-1 Transaction Data

Tables 2 and 3 show the analog and digital currencies used in each game. Games I and III, which used the Banknote and D-Charge types of CC, indicate that yen expenditures decreased in both cases after the introduction of CC. However, yen income increased after the introduction of the CC, except in Game III, in which digital currency was used.

Table 2. Game transaction status (Banknote type and D-Charge type)

Transactions	Game Ⅰ		Game Ⅲ	
	Banknote	D-Charge	Banknote	D-Charge
Income per turn (yen) before the introduction of CC	47000	41700	45500	53150
Income per turn (yen) after the introduction of CC	49200	46733	52567	47400
CC revenue per turn (J)	5667	13400	10433	6400
CC as a percentage of revenue per turn	10.3%	22.3%	16.6%	11.9%
Expenses per turn (yen) before the introduction of CC	61700	66300	41700	41750
Expenses per turn (yen) after the introduction of CC	38133	33033	38867	38100
CC expenditures per turn (J)	4533	11733	9100	5400
CC as a percentage of expenditures per turn	10.6%	26.2%	19.0%	12.4%

Table 3. Game transaction status (A-LETS type and D-LETS type)

Transactions	Game Ⅱ		Game Ⅳ	
	A-LETS	D-LETS	A-LETS	D-LETS
Income per turn (yen) before the introduction of CC	51750	39050	51100	66750
Income per turn (yen) after the introduction of CC	45000	44733	38100	38100
CC revenue per turn (J)	9367	10800	4367	17367
CC as a percentage of revenue per turn	17.2%	19.4%	9.0%	31.3%
Expenses per turn (yen) before the introduction of CC	52300	51250	59700	39900
Expenses per turn (yen) after the introduction of CC	33200	31033	24100	24100
CC expenditures per turn (J)	7867	9300	3533	15867
CC as a percentage of expenditures per turn	19.2%	23.1%	7.3%	39.7%

When examining the amount of CC spent per turn, the highest percentage was in the digital currency in Game IV, and the lowest percentage was in the analog currency in Game IV. Examining CC as a percentage of income and expenditures per turn, the highest percentage was for digital currency in Game IV and the lowest was for analog currency in the same game.

Regarding the changes due to digitalization in terms of the types of CCs, it was found that the Banknote and D-Charge types, which are digitalized versions of the Banknote type, respond differently to

Games I and III. In Game I, the amount and percentage of CC use increased as a result of digitalization. After the introduction of the CC, expenditures in yen decreased while income increased. The effect of the changes due to digitalization on the local economy can be seen in that the use of CC not only increases within the region but also leads to an increase in income due to an increase in purchases within the region. In contrast, in Game III, the amount and percentage of CC use decreased due to digitalization. In Game II, where digital currency was used, the amount of yen spent decreased, as did income. This finding indicates that the digital currency in Game III did not generate positive local economic effects.

Conversely, in Games II and IV, which used the A-LETS and D-LETS types of CC, the amount and percentage of CC use increased in both games. Especially in Game IV, the amount and percentage of digital currency use were the highest among all games. LETS-type CC did not show any positive local economic effects in either analog or digital games.

3-2 Evaluation of Currencies

3-2-1 Relative valuation of two CCs

Regarding the evaluations of each CC by the game participants, Tables 4 and 5 list the ratings given to the analog and digital CCs used on each game day in the questionnaires administered at the end of each day. Each table shows the mean and standard deviations on a five-point scale with the highest and lowest ratings of 5 and 1, respectively. The four items evaluated were convenience, contribution to the local economy, volunteer activities, and neighborhood activities.

With regard to convenience, digital currency was rated higher than analog currency in all the games. This finding suggests that reading the QR code and paying with a tablet was considered convenient regardless of whether it was banknote currency or LETS-type CC. However, digital currency was rated higher than analog currency in terms of its contribution to the local economy in all the games. In the games, the local economic effect was positioned as the effect of decreasing yen expenditure and increasing yen income through the circulation of CC within the local community. From this perspective, only analog currency in Games I and III had a local economic effect. However, as indicated by the decrease in yen expenditure after the introduction of CC, it can be inferred that the participants recognized the contribution of CC to the local economy through the opportunity to pay for items with CC.

Both contributions to volunteer and neighborhood activities were rated higher by digital currency users, however, the difference was not very high.

Table 4. Evaluation of CC (Banknote type and D-Charge type)

Game Ⅰ n=14								
	Convenience		Contribution to the local economy		Contribution to volunteer activities		Contribution to neighborhood activities	
	Banknote	D-Charge	Banknote	D-Charge	Banknote	D-Charge	Banknote	D-Charge
Mean	2.57	3.86	2.93	3.5	3.07	3.14	2.93	2.93
Standard Deviation	0.51	0.36	0.73	0.52	0.83	0.54	0.48	0.48
Game Ⅲ n=17								
	Convenience		Contribution to the local economy		Contribution to volunteer activities		Contribution to neighborhood activities	
	Banknote	D-Charge	Banknote	D-Charge	Banknote	D-Charge	Banknote	D-Charge
Mean	2.53	3.47	3	3.24	2.65	2.76	2.76	2.88
Standard Deviation	0.8	0.62	0.71	0.66	0.86	0.75	0.83	0.7

Table 5. Evaluation of CC (A-LETS type and D-LETS type)

Game Ⅱ n=13								
	Convenience		Contribution to the local economy		Contribution to volunteer activities		Contribution to neighborhood activities	
	A-LETS	D-LETS	A-LETS	D-LETS	A-LETS	D-LETS	A-LETS	D-LETS
Mean	2.38	3.62	2.85	3.08	2.85	2.92	2.69	2.77
Standard Deviation	0.65	0.51	0.56	0.49	0.38	0.28	0.48	0.44
Game Ⅳ n=17								
	Convenience		Contribution to the local economy		Contribution to volunteer activities		Contribution to neighborhood activities	
	A-LETS	D-LETS	A-LETS	D-LETS	A-LETS	D-LETS	A-LETS	D-LETS
Mean	2.18	3.71	2.59	3.65	2.65	2.94	2.71	3
Standard Deviation	0.65	0.59	0.8	0.49	0.79	0.83	0.59	0.71

3-2-2 Impressions of the two currencies

Next, a textual analysis[5] of the free descriptions of the characteristics of each of the analog and digital currencies used on that day was conducted to analyze the co-occurrence relationships between the terms. Figures 2–9 illustrate these results. The color of each node indicates nouns in blue, verbs in red, and adjectives in green. The size of the node indicates the number of occurrences and the larger the degree of co-occurrence, the thicker the line.

a) Impressions of Banknote-type CC

Figures 2 and 3 show the co-occurrence of the terms used in the free descriptions for the Banknote-type CC used in Games I and III, respectively. Figure 2 shows that the characteristics of banknote-type currencies are that they can be transacted like cash, they can be used by a wide range of age groups, they carry a large amount of money, they can be lost, they cannot be broken like digital currencies, and they

[5] "User-local text mining tool (https://textmining.userlocal.jp/)" was used in the analysis.

increase the number of people involved. In Game III, the characteristics of the Banknote type were that it is labor-intensive, the conventional mechanism is friendly to older adults, it is less convenient, and it is more familiar (Figure 3).

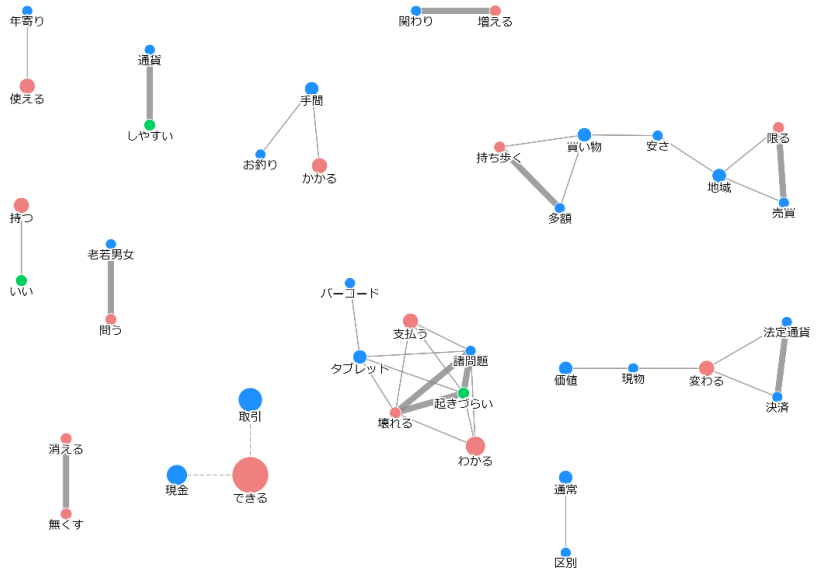

Figure 2. Impressions of Banknote-type CC (Game Ⅰ)

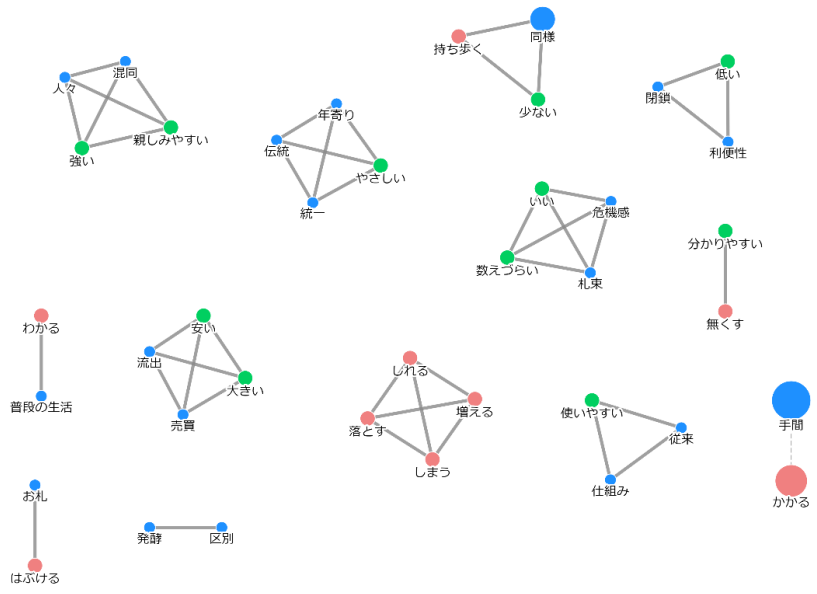

Figure 3. Impressions of Banknote-type CC (Game III)

b) Impressions of D-Charge type CC

Figures 4 and 5 show the co-occurrence of terms used in the free descriptions of D-charge-type CCs. Figure 4 indicates the following characteristics of D-charge-type CCs: transactions can be made with a tablet, easy settlement, easy understanding of transactions, balances, income, and expenditure unlike paper money, difficult to lose and does not need to be carried around, no need to carry cash, and the risk of data loss. From Figure 5, the following points have been derived: the ability to manage money, the ability to view the balance and transactions briefly, the ability to make transactions using a tablet terminal, the risk of overspending, and the convenience of the system.

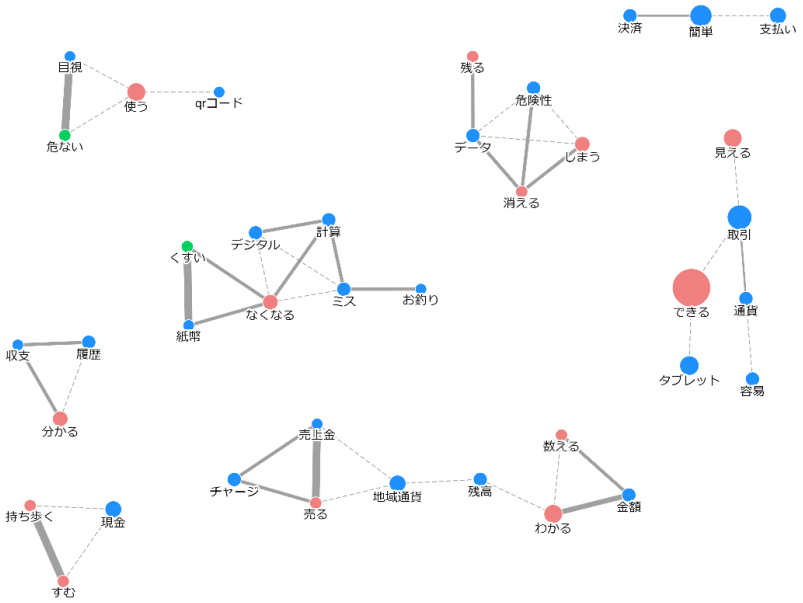

Figure 4. Impressions of D-Charge type CC (Game Ⅰ)

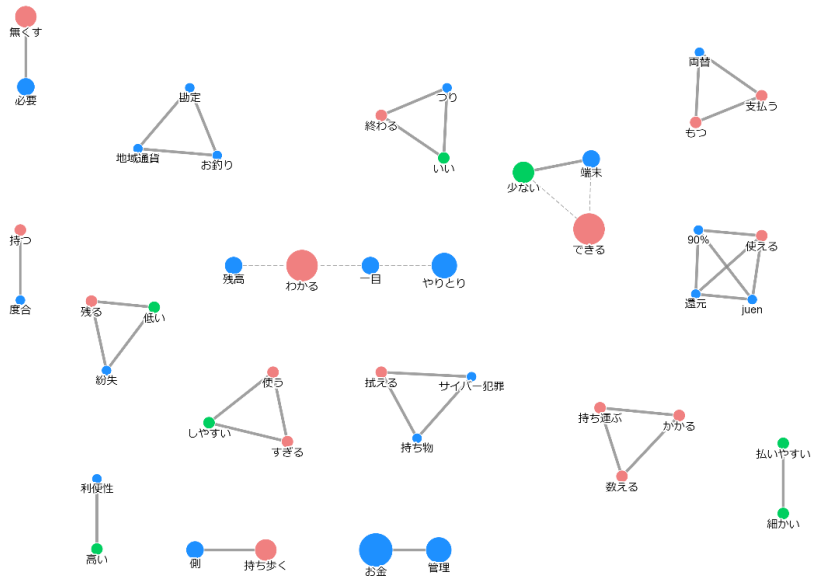

Figure 5. Impressions of D-Charge type CC (Game Ⅲ)

c) Impressions of A-LETS type CC

Figures 6 and 7 show the co-occurrence of terms used in the free descriptions of the A-LETS type CC. In Figure 6, the following points are mentioned: recording expenditures and income by hand, keeping a record of transactions, being able to use the system even with a negative balance, the need to check each other, cumbersome procedures, time consumption, difficulty in feeling the exchange, and being able to see the transactions briefly. Figure 7 indicates the following points: carrying a bankbook is troublesome, the results of transactions are visible for peace of mind, negative transactions are possible, a change in the sense of money occurs, increases, and decreases in funds can be observed, and the system is easy to use for both parties involved in transactions.

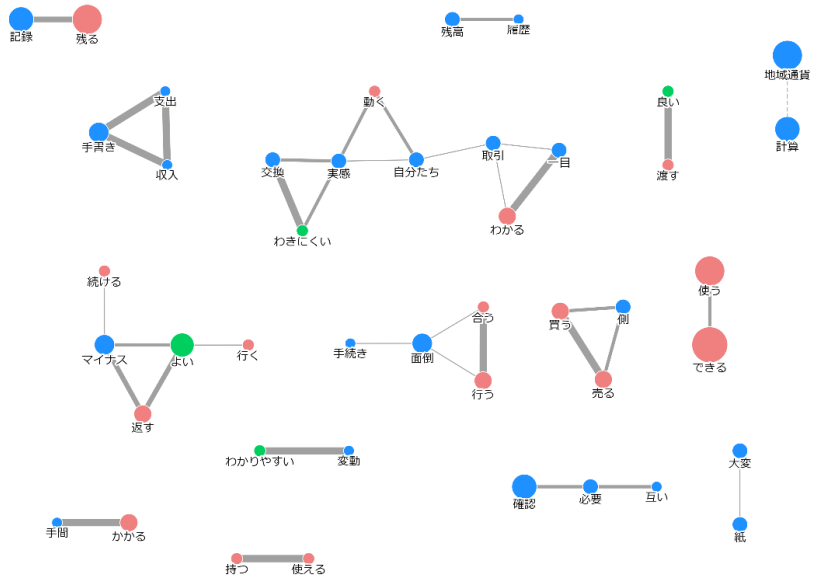

Figure 6. Impressions of A-LETS type CC (Game Ⅱ)

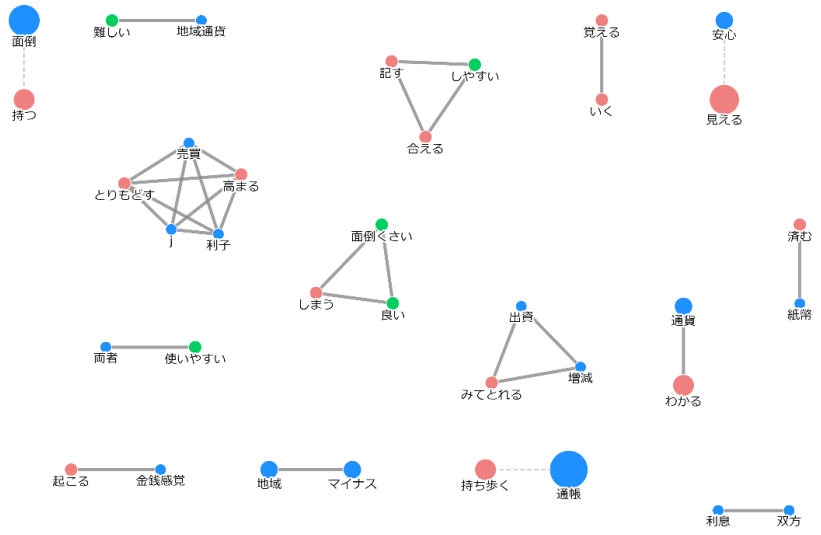

Figure 7. Impressions of A-LETS type CC (Game Ⅳ)

b) Impressions of D-LETS type CC

Figures 8 and 9 show the co-occurrence of terms used in the free descriptions of the D-LETS type CC. In Figure 8, the following points are mentioned: transactions can be made with a negative balance, calculations can be made on a tablet, calculations are automatic, easy, and convenient, input confirmation operations on an electronic device are necessary, writing is not required, and the history can be viewed

briefly. In Figure 9, the following points are mentioned: payment can be made with a tablet, transactions can be understood briefly, transaction history can be inquired, transactions of CC by multiple people are easy, and any amount can be spent without any sense of money.

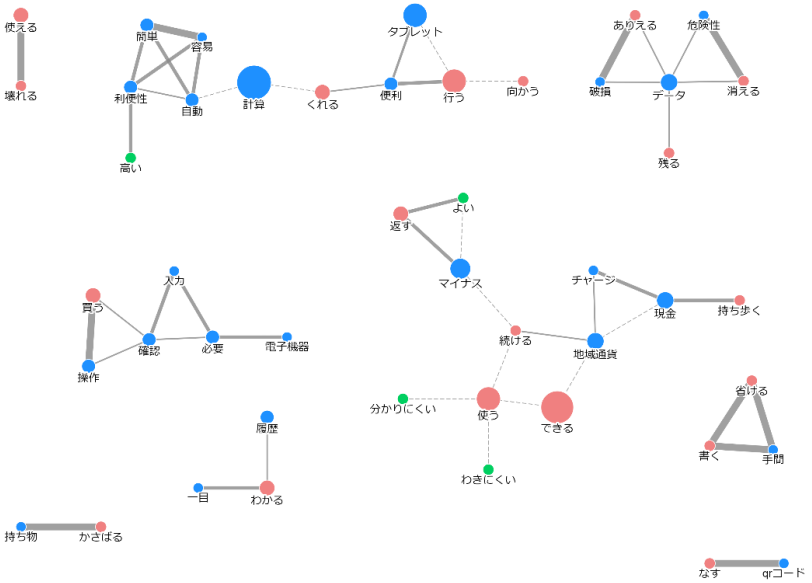

Figure 8. Impressions of D-LETS type CC (Game Ⅱ)

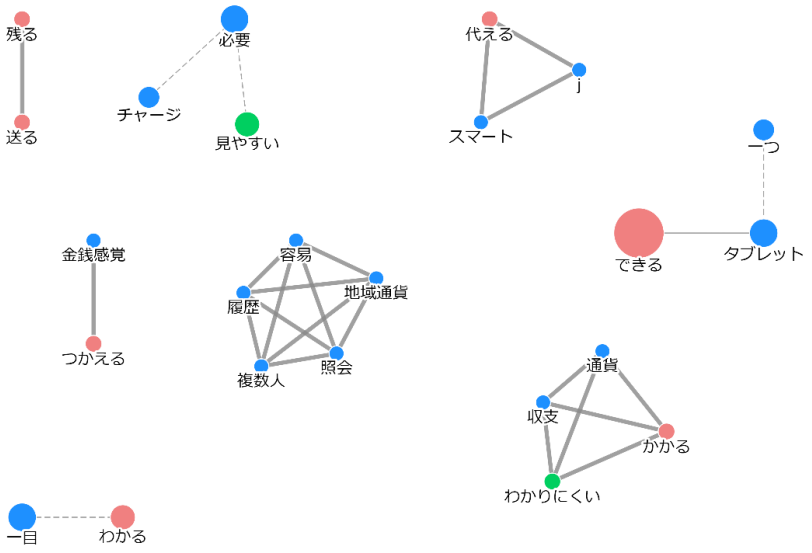

Figure 9. Impressions of D-LETS type CC (Game Ⅳ)

Regarding the co-occurrence of terms in the above free descriptions, the D-Charge and D-LETS

types of CC are similar in that they both cite high convenience as a feature, giving the impression that they do not reflect the original characteristics of analog currencies. Therefore, we categorized and compared the free descriptions of the two types of digital currencies[6] (Table 6). The numbers in the table indicate the number of descriptions that fit each category. According to the results, the features common to both the D-Charge and D-LETS types are high convenience, visualization of transaction data, retention of data history, smart, insubstantial, and smooth exchange, among others.

The characteristics unique to the D-Charge type, which is a digitalized version of the Banknote type, were that unlike paper currency, it is cumbersome to handle, it eliminates the risk of losing paper currency, it is cashless and bold in usage, it reduces communication, and the degree of happiness is subtle. The characteristics unique to the D-LETS type, which is a digitalized version of the A-LETS, are that transactions can be made even with negative balances, transactions can be made with a tablet, automatic calculations are easy, cash cannot be charged, there is no sense of money, the user does not feel a real sense of money, and transactions can be confirmed briefly.

These results indicate that convenience is the most frequently cited feature of digital currency, suggesting that it is recognized as an advantage of digitalization that eliminates the need to use paper money, record each transaction, and have the counterparty confirm it, as in the case of A-LETS type transactions. Furthermore, as a characteristic peculiar to the D-charge type, the advantages and disadvantages of eliminating the need to use banknotes were mentioned, while the characteristic of the feeling of happiness was also mentioned as a subtle feature of use. Regarding the features unique to the D-LETS type, the advantages of eliminating the labor required to record and calculate each transaction in the A-LETS type and the differences from the digital charge type were mentioned, as well as the feeling of not having a sense of money and not feeling a real sense of using the currency. In this respect, it can be inferred that the sense of use reflects the characteristics of each analog currency.

Table 6. Comparison of characteristics of free statements regarding digital CCs

Characteristics	Features of D-Charge type	Features of D-LETS type
Convenience	38	16
Risks of Digital Currency	12	4
Visibility of transaction data	11	6

[6] We used MAXQDA2022 in our analysis.

Cumbersome to handle	5	0
Cost of using cash	5	0
Data history saved	3	6
Cashless	3	0
Bold in usage	3	0
Smart	2	1
No substance	1	1
Smooth interaction	1	1
Unfamiliar	1	0
Digital divide problem	1	0
Reduced communication	1	0
Need to confirm with other people	1	0
Easy to pay small amounts of money	1	0
You are tempted to charge anyway	1	0
Liberating	1	0
I don't feel happy	1	0
Confirms the value of the CC	1	0
Transaction security	1	0
Can be used even with a negative balance	0	11
Money can be transferred using a tablet	0	7
Automatic calculation	0	6
Easy to operate	0	4
Cannot be recharged with cash	0	4
Cannot be redeemed for cash	0	3
Easy to calculate	0	3
Not much sense of money	0	2
No need to give money directly	0	2
No need to write	0	2
Easy to carry	0	2
No need to carry bulky items	0	2
No need to carry paper money	0	1

Easy to manage	0	1
Difficult to feel like you paid for it	0	1
Difficult to see the balance of money briefly	0	1
Easy to read the display	0	1
Can be done without facing people	0	1
Fast transaction	0	1
Difficult to know how much was spent on which product	0	1
Confirm with each other	0	1
Need to confirm with other people	0	1
Can send messages	0	1
Easy to save money	0	1
Can only be used within the community	0	1
Currency is not reliable	0	1
Can transact with several people simultaneously	0	1
Can be used at any time	0	1
No interest	0	1

3-2-3 Evaluation of Four CCs

Finally, this study examines the participants' evaluations of the four forms of CC issuance that they completed on Worksheets II and IV. Table 7 shows the results in which participants ordered the four CCs used in the game according to the issuance form in which they promoted local economic activity, strengthened community ties, and the form they wanted to use. The numbers are the averages of the rankings, with smaller numbers indicating higher rankings. The figures in parentheses indicate standard deviations.

Table 7. Evaluation of Four CCs

	Form of issuance that promotes local economic activity		Form of publication that strengthens community ties		Form of issue you want to use yourself	
	2018	2019	2018	2019	2018	2019

Banknote	3.42 (.99)	2.59 (.94)	2.38 (1.39)	1.75 (.78)	3.38 (1.04)	2.65 (.86)
D-Charge	1.92 (.64)	1.94 (.75)	2.77 (.73)	2.94 (1.12)	1.69 (.95)	1.59 (.71)
A-LETS	3.08 (.64)	3.65 (.70)	2.08 (.86)	2.38 (1.26)	2.92 (.86)	3.76 (.56)
D-LETS	1.54 (.97)	1.82 (1.07)	2.77 (1.36)	2.94 (.93)	2.00 (.82)	2.00 (.94)

Table 7 shows that the D-LETS type and the D-Charge type were the top issuance types that promote local economic activities, indicating that the convenience of digital currency was highly evaluated. Conversely, the Banknote type and the A-LETS type were the most popular forms of issuance for strengthening ties among local communities. As shown in Table 6, this may be due to the decrease in communication due to digitalization and the influence of the sense of use such as subtlety and the lack of a real feeling of happiness. Regarding the type of issuance that the participants would like to use themselves, the D-Charge type and D-LETS type are at the top of the list, which can be understood as a result of their high level of convenience.

4. Discussion

This study examined the impact of digitalizing CCs by evaluating the hypotheses:

Regarding Hypothesis 1, both the transaction data and the evaluation of the CC by the participants confirmed that the digitalization of the Banknote-type is recognized as having more local economic benefits. For Hypothesis 2, the D-LETS type was not selected as a form of issuance that strengthens community ties. Even when its characteristics were compared with those of the A-LETS type, the improvement in convenience was focused on, and it was not regarded as a form that promotes more communication than the A-LETS type.

The findings of this study indicate that while the digitalization of CCs is highly valued as a means of promoting the circulation of resources within a region by increasing their convenience, digitalization itself does not increase the fertility of the community-building function using such currencies. For digital CCs to continue to grow as a means of stimulating economic activities based on community ties through the sharing of common ideals and values, it may be important to provide users a sense of belonging to a community that shares common ideals and values using the currency, in addition to improving the convenience for users at the settlement stage. Since Com-Pay, the digital CC used in this study, does not have such a function, it is necessary to experimentally verify the kind of post-use feedback that will enhance the sense of belonging of users to a community.

Acknowledgments

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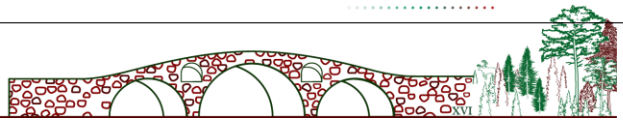

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Monetary ecosystems

LOCAL CURRENCY CHIEMGAUER AND THE QUANTITY THEORY OF MONEY

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Keywords
Chiemgauer, Complementary Currencies, Local Currencies, Theory of Money

Abstract

The roots of the Chiemgauer are closely related to the quantity theory, which has a long history and goes back in its modern form to David Hume and John Locke. Keynes admits a high value to the quantity theory. Despite extensive and diverse criticism of the quantity theory, it can be very helpful in the context of complementary currencies, especially if they are linked to an experimental character and to social und ecological goals. The empirical part begins with a data collection on the Chiemgauer and leads to experimental application via a contextual representation of quantity theory.

CONTENT

1 THE COMPLEMENTARY CURRENCY CHIEMGAUER

The regional currency Chiemgauer was developed in 2003 in Prien am Chiemsee at a Waldorf school. Initially, only 20 companies and 30 consumers were involved. After one year, 100 acceptance points and 200 consumers took part. This dynamic growth continued in the following years. In 2022, more than 700 companies and associations as well as 4,000 consumers will be members of the Chiemgauer. The annual turnover has risen from 70,000 Chiemgauers in the first year to over 5.6 million Chiemgauers in 2020. The Chiemgauer is a reserve-backed complementary currency (Gelleri, 2020b). The most important reserve is the national currency euro. Each Chiemgauer issued is covered by one euro, and the value of the Chiemgauer unit of account is also one euro. In addition, there is also participation in local energy production, which can also be regarded as a reserve.

In addition to strengthening regional economic cycles, the largest share of the Chiemgauer fees is used to promote non-profit associations. Every year, more than 50,000 Chiemgauer are donated to charitable projects. Since the Chiemgauer's foundation, more than 850,000 Chiemgauers have been given to projects. These funds were financed from fees that were charged for the exchange of Chiemgauers into euros. The fees were returned to the money cycle via the non-profit organizations and provided further sales for the companies.

Since there is already a lot of descriptive literature on the Chiemgauer (Gelleri, 2008, 2009; Herrmann, 2005), this paper focuses on a monetary theoretical aspect. Integrated into the Chiemgauer is a special feature, i.e. a circulation incentive. Anyone who holds the Chiemgauer for a longer period pays a fee of 6% per year for the preservation of value. In the case of cash, this is implemented by stickers worth 3% each. With the electronic Chiemgauer, implementing the circulation incentive is carried out by a formula that is calculated daily and works exactly like calculating negative interest rates. One difference is that the fee is not due immediately but only after a certain amount of time. Recipients of the digital Chiemgauer have three months to pass it on before fees are due.

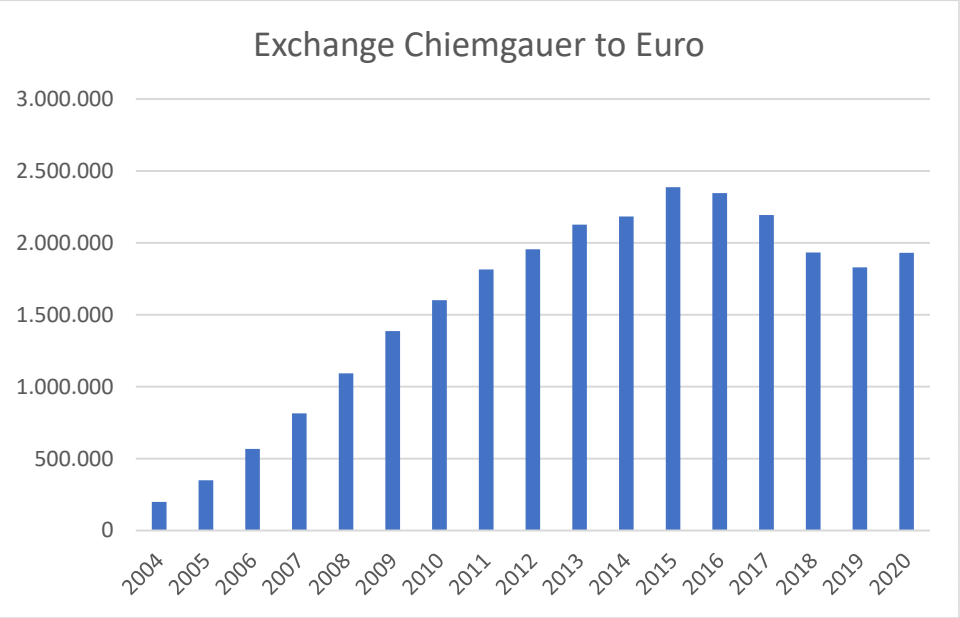
1.1 IDEA AND GOALS OF THE CHIEMGAUER

The idea behind this is to influence the speed of money in circulation (Assenmacher & Krogstrup, 2018, p. 10). To better understand the mode of action, it is necessary to present the theory behind this idea. This aspect covers only a small part of the living environment of the Chiemgau regional currency. We take a look under the bonnet, so to speak, and examine parts of the overall machine. Looking at the machine, we allow ourselves to explain part of the mechanism of action. A complementary currency is much more than a mechanism. It includes people, a network of institutions, relationships, feelings, and much more. Ideally, the mechanics promote the living environment of a complementary currency.

One of the goals of the Chiemgauer currency is to promote business cycles. The regional focus increases the turnover of the participating companies and leads to a better usage of the existing capacities. The number of unemployed in a place is suitable as a criterion for measuring the activity of a complementary currency. For this purpose, developments over time are examined empirically and analytically to check the operationalized measurement criteria. The Chiemgauer database is used for the analysis. The author retrieves the data from the system using SQL queries. For complex requests, programmers were involved who built the query according to the author's specifications. The execution and adaptation of the queries were again carried out by the author. For comparisons, statistics on the region are used, usually from the Bavarian State Office for Statistics. Economic data are used by common databases of the European Union (Eurostat), the European Central Bank, the OECD, and others. The respective data basis is indicated in the statistics.

1.2 Components of the Chiemgauer Cycle

The Chiemgauer cycle begins with consumers exchanging euros for Chiemgauers. This activity looks like this in total over time[1]:



Year	Exchange Cto€
2004	198,991
2005	349,917
2006	567,861
2007	814,402
2008	1,092,614
2009	1,386,880
2010	1,601,649
2011	1,814,953
2012	1,954,878
2013	2,127,225
2014	2,183,669
2015	2,387,405
2016	2,345,516
2017	2,193,007
2018	1,932,985
2019	1,829,153
2020	1,930,365

FIGURE 1: ANNUAL AMOUNT OF EXCHANGE FROM EURO TO CHIEMGAUER (BLUE) FROM 2004 TO 2020, GRAPH AND TABLE

The monthly exchange of euros for Chiemgauers had been on a continuous upward trend until 2015. From 2016 onwards, the number of monthly exchanges has fallen. This trend was interrupted by the Covid-19 pandemic, which can be explained by solidarity effects within the community, but also by an increased demand for high-quality food and other products from the region.

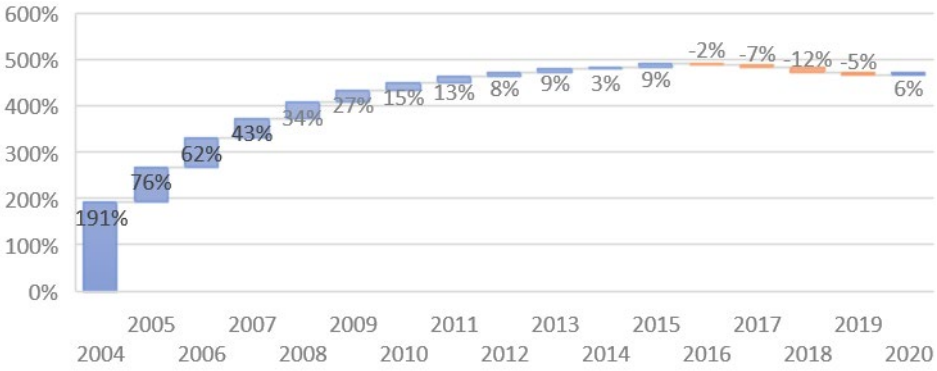


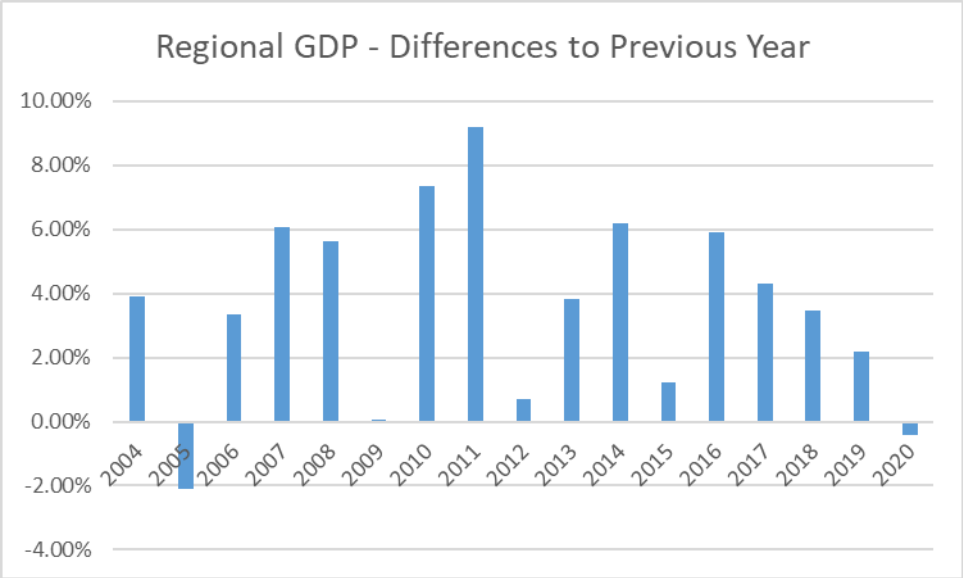
FIGURE 2: EXCHANGE WITH DIFFERENCE TO PREVIOUS YEAR IN PER CENT

Double-digit growth rates were achieved until 2011. In the following years, growth rates declined. This is because a high level of penetration has been achieved in sectors such as food retail. From 2016 onwards, there were saturation tendencies among companies, for example in the handcraft sector, which were related to an economic boom in the region between 2015 and 2019. In 2020, there was, surprisingly, a U-turn because consumers

[1] The data was collected by the author via SQL queries of the Chiemgauer database and evaluated in anonymous form. The graphics were created by the author.

placed higher value on regionally and organically produced goods in times of lockdown. The data for 2022, however, shows the opposite effect, and it is not yet clear what consequences the crisis year 2022 will have for the regional economy.

If the economic data for the regional value added in the region are included, changes in the Chiemgauer exchange can be partially explained. For example, the region's boom phase in the years 2016 to 2019 seems to have had a countercyclical effect on the Chiemgauer exchange.



Year	CHM M1
2004	33,329
2005	58,428
2006	75,428
2007	131,834
2008	227,640
2009	243,816
2010	400,757
2011	517,552
2012	574,777
2013	596,000
2014	724,097
2015	897,521
2016	913,054
2017	669,460
2018	672,572
2019	670,324
2020	791,251

FIGURE 3: REGIONAL GDP IN THE DISTRICT OF TRAUNSTEIN - DIFFERENCES TO PREVIOUS YEAR IN PER CENT

The study of regional economic data and the Chiemgauer variables is not further elaborated at this point. Reference should be made to econometric analysis, which was developed together with James Stodder of Boston University (Gelleri & Stodder, 2021). This approaches the Chiemgauer via existing data and initially does not require its own theory. Only data movements are compared with each other and checked whether there is a co-integration of these movements. In this article, an attempt is now made to find a possible explanatory approach to the mechanics of the quantity theory. For this, we need further empirical data on the Chiemgauer, above all data about the money supply. With the exchange in Chiemgauer, the main part of the money supply $M1_C$ is created.

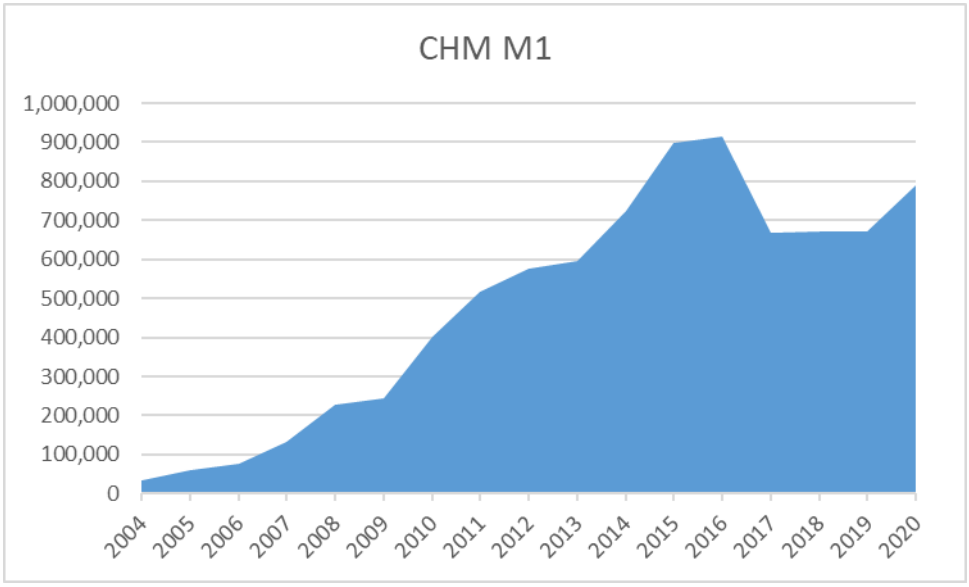


FIGURE 4: MONEY SUPPLY OF THE CHIEMGAUER M1 (DIGITAL + CASH)

The Chiemgauer money supply, consisting of cash and digital Chiemgauer, initially increased continuously. There were above-average increases in 2008 with the introduction of the digital Chiemgauer parallel to the financial crisis, and in 2010 with the beginning of the euro crisis. A second boost was recorded in mid-2014. The Chiemgauer money supply declined from the beginning of 2016 until the end of 2019, when there was a rebound, with an acceleration in 2020.

1.3 Relation between Digital and Cash Chiemgauer

When we compare the annual exchange of euros for Chiemgauer notes and the digital Chiemgauer, we can see an increasing importance of the digital Chiemgauer:

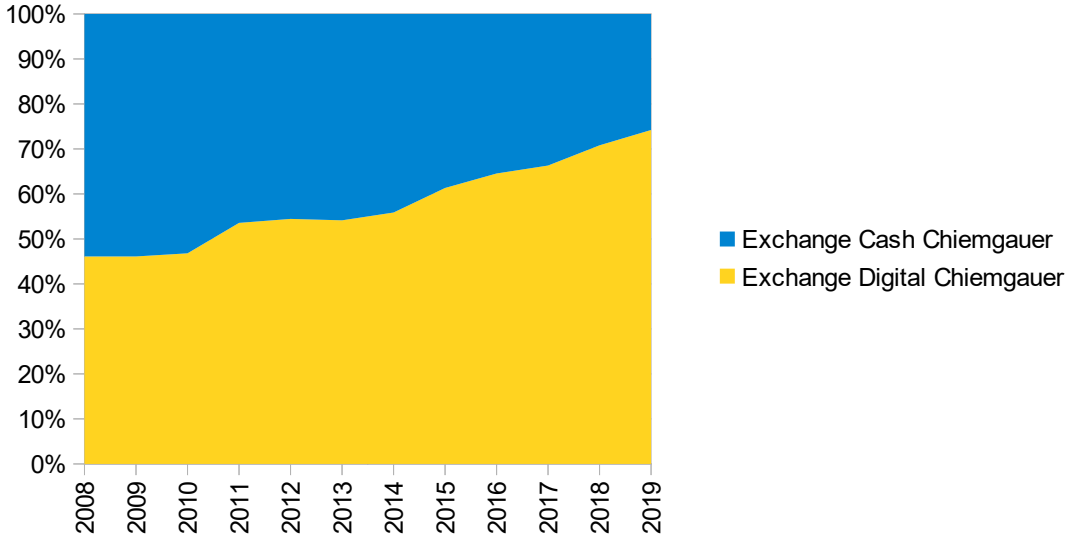


FIGURE 5: COMPARISON OF CASH CHIEMGAUER AND DIGITAL CHIEMGAUER

Since the introduction of the digital Chiemgauer in 2007, the share has steadily increased and now stands at three quarters of the total exchange. Despite the love of many members for the Chiemgauer paper currency, most consumers prefer the digital Chiemgauer in

everyday consumer life because it facilitates the processes and is therefore not perceived as an additional burden (Ziegler 2009, p. 57).

This is based on a general trend towards cashless purchases, which is visible above average among the younger generation, and also among the female population (Bundesbank 2018, p. 51). For the period from 2014 onwards, the Deutsche Bundesbank states: “The downward trend between 2011 and 2014 towards the substitution of cash by cashless payment instruments has thus accelerated somewhat” (Bundesbank 2018, p. 8).

The Covid-19 pandemic has caused another strong shift to electronic forms of payment. In the meantime, the share of cash in retail has fallen below 40%. At the end of 2019, the share of the Chiemgauer paper currency was only 25%. Of the participating Chiemgau companies, 128 acceptance points have so far offered the option of digital payment by Regiocard or to the Chiemgauer current account. This corresponds to 30% of the participating companies, which accounted for 75% of Chiemgauer sales.

In practice, this leads to a two-sided perception of the Chiemgauer. While the acceptance points that accept the digital Chiemgauer deal with a high demand, the points of sale that only accept Chiemgauer cash often feel like activity is decreasing. This feeling coincides with the actual sales figures for digital Chiemgauer and cash Chiemgauer. Nevertheless, the Chiemgauer Initiative continues to offer both means of payment, as Chiemgauer cash is still more widely perceived by the public. To this day, many do not know that there is a digital Chiemgauer at all. The symbolic significance of Chiemgauer cash should therefore not be underestimated.

1.4 CHIEMGAUER SALES

The collection of data on Chiemgauer sales is anything but easy. The simple part is to perform the database queries for digital Chiemgauer sales. The collection of cash turnover in Chiemgauer is much more difficult, as a full survey of more than 700 acceptance points is difficult and a voluntary survey leaves a gap.

Together with several students, the author has led surveys over several years, which included, among other things, the questions of the Chiemgauer cash turnover and how much of it was spent again in Chiemgauer (Cremer et al., 2020; Großschmidt, 2008; Ziegler, 2009):

Study	Year	Businesses	Sample	Spent again (w)	Error margin
Joerg Großschmidt	2006	540	106	61%	11%
Franziska Ziegler	2007	631	110	69%	11%
Alexander Christ	2013	627	145	66%	9%
Cramer et. al.	2020	491	28	80%	24%

To test the reliability of the surveys, the sample size was compared with the population size, i.e. the number of companies participating in the respective year. An average value was determined from the individual data of the entrepreneurial Chiemgauer expenditures (“w”). Due to the response rates (sample), there are error margins between 9 and 24% at a confidence level of 99%, although the last survey is probably an outlier due to the low response rate. The survey by Christ shows the highest accuracy with a transfer rate of 66% and a margin of error of +/- 9%.

Based on anonymized data summaries, an exact transfer rate can be determined for the digital Chiemgauer. The revenue share of the digital Chiemgauer was 69% in 2019 and therefore makes a significant contribution to explaining the quota:

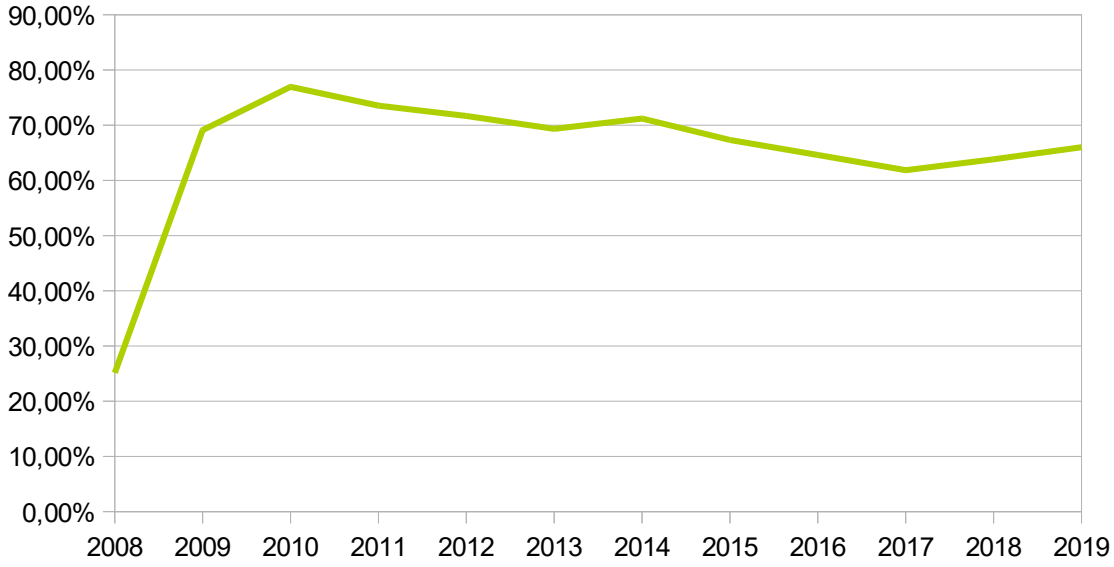
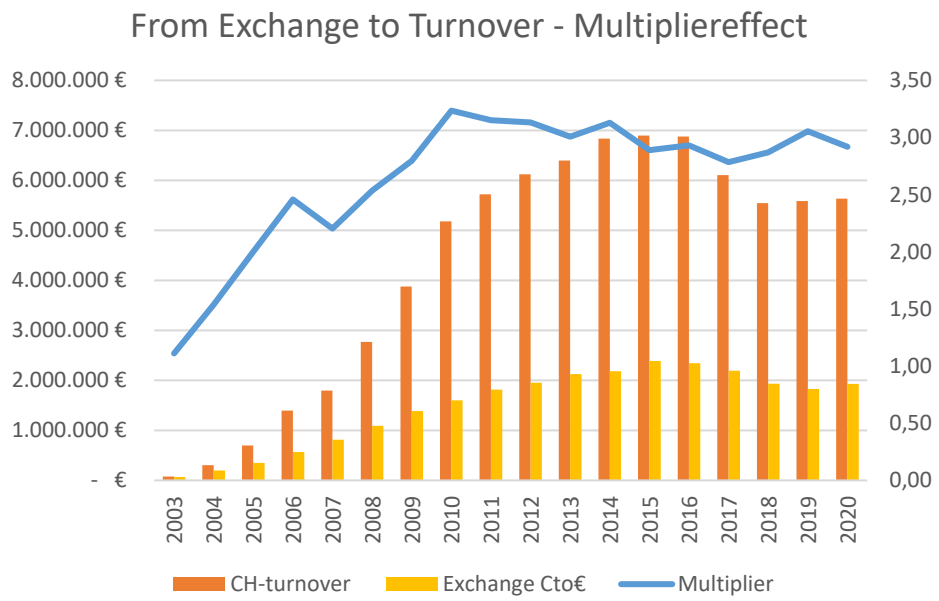


FIGURE 1: TRANSFER RATE OF THE DIGITAL CHIEMGAUER

In 2008, the digital Chiemgauer was launched and had only a few participants. Already in 2009, however, a high level of transfer was reached, which averaged 69%. The course has been relatively stable since 2009 in a range between 62 and 77%.

Based on the surveys and the data for the digital Chiemgauer, a quota is assumed for the cash Chiemgauer that corresponds to the average transmission rate of the digital Chiemgauer. If the lower margin of error of the Ziegler and Christ surveys were to apply to the cash Chiemgauer so that the transfer rate would only be about 57%, the influence on total sales would be minus 3.6%. Conversely, with a transfer rate of 75%, the upper deviation would be 1.8%. For further consideration, these relatively small deviations seem negligible.

The meta-evaluation results in an overall picture that leaves little doubt as to how many Chiemgauers are spent on average and how many are exchanged back after each sales process. The Chiemgauer turnover is calculated from the direct query of the digital turnover, the Chiemgauer cash exchange, and the multiplier effect, which arises from the fact that the cash income of companies is passed on to other companies.



Year	CH-turnover
2003	75,873 €
2004	306,140 €
2005	699,834 €
2006	1,395,705
2007	1,794,956
2008	2,769,896
2009	3,877,760
2010	5,181,911
2011	5,720,779
2012	6,121,513
2013	6,396,166
2014	6,834,431
2015	6,897,551
2016	6,877,490
2017	6,106,737
2018	5,546,780
2019	5,587,180
2020	5,634,903

FIGURE 6: EXCHANGE, MULTIPLIER AND CHIEMGAUER-TURNOVER

On the left side is the scale for the Chiemgauer exchange and the Chiemgauer turnover. On the right side is the scale for the Chiemgauer multiplier, which expresses that an exchanged Chiemgauer generates x times the turnover. A multiplier of 3 therefore means that the exchange of one euro causes a Chiemgauer turnover worth three euros (see also formalized description: 3.1).

In 2019, a Chiemgauer turnover of 5.59 million euros was achieved. The turnover consists of a digital Chiemgauer turnover of 3.87 million euros, a cash exchange of 0.53 million euros and a cash transfer worth 1.18 million euros. Total cash sales amounted to 1.7 million Chiemgauers. The multiplier was thus about 3. The risk of a larger deviation is very small, as the margin of error for the cash transfer is about 10%, which only amounts to about 0.1 million euros.

Now that we have compiled and explained the most important components, we can now turn to quantity theory. First, the theory is explained, then it is applied to the empirical data.

2 Fisher's Quantity Theory of Money

Irving Fisher formalizes the quantity theory. Accordingly, the nominal gross domestic product of a country results from the multiplication of the money supply by the velocity of money in circulation (Fisher, 1911/1922).

$$M \times V = T \times P$$

The transaction volume "T" valued in prices "P" is the result of the money supply "M" circulating in the national economy ("V"). Wicksell speaks of changing hands, i.e. how often a coin changes hands in a period: "We thus define the velocity of circulation of money simply as follows: the number of times that the existing coins change hands on average by way of purchase and sale (i.e. not by way of loan) during the selected unit of time, e.B. a year" (Wicksell, 1898, p. 46).

Excluded are, therefore, circuits with the purpose of brokering investments, gifts, and similar circulations that do not have the objective of the turnover of goods. If the money is not used, Wicksell calls this interval “rest period” of the money (Wicksell, 1898, pp. 46–47). The Chiemgauer is therefore about avoiding a too long rest period; for example, the electronic Chiemgauer sets a negative interest rate from the 91st day onward.

2.1 Quantity Theory of Money Extended by Complementary Currencies

In his remarks, Fisher differentiates between cash and book money created by banks. Accordingly, both have different amounts of money and velocity of circulation:

$$M \times v + M' \times v' = T \times P$$

M' stands for the money created by the banks, and V' for the velocity of the bank sight deposits. The Chiemgauer can also differentiate between the amount of cash (M_C) and the amount of digital complementary currencies (M'_C) as well as the respective circulation speeds. If complementary currencies are also considered in the formula, the following extension results:[2]

$$M \times v + M' \times v' + M_C \times v_C + M'_C \times v'_C = T \times P$$

The turnover valued in prices could be expressed as the sum of the turnover achieved in euro and in complementary currency. Since the turnover is included in the overall statistics, identity is expressed with transactions on a national level; therefore, no further subdivision is made.

Consequently, the turnover is the sum of the respective amounts of cash created (M_P), bank balances (M_B) including balances of the e-money and payment institutions as well as the complementary currencies. If a 50 euro note is collected five times from companies as a turnover, this corresponds to a cash turnover of 250 euros (50 x 5 = 250). The same applies to the balance on a current account, which is transferred three times to other accounts (50 x 3 = 150).

Since the turnover also includes intermediate consumption and thus the added value of a product is calculated several times, James W. Angell corrects the sales by the respective intermediate consumption (Angell, 1936/1969). This results in the gross value added “Q” and thus the formula M x V = Q x P. When calculating the orbital velocity, care must be taken to make sure that the same formula is always used. For example, in a research paper, the velocity of the euro was calculated using the “Q formula”, while for the complementary currencies the transaction-based velocity of circulation was determined (de la Rosa & Stodder, 2015). This error is avoided by converting with a correction factor resulting from the ratio of sales to gross domestic product (T/Q).

When banks create new money, central bank money is also created at the same time, which is not considered in the quantity equation because it does not circulate in the economy. For some years now, the opening of central bank money to the public has been the subject of discussion. Digital central bank money is already being used in some places in China, so these amounts of money would have to be included in M.

[2] The “C” stands for “complementary”.

Euro banknotes and coins account for 11.6% of the circulating money supply, and the daily balances created by banks are 88.3% (Bundesbank, 2019b). The role of the endogenous money creation of the banks is thus dominant and also dominates in the theoretical presentation of the common economic theoretical strands (Şener, 2014, p. 5).

2.2 Quantity Theory as Pure Tautology?

The role of quantity theory is questioned for various reasons. It is charged with being meaningless because the money supply results endogenously from the economic process. It is seen as merely a tautology:

“Indeed, it is a tautology, summarized in the famous quantity equations, that all changes in nominal income can be attributed to one or the other – just as a change in the price of any good can always be attributed to a change in either demand or supply. The quantity theory is not, however, this tautology.” (Friedman, 1987, p. 3)

The formula is “neutral” and contrasts the monetary side with the real economic side. Put simply, the sums of purchases (M x V) and sales (TxP) are the same. In this sense, quantity theory is tautological; however, the simplicity and clarity of the formula makes it possible to discuss monetary theoretical and monetary policy approaches from a normative and empirical point of view. Monetaristic representations assume a production potential that is optimally fully exploited by corresponding money supplies and money circulation. The velocity of money circulation is neglected because it is assumed that it behaves relatively steadily in phases of peace (Friedman, 1987, p. 28). This is also true for the USA in the period between the Second World War and the financial crisis of 2008. The velocity of circulation in Europe, Japan, and many other countries has been subject to a declining trend since the 1980s.

This is explained by high saving rates. If the banking system and the central banks do not succeed in exploiting the optimal production potential, there will be an output gap.

$$T_{opt} \times P_{opt} - M \times v - M' \times v' > 0$$

The Keynesian analysis cites a lot of reasons how an imbalance in this form can occur, and why full usage without economic policy measures is more of a special case (Keynes, 2013, p. 28). Typical examples are a slump in the credit creation activity of banks as it occurred during the financial crisis, but also a sharper decline in the speed of money in circulation. The cause of the decline could be manifold. A convincing explanation is provided by explanations that find the cause in the increased propensity to save, which are discussed under the keyword of saving glut. Empirical studies identify, above all, the savings of companies as relevant for economic fluctuations (Klug et al., 2021).

2.3 Combining Quantity Theory with Community Goals

To assess the macroeconomic situation, Bofinger proposes a social loss function that goes back to Okun in its origins (Bofinger, 2010; Brunnermeier & Sannikov, 2016). The focus is on unemployment and monetary stability, and, depending on the political focus, either one goal or the other is in the foreground. In the Misery Index, unemployment and inflation are equally weighted and added together (Bofinger, 2010, p. 301). This is an extremely strong simplification. Bofinger's loss function considers weightings with factors and considers target values such as the inflation target of close to but below the two percent target set by the

European Central Bank (Bundesbank, 2019a). For our purposes, we can use the Misery Index as an indicator to explain a region's need for a complementary currency.

Agnell, like Fisher, emphasizes the need to compensate for a declining velocity of circulation during recessions by increasing the money supply. Interest rate and open market policies are available as a means of monetary policy (Lee & Wellington, 1984, 973). Fisher and Angell also point to the minimum reserve as a strong lever for reliable control of the money supply (Lee & Wellington, 1984, p. 974). This led to the proposal of a state sovereign money and a simultaneous end to the endogenous creation of money by the banks (Huber, 2018). Keynes and Lerner, however, argue, in the event of a decrease in the velocity of circulation, for an expansion of the money supply through borrowing by the state to ensure an effective macroeconomic demand (Keynes, 2002; Lerner, 1943). Additionally, there are a variety of monetary, fiscal, and structural policy approaches to optimize the usage of potential output targeted by the analysis of the quantity equation (Samuelson & Nordhaus, 1998, pp. 692–717). The fundamental debates are partly reflected in the design of a complementary currency, even if this theoretical background is often not explicitly discussed.

Ultimately, it does not matter whether an output gap is triggered by failed exogenous management, restrained endogenous bank money creation, or a surprising externality. As soon as output gaps arise and persist despite economic policy measures, the question arises as to whether complementary currencies can help balance the balance temporarily or permanently.

Similar to regular monetary policy, complementary currencies can send signals to market participants. An increase in the money supply M_C means higher liquidity for those who participate in the complementary currency. The provision can be made via an interest rate that is lower than in the regular credit market. Especially for small and medium-sized enterprises, the differences can be even more significant if there are no more loan additions in the regular market. Such a “credit crunch” can be defined as follows:

“Accordingly, there is a credit crunch if there is a significantly higher credit demand surplus than the long-term average for a given economic environment and company creditworthiness. An essential feature of this credit crunch term is that both environment-related variables and company-related factors are taken into account.” (Reize, 2010, p. 6)

In this case, M_C can take on the role of M', i.e. the credit creation activity of the banks. It is also conceivable that a complementary amount of money is put into a network as exogenous money creation. Complementary currencies, which combine the approach with an unconditional basic income, give a certain amount of money in complementary currency to all participants each month. In experimental projects like Circles, Gradido, and Lindentaler, the amount of money is centrally controlled and put into circulation, often combined with high transaction fees or negative interest rates. The problem here is the real side of Q, because only a few businesses are ready to accept such monies. For businesses, the currency only has value if they can spend it again. A solution would be the state accepting the currency for taxes, but this would need a democratic decision that an unconditional basic income should be paid. Another solution could be that common property like land is used. Such projects show that the creation of money alone does not solve any problems. The quantitative theory of money focuses on the necessity that the monetary side has to be linked to the real side of the economy.

2.4 APPLYING QUANTITY THEORY TO CHIEMGAUER

In the case of the Chiemgauer, the increase in the money supply takes place through the purchase of Chiemgauers with euros. Rösl assumes a substitution of the euro by the Chiemgauer (Rösl, 2006); however, the euro money supply remains the same and continues to circulate in the banking system because the euro is deposited with a cooperative bank and the latter can make loans with it. Only if the bank deposited the deposit with the European Central Bank or if the amount were set aside as cash in a vault would the euro money supply be reduced. Hayek uses the example of the ducat to discuss whether a 100% deposit in cash, gold, or with a bank is required at all (Hayek, 1977). For the establishment of such a system, confidence-building is crucial, so he pleads first for a 100% reserve, which guarantees the money holder of an alternative currency to get paid the currencies recognized in the public (Hayek, 1977/1990, p. 49). Once trust is built, however, the currency issuer can work with the money, preferably by issuing loans in their own currency (Hayek, 1977/1990, p. 50). With the Chiemgauer, the 100% reserve was always retained, but possibilities were developed with banks to give loans directly from the reserves in euros or Chiemgauer to the network participants.

Another assumption made by Rösl is that the demand for money for euros (M ↓) decreases when the demand for money for Chiemgauer (M_C↑) increases. An empirical evidence for this statement is not presented. Instead, it is based on the assumption of “superneutrality” of money, which has no influence on the utilization of the production potential or even on the size of the production potential itself:

“This result, as in the traditional Ramsey and Sidrauski model, is independent of the growth rate of the money supply, i.e. money is 'super neutral' in the long run.” (Rösl, 2006, p. 30)

Accordingly, it would always be only a matter of shifts in means of payment, but no expansive impulses could be set by money. Monetary policy would therefore be an illusion behind the veil of which the real economy would always run as the potential provides. From Rösl's point of view, the money creation activities of the complementary currencies are a negligible residual ($T_{opt} \times P_{opt} - M_K \times V_K - M_B \times V_B = 0$).

An alternative to the Rösl model was presented by Guenther Rehme. This complements Sidrauski's model with two essential components: firstly, the tendency to own assets that create a benefit in addition to money. The propensity to save and the benefits realized by wealthy people through real estate and equities are taken into account (“Love of Wealth”). Secondly, fees on money are included as an influencing factor for holding money. The benefit functions show that perseverance costs on money change the behavior of those involved and lead to shifts in consumption (Rehme, 2018).

The Chiemgauer views money as a “production factor” (Binswanger, 2013). With money, production is merely set in motion, and sophisticated collective money designs are needed that optimally activate people's abilities (Desan, 2017, p. 111).

Within this view, a complementary currency does not only go beyond the perpetual motion view. For example, in the Sidrauski model, which relies on markets that are as self-controlling as possible (Polanyi, 1944/2001). Initially, output gaps are addressed, but it depends very much on the quality of the goods that are to be produced. Money becomes the activation factor of idle skills in the context of goals that may impose further limits on the

production of goods, such as the avoidance of environmentally harmful products. Money design itself plays a major role in what is produced in a division of labor and what is not.

In a large currency area such as the eurozone, it is by no means possible to close the output gaps and keep the losses caused by inflation, unemployment, and environmental damage at a satisfactorily low level. Heimberger and Kapeller estimate high output gaps, especially for the peripheral countries of the eurozone (Heimberger & Kapeller, 2017, p. 15):

	Output gap	Output gap**
Periphery countries		
Greece	−9.1%	−42.1%
Ireland	−1.1%	−25.2%
Portugal	−3.9%	−12.6%
Spain	−6.9%	−25.2%
Italy	−4.0%	−15.2%
Core countries		
Austria	−0.9%	−7.9%
Germany	−0.4%	−1.4%
France	−1.9%	−8.3%
Netherlands	−2.7%	−7.1%
Belgium	−1.0%	−8.0%

FIGURE 2: OUTPUT GAPS IN THE EUROZONE IN 2014

The first column presents output gaps based on current estimates for 2014. The effects of the 2008 financial crisis are “priced in”. They show large gaps in Greece and relatively large gaps in Italy, Spain, and Portugal. The second column assumes that there would have been no breaks in production potential as a result of the financial crisis; thus, if production potential is continued at the previous average growth rates, there are sometimes much larger output gaps. Only in Germany would the output gap be small in both considerations. Due to the different growth paths that are causing ever greater inequality in the eurozone, there are recommendations to coordinate economic policy so that it would be reduced again (Gräbner et al., 2020).

Complementary currencies open up a regionally differentiated view. In a region with high unemployment, the focus will be very much on closing output gaps (Gelleri, 2019). In the Chiemgau region, however, we have been dealing with relatively low unemployment for many years. Put simply, regions with severe underutilization are more concerned with “job-creating complementary currencies”, while the Chiemgauer views itself as an “awareness-raising” complementary currency and is more concerned with maintaining, strengthening and sustainably aligning regional structures and directing funds into cultural and social areas (Gelleri, 2020a). Nevertheless, it is intuitively obvious to assume that the volume of complementary currencies is likely to be greater in regions with severe underutilization.

3 APPLYING QUANTITY THEORY TO THE CHIEMGAUER

Quantity theory has certain weaknesses in the context of the prevailing monetary system. Milton Friedman in particular has contributed to a negative image of quantity theory by claiming that the money supply has a direct effect on the price level (Friedman, 1987). The quantity theory developed by Fisher counters this simplification by considering the velocity of circulation. This connection was known much earlier, when John Locke pointed to the

possibility of hoarding saved finances (Locke, 2020). But Aristotle and Plato were also beyond the ideas of a “naïve quantity theory” in their trains of thought (Aristoteles, 1911; Binswanger, 2009, p. 68).

Another reason quantity theory plays a less prominent role is the fact that money is created by commercial banks. For the most part, money is endogenous. Also, there is not just one form of money, but different forms and also other currencies, so that determining the money supply is difficult. Due to these limitations, the components of quantity theory are fluctuating and beyond control.

With a regional currency embedded in regulated contexts, the impact on components is much greater. For that reason, applying quantity theory in the context of complementary currencies is easier. If the price level is assumed to be external because the prices are 1 to 1 excellent, and it is possible to stabilize the circulation speed of the Chiemgauer, then the turnover can be changed by influencing the money supply. From a political economy point of view, this is particularly interesting when the money supply is externalized, i.e. when the amount of money supply is not determined endogenously by the exchange of consumers but by the circulation of money supplies, for example by municipalities.

The success of the “Miracle of Wörgl” can be traced back to two factors: firstly, the money circulation rate was fixed at a high level by the money circulation security, and secondly, new money was introduced into the local money cycle (Broer, 2013). While some critics try to reduce the success in Wörgl solely to the creation of credit money by the municipality, the control of the two variables M and V is decisive in an analysis of the quantity equation (Ottacher, 2007).

Based on the Chiemgauer data, we can understand these processes even more precisely.

3.1 Multiplier Effects of Chiemgauer and Quantity Theory

From an economic point of view, the Chiemgauer begins with the exchange of euros for Chiemgauers. At the same time, a money supply is created in the network. Since not every exchanged Chiemgauer is exchanged back immediately, amounts of money are created over time which consist of the exchange of the previous periods. The money supply M_C is the sum of all impressions made, which are reduced by all back exchanges:

$$M_C = \sum_{t=1}^{\infty} (X_t - R_t)$$

Since the Chiemgauer is limited in time, they lose their validity; however, they do not reduce the money supply if Chiemgauers that have become invalid are replaced by new Chiemgauers. The same applies to the periodic devaluation of the Chiemgauer. The devaluation of the Chiemgauer is not considered on the condition that the devaluation in the same period is replaced by new Chiemgauers. They are put back into circulation by the issuer in the form of expenses.

The exchange X in turn depends on the willingness of the exchangers. Economically, the exchange can be seen as a function of income. No exchange would take place if the entire income were to be collected in Chiemgauer, so another condition is that the income is paid out in euros or another foreign currency so that it can be exchanged for Chiemgauers at all.

$$X_t = f(Y_t^{€})$$

We first describe the exchange in general as a function of the euro income in the respective period and will specify this in more detail in the further course.

Chiemgauer sales (T) valued in euro prices (P) can be represented as a money supply multiplied by the speed of money in circulation.

$$T_t^C \times P_t = M_t^C \times V_t^C = X_t \times m_t^C$$

Money supply and exchange are known from above. Initially unknown were the Chiemgauer turnover and the speed of money in circulation. The revenues as a product of the transaction quantity T in the Chiemgauer network and the prices shown in euros can also be derived by multiplying the exchange of euros for Chiemgauers by the transfer multiplier within the Chiemgauer network.

$$T_t^C \times P_t = X_t \times m_t^C$$

This multiplier results from the income of the companies and the quota of the exchange or transfer in the Chiemgauer network. As a simple example, we take 100 euros, which are exchanged for 100 Chiemgauers. These are passed on in full by the consumers, which generates 100 Chiemgau revenues. The company then exchanges 50 Chiemgauers for euros and passes on 50 Chiemgauers. The second company also exchanges half back, etc. In this case, the transfer rate (w) is 50%, and the exchange rate is also 50%. The total turnover is 100 + 50 + 25 + 12.50 + 6.75 + 3.38 + 1.79 + 0.90 + 0.45 + 0.23 + 0.12 + 0.06 + 0.03 + 0.02 + 0.01 = 100 / 0.5 = 2.

The Chiemgauer turnover can thus also be written as:

$$T_t^C \times P_t = \frac{X_t}{(1-w)}$$

By forming and equating, we get the network-internal multiplier m:

$$\hat{=} \frac{T_t^C \times P_t}{X_t} = \frac{1}{(1-w)}$$

$$m_t^C = \frac{1}{(1-w)}$$

To determine the transfer rate, participating Chiemgau companies have been surveyed (see 1.4); questions were asked about the Chiemgauer turnover achieved per month or year and either the sum that was exchanged back or the sum that was passed on. With this data, the transfer rate w or the exchange rate (1-w) could be determined.

3.2 Calculating the Velocity of the Chiemgauer and Comparing it with the Euro

For the Chiemgauer, the quantity equation with the money velocity contains only one unknown, which can be calculated directly from the known variables. For 2019, the figures are as follows:

$$V_{2019}^C = \frac{T_{2019}^C \times P_{2019}}{M_{2019}^C} = \frac{5{,}621\ Mio.\ CHM}{0{,}615\ Mio.\ CHM} = 9{,}14$$

[15]

The sales volume of the Chiemgauer was determined from the statistics of the digital Chiemgauer plus the exchange of euros for Chiemgauers plus the estimate of the passed on cash Chiemgauers, which results from the transfer rate. The Chiemgau money supply contains the daily sight deposits on the Chiemgauer accounts and the cash volume of the Chiemgauer put into circulation by the Chiemgauer e.V. A comparison with the money circulation speed of the euro is possible. The transaction concept is used in calculating V; therefore, either the gross domestic product must be transformed into the transaction volume, or the sales must be determined directly. In statistics for small and medium-sized enterprises, the Federal Statistical Office directly reports the turnover for all types of companies, including large companies, which is why the transaction-based circulation speed can be calculated (Destatis, 2020):

$$V_{2019}^{€} = \frac{T_{2019}^{€} \times P_{2019}}{M_{2019}^{€}} = \frac{7008\ Mrd.Euro}{2648\ Mrd.Euro} = 2{,}65$$

The euro money supply contains the money supply M1 specified by the Deutsche Bundesbank and the cash put into circulation in Germany by the Deutsche Bundesbank as of end of 2019 (Bundesbank, 2020). The money supply M1 contains all sight deposits due on a daily basis. The usual definitions for M1 also include cash, but the Deutsche Bundesbank has been reporting cash in circulation separately in the monthly report for some time, so this sum must be added to M1 in each case (Bundesbank, 2019a). This addition makes both the money supply and turnover comparable. The money circulation speed of the Chiemgauer in 2019 was 3.45 times higher than that of the euro. This is because the euro is mainly used as a store of value, while the Chiemgauer is mainly used as a means of payment. The objective formulated by the Chiemgau community of emphasizing the created regional currency as a means of payment is thus confirmed. The same picture can be seen in a multi-year comparison:

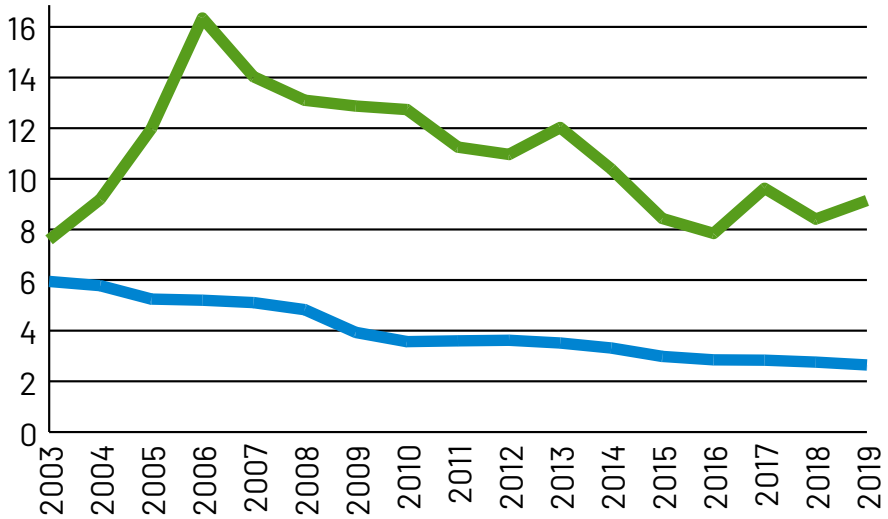


FIGURE 3: COMPARISON OF VELOCITY OF CHIEMGAUER (GREEN) AND EURO (BLUE)

In the early days, the money circulation speed of the Chiemgauer was still characterized by small volumes and a strong variance. This is typical for newly launched complementary currencies. The level between 2015 and 2019 corresponds to the initial level. Throughout the existence of the Chiemgauer, the payment function has dominated over the value retention function.

3.3 EMPIRICAL DEVELOPMENTS OF THE VELOCITY OF DOLLAR AND EURO

Due to well-established payment habits, Friedman assumed that the velocity of circulation was constant, at least in the short term (Friedman, 1987, p. 19). In the traditional Ramsey and Sidrausky model, it is also assumed that production automatically results in an optimum regardless of the choice of money supply growth (Rösl, 2006, p. 30). Under these assumptions, an excessive increase in the money supply results in inflation. The connection between M and P was first postulated by David Hume.

“According to the classical dichotomy, changes in the money supply affect the nominal variables, but not the real variables. When the ECB doubles the money supply, the price level, nominal wages and all other variables expressed in monetary units double. The real variables, such as production, unemployment, real wages and real interest rates, remain unchanged. This irrelevance of changes in the money supply with regard to real variables is called the neutrality of money.” (Mankiw & Taylor, 2008, pp. 740–741)

Evidence of the close relationship between money supply and price developments is mainly based on examples of hyperinflation, especially in Germany, Austria, and Hungary in the early 1920s (Sargent, 1982). Empirical data in the second half of the 20th century shows no constancy in the velocity of money in circulation, so a stable development trend is assumed in the meantime. Econometrics speaks of a stationary context (Auer & Rottmann, 2020, p. 539). For the monetary aggregate M2, Nobel laureates Engle and Granger state a corresponding correlation with the gross domestic product of the USA, but not for M1 and M3 (Engle & Granger, 1987, p. 274).

A closer look at the trend in the euro's velocity shows a downward trend, which is associated with a decline of 56% between 2003 and 2019 alone. This downward trend is not linear, but has a structural break in 2008 at the latest, which seems to be related to the financial crisis of 2008; however, the trend deviation begins as early as 2002:

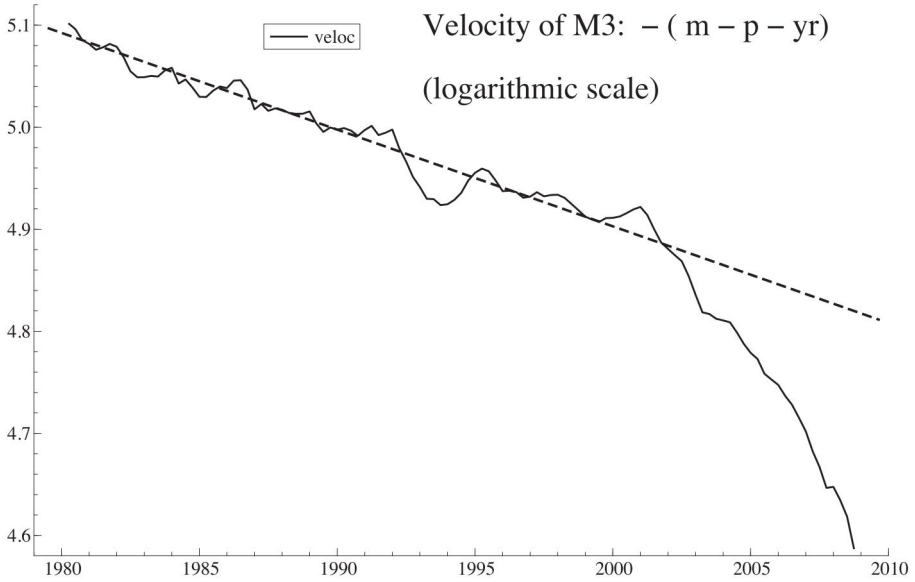


FIGURE 4: TREND BREAK OF THE MONEY VELOCITY M3 (BEYER 2009, S. 2010)

The money circulation speed was calculated for the money supply M3. Instead of transactions (sales), the gross domestic product was used. The trend break in the years 2002/2003 is striking.

A similar picture for the monetary aggregate M1 can be seen in the USA since 2008. A particularly sharp slump can be seen in 2020, when lockdowns were implemented in the USA.

FIGURE 5: ORBITAL VELOCITY OF M1 (SOURCE: FRED.STLOUIS.ORG)

In case of a surprising decline in the velocity of money in circulation, the other side of the quantity equation, i.e., the nominal demand for goods, decreases if the money supply develops unchangedly in the short term. Empirical studies show a procyclical relationship between money velocity and real gross domestic product (Leao, 2005). The velocity of money in circulation has a direct impact on gross domestic product and is the cause of its rise or fall (Tobin, 1970). With the help of vector error correction models, a cointegration between gross domestic product and velocity of circulation can be demonstrated in the main currency areas, which attribute changes, especially shocking declines in economic output, to changes in the velocity of circulation (de la Rosa & Stodder, 2015).

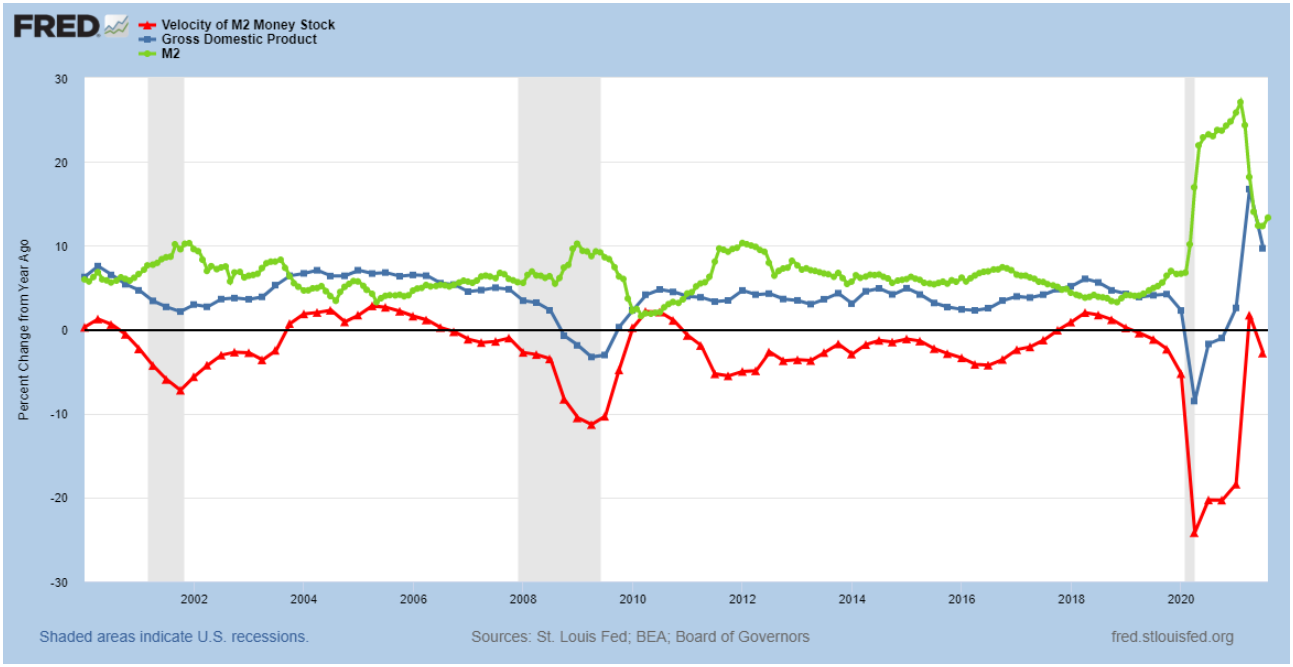


FIGURE 6: RELATIONSHIP BETWEEN GDP AND VELOCITY OF CIRCULATION IN THE USA

The connection can also be illustrated graphically. A decline in the velocity of circulation is followed by a decline in economic output. Although central banks can balance the money supply through monetary policy measures, there are time delays here because measures via the interest rate channel and also unconventional measures such as bond purchases by the central bank take time to increase the money supply and, as a result, demand (Tobin, 1970, p. 315). Changes in the circulation of money are seen as the cause of changes in investment behavior and, for the holding of money itself, the level of interest rates, which influence the holding of money as an opportunity cost. Low interest rates reduce the cost of holding money, thereby reducing the speed of money in circulation (Leao, 2005, p. 120). Above all, the highest decile of the population reacts sensitively to this and develops a higher need for money holding at low interest rates. From the point of view of equal opportunities, this is not necessarily a positive one (Beckert, 2007, p. 5); therefore, economists who are open to distribution theory have repeatedly pleaded for a redistribution of money from people with a low tendency to people with a high propensity to consume (Brunnermeier & Sannikov, 2016, p. 5).

3.4 Increasing the Velocity of Money and Its Policy Implications

The regional currency Chiemgauer tries to start directly at the velocity of circulation by setting the opportunity costs of holding money so high that the transmission of interest rate changes remains unaffected. The price for this, however, is that the Chiemgauer becomes unattractive as a store of value (Mersch, 2014). If only one currency were available as an option, it would have to be decided politically which property would have a higher weight. Since the Chiemgauer views itself as a complementary currency, the focus on the means of payment function is not a problem as there are other forms of currency that are dedicated to the storage of value.

The circulation incentive embedded in the Chiemgauer emphasizes the priority of the payment function and can be seen as an attempt to stabilize the speed of money in

circulation at a high level. Parallel considerations also exist at the macroeconomic level (Assenmacher & Krogstrup, 2018; Buiter & Panigirtzoglou, 2003; Kimball & Agarwal, 2019). In this sense, the Chiemgauer can be seen as an experiment to find out the optimal conditions and rules. The fact that the founding of the Chiemgauer coincided with the beginning of the structural break in the velocity of the euro is no coincidence, since the steadily declining tendency was one of the reasons to think about this aspect (Gelleri, 2005). This discussion played a significant role in developing Chiemgau's money design. Stabilizing the velocity of circulation is seen as a better alternative to a continuous increase in the money supply, because the great risk of pure control over interest rates and the money supply is that the velocity of circulation can rise again. If such a turn occurs, this can result in an accelerating development of the velocity.

The reason for a gradual reversal can be manifold, such as a shortage of supply in a submarket such as energy. By signaling scarcity from the supply side, price surges arise that can have a direct effect on spending behavior. The velocity of money in circulation is influenced by many factors such as consumer behavior, investment, and government spending. With the Chiemgauer, a reduction in the velocity of circulation is counteracted by associating the holding of money with costs. If the money supply of the Chiemgauer is determined endogenously, here by the voluntary exchange of euros for Chiemgauers, it can result in evasive behavior, so that not the velocity of circulation, but the money supply decreases; however, Yves Mersch’s prognosis has never materialized (Mersch, 2014, pp. 8–9). It would be necessary to investigate in more detail why this is not the case. A trace leads to the relationships between the Chiemgauer users. In crises, the willingness to show solidarity is increased. After the Covid-19 crisis and an appeal to members, more than 100 people were willing to change their funding projects to damaged small companies. The willingness to buy specifically at these companies also increased. A second trail leads to the communities. Similar to Wörgl in 1932, the city of Traunstein issued aid in 2020 and 2021 in the form of tailor-made vouchers and the local currency Chiemgauer. These subsidies for companies and citizens act like an external amount of money that comes into circulation.

By democratically adjusting the design of a complementary currency by the local people and adapting it to the time conditions, even an outdated theory such as the quantity theory can be revived. If money is understood as a “government technology” (Desan, 2017), or even better as a democratic community technology, the variables of quantity theory also become controllable; however, this also shows that the machine is more of a social technique that is related to the consciousness of people and can be democratically shaped by them.

3.5 Thinking Beyond the Mainstream

The next steps in the research are first to examine the link between transaction volume and local unemployment. At first sight, there is a cointegration for some places in the region of Chiemgau (Gelleri & Stodder, 2021). The increase in the transaction volume in Chiemgauer increases local GDP and decreases local unemployment.

The second step is to connect the quantity theory of money with the quantity theory of the environment. When we define the limits of the earth as given, we can calculate a GDP which is compatible with the environmental limits.

Humanity's influence on Earth is diverse, complex, and expanding. The ecological footprint has been too high for several decades. To make the excesses economically tangible,

individual components such as greenhouse gases can be used. Greenhouse gases are calculated by the IPCC as a residual quota and thus represent an absolute limit. Emissions of greenhouse gases result from resource extraction and from the resource cycle and the landfilling of resources. Each stage of value creation can be measured individually in terms of emissions. In addition, there are value creations that do not take place in monetary form, such as breathing or activities that do not take place as part of the official economy, such as, for example, the collection and burning of wood. Most emissions occur during the monetarily value-added stages, so it makes sense to focus on these large emitters.

The quantity theory of money can be subordinated to the goal of sustainability. This would mean that the transaction volume may only be as high as it corresponds to the available quota. This goal could be achieved particularly well if it were possible to stabilize the velocity of money circulation so that the money supply could be adjusted so that the economy could no longer emit due to the quantity limit. Economic actors could increase CO2 efficiency per unit of currency, thereby influencing the money supply; however, it should be assumed that the potential for technological efficiency is limited. Further potential lies in sustainable cycle management (consistency) and in sustainable behavior through sharing, extension of service life, repair, and similar approaches. Complementary currencies that focus on these goals are eligible for this purpose, while there is an urgent need to return the large monetary systems to a sustainable level due to their high emissions.

People who take the challenges of climate change seriously should agree to a goal that corresponds to the goal of a global maximum warming of 1.5 degrees. For a country like Germany, this would mean reducing emissions by 17% per year by 2030. Although technological efficiency is increasing and CO2 intensity is increasing by 3% annually, this would not only mean that the economy can no longer grow, but also that the German economy would have to shrink by 14% annually to meet the targets. In a democracy, such an approach seems hardly reasonable. The ecological objective would also contradict the objective of a high level of employment. Such a goal could only be achieved with a radical restructuring of society and the economy. We would all have to slow down, settle for less, work less than we do today, and, above all, people with a large ecological footprint would have to consume much less. This would go together with the reduction of the money supply, and this would have to start where there is a particularly large accumulation of money.

This approach is in stark contrast to approaches that see money creation as an opportunity to stimulate investment in climate-friendly technologies. Further growth in the money supply would inevitably be accompanied by further increases in CO2 emissions; therefore, limiting the amount of money should be the order of the day. Climate-friendly investments would have to be organized through the activation of existing money supplies or, if there is no willingness to do so, through redistribution. Complementary currencies could be used to control this redistribution process much better, as they can be influenced both in the creation of money and in the circulation of money. A regional currency like the Chiemgauer moves in sustainable regional cycles and therefore requires much less CO2 emissions per currency unit than a unit in a national currency.

Due to the challenges of climate change, the issuance of complementary currencies should not be seen as an addition to the existing monetary system; rather, they should replace it if they can reduce CO2 emissions. Wherever the national currency fails in large currency areas, such as in southern Europe, complementary currencies offer a historically unique

opportunity to build truly sustainable currency cycles. National currencies such as the euro or the dollar could be deposited as a reserve unit. Against this background, the issuance of digital central bank currencies makes sense because they would facilitate the decommissioning of euros (Martín Belmonte et al., 2022).

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Convertible local currencies as an economic development tool for businesses ?
Findings from an panel econometric analysis on french companies joining a Convertible ocal currency

Communication to the RAMICS 2022 Conference - online

28/10/2022

Foreword :

The following work is presently a doctoral dissertation chapter. It is originally written in French and, at this stage, I have translated it only very roughly in order to provide some support for the RAMICS presentation. I apologise beforehand for the poor quality of the translation and thank you in advance for your understanding in these particular circumstances. It will be further edited to produce an article in the months following the thesis defense in November.

I also wish to thank Vincent Carret for his precious help in the webscraping of the Siren numbers of CLC member companies, which was necessary for the realisation of this work. I would also like to thank the Nouvelle Aquitaine region, Sciences Po Lyon, and the Centre de recherche de développement territorial de l'Université du Québec en Outaouais, which, through the MoLoNa and TerMos research projects and a study grant, financed access to the Fare files at the Centre d'accès sécurisé aux données (CASD) and enabled the realisation of this study.

Introduction :

The number of convertible local currencies (CLCs) grew particularly quickly in France during the 2010s, with a tenfold increase in the number of CLCs in circulation between 2011 and 2019 (Blanc, Fare, and Lafuente-Sampietro 2020). Thus, 82 MLCs were circulating in France at the end of 2019, covering nearly 30% of French municipalities. The rapid spread of this phenomenon has awakened and been reinforced by the joint interest of public authorities, which legislated on their status in 2014, as well as activist circles that present them as potential tools for ecological and social transition, notably through films such as Demain (Dion and Laurent 2015) or the online training course of the Colibris movement . This proliferation of projects and the attention received by CLCs in France leads us to question their social, economic and environmental effects from a scientific point of view. While there is already an abundant literature on alternative currencies (Blanc 2018a) and on the potential theoretical effects of CLCs (Fare 2016), the measurement and empirical evaluation of these effects is still weak and deserves to be investigated. In this work, we adopt an approach similar to that of public policy evaluation, thinking of CLCs as devices used or not by actors and trying to measure their impact by comparing a test group using an MLC to a non-user control group. We therefore seek to measure the benefits in terms of turnover that companies derive from their use of a CLC.

Convertible local currencies (CLCs) are monetary instruments for specific purposes and circulating alongside national currencies in a given territory. They are created and managed by groups of citizens gathered in non-profit organizations or community banks, sometimes supported by local public authorities. These currencies can take different forms, depending on the project, from paper banknotes to digital payments by card, text message or mobile application. What distinguishes them from other alternative currencies is the way they are issued. The currency is issued through the exchange of national currency units for local currency units at a fixed exchange rate. The currency obtained can then be used in shops and at companies, associations or institutions in the territory that accept it as a means of payment. The national currency used to obtain the local currency is kept in a guarantee fund, allowing the local currency to be converted back into national currency under the conditions set by the issuing institution. This conversion is generally forbidden for individual users, but authorized for companies at the price of conversion fees or at least implicit costs.

The CLCs thus build a separate monetary circuit, forcing their users to exchange among themselves to spend the CLC units they receive. The managing associations also participate in this linkage by playing an intermediation role through the provision of tools and the animation of the user community. The use of the CLC also acts as a signal, identifying economic actors who share similar values and thus splitting the market. The redirection of demand from MLC users to businesses in the monetary community, either through the mechanical constraint of their spending ability or the signal sent by the acceptance of MLC, may result in additional demand for MLC member companies and thus enable them to increase their total turnover. This increase in turnover is, in our view, imperfectly correlated with the turnover achieved in MLC. Indeed, if the constraint effect on the place of expenditure of the monetary units received as payment applies only to the revenues realised in MLC, the signal effect relates more generally to the enterprise as such. Thus, it is likely that actors will choose to buy from one enterprise in the monetary community rather than another because of its acceptance of MLC, while consuming from it in national currency. The additional activity generated by the acceptance of MLC does not therefore seem to be perfectly measurable thanks to the activity carried out in MLC and must therefore be measured on the scale of the companies total accounts.

In order to measure these changes in economic activity, we have chosen to conduct the analysis at a micro level. Krohn and Snyder (2008) have previously attempted to measure the effects of local currencies on economic development by comparing growth in US cities with and without local currencies. However, they failed to show significant impacts of local currencies, but we believe that because of the low territorial coverage of CLCs, the municipal scale they chose is too large to measure a general effect (Michel and Hudon 2015; Matti and Zhou 2022). Moreover, CLCs do not necessarily aim to develop an entire locality, but rather a selected territorial community. We therefore propose to focus the study on the community that actually uses the MLC, and thus to concentrate on the companies involved and not on the municipality as a whole. Our analysis is therefore positioned at the microeconomic and individual level of the activity of MLC member companies.

In order to carry out the econometric study measuring the effect of the acceptance of MLC as a mean of payment on the turnover of companies, we used data from the Fare file, which contains all the tax data of French companies from 2009 to 2019. Since companies are identified by their national Siren number, we can follow the evolution of their activity over the years and use the data in panel form, simplifying the identification of effects.

In this chapter, we will first describe the data used for this study and then the methodology applied for their analysis. We will then present the results of these econometric models and discuss them as a conclusion to this last chapter.

1. Data

To carry out this study, it was necessary to combine several complementary data sources. We first needed to obtain a list of companies that had joined MLCs in order to identify them in other databases. We also needed access to the production information of these firms and of firms in a control group over several years surrounding the dates when the firms joined an MLC, which we obtained from the Fare file.

a. FARE data and their preparation

The Fare file is a file containing all the tax data of French companies in the market sector and involved in productive activity, except for the financial sector and agricultural activities. Companies are identified in the file by their Siren number, a 9-digit public identifier.
The Fare scheme has been in existence since 2008 and has one vintage per year until 2019. However, the first vintages have different variables from the following years, some of which are necessary for our analysis, and we have therefore chosen to use only the vintages from 2010 onwards.

Table 1 - Number of observations in each year of the Fare file

Year	Observations
2010	3 340 887
2011	3 737 728
2012	3 866 486
2013	4 224 263
2014	4 385 731
2015	4 052 206
2016	4 245 075
2017	4 188 215
2018	4 290 267
2019	4 456 558
Total	43 677 123

Each year contains about 190 variables, containing various information ranging from the statistical status of the observation, to the variables of identification and administrative description of the enterprise (Siren, name of the legal entity, legal status, type of enterprise, sector of activity) to the fiscal data of activity (turnover, profits, value added, taxes, assets, number of full-time equivalent employees). This information provides a fairly accurate picture of the companies' financial situation.

c. Experience design

We identify 1,895 companies belonging to 9 french CLCs them in the Fare data. We then had to develop a strategy for selecting companies that were not members of CLCs as control. As we did not have a list of the members of the 80 French CLCs, we had to develop identification strategies in order to be sure to select companies that did not use CLCs.

A first solution was to choose areas with no known CLCs. This solution had the advantage of ensuring the absence of contamination between member companies of CLCs and those of the control group. Indeed, it could happen that, by being located in the same area, the positive effects from which the companies in the test group could benefit would be to the disadvantage of their neighbours. Thus, the measured effect would be overestimated, since the cyclical variation captured by the control group would take into account the negative externality of the use of the CLCs. Furthermore, choosing firms in areas without available CLCs limits the self-selection bias in the schemes. Firms in the control group without access to CLCs did not voluntarily choose not to use them. However, information on all areas with or without a CLC is currently not systematised and we were only able to obtain a list of departments without known CLCs, rather than a finer grid of employment areas or municipalities. This very broad identification of areas without CLCs leaves little choice of areas without known CLCs for selecting the control sample, and these areas turn out to have characteristics very different from those occupied by the CLCs in the test group. Indeed, the fact that an entire department is currently free of CLCs is potentially correlated with many characteristics that may have a joint effect on its economic development. For example, departments without CLCs include far fewer large cities than those with identified CLCs, as these schemes are often located around metropolitan areas ((Blanc, Fare, and Lafuente-Sampietro 2020). It therefore seemed to us that the companies in these localities were probably facing different environments and exogenous shocks than those of the companies in the test group, which could bias our analysis. Moreover,

as the census of CLCs is still imperfect, it is not impossible that CLCs exist in some of these departments without our knowledge and could contaminate the control group.

We therefore abandoned this first solution in favour of selecting the control companies within the same employment zones as those of the test companies so that the companies in the test and control groups face similar exogenous contexts. Moreover, as the territories of the CLCs rarely overlap, we know that in these areas, firms not identified in our files are unlikely to be users of a CLC. However, this choice makes it possible for negative externalities to exist for the control group: the decision to enter the CLC of a tested firm could have a negative impact on the activity of firms in the control group in the same locality, due to a transfer of customers for example. As the coverage rates of CLCs in employment areas are still low, we believe that these externalities are minimal and unlikely to be observed at this stage of their development. Furthermore, there is a selection bias between the CLCs and the control group. Indeed, the latter have access to a CLCs, but have chosen not to join it, or have not been aware of it. The factors explaining this choice, such as the socio-economic environment in which these companies and their managers operate, are most likely not observed in the database and could have an effect on the turnover trajectories of these companies.

Despite these biases and in view of the impact identification method deployed, we have chosen the latter solution. We have thus restricted the analysis to companies present in the same employment zones as CLCs members and belonging to the same sector of activity, identified by their APE code, i.e. 1,997,832 controlled companies.

In order to increase the similarity between the control group and the test group, we choose to restrict the samples to the companies present in the 2019 Fare vintage. This choice allows us to avoid dealing with the bankruptcy situations of the companies, in the test group as well as in the control group, but above all to keep only the companies with a long-term activity, whose evolution can thus be analysed. Thus, with this decision, only 1,701 enterprises are retained in the test group, i.e. 90% of the enterprises in the sample. However, on the side of the control enterprises, this decision allowed us to keep only 1,054,053 enterprises, i.e. 53% of the enterprises in the sample. This drastic restriction bring the profiles of the companies in the control group and the test sample closer together. Indeed, it seems that the CLCs member companies have a more durable period of activity than a large proportion of the other French companies and this choice makes it possible to limit this type of difference.

Finally, two last steps of data restriction consisted in removing the data statistically imputed by the teams producing the Fare files for some companies and in keeping only the observations of enterprises aged at least one year and with a turnover different from 0. The imputations are particularly important for microenterprises, i.e. companies composed from only one individual, which are very present in the test sample. This restriction decreases the number of enterprises in 2019 in the test sample to 1,215 and in the control group to 784,846. The choice to keep only enterprises older than one year is explained by the comparability of the activities of enterprises in their first year. Indeed, some enterprises may have been created at the beginning of the year and others in the last half of the year and therefore do not have the same number of half-years to compare in their first year of existence, in particular in order to measure their own evolution with respect to the following year. The restriction to turnover figures other than 0 comes from the hypothesis that a turnover equal to 0 is similar to an absence of activity that year, without being linked to an immediately productive problem. All these choices result in a test sample of 1,281 firms in total, of which 1,182 can be found in 2019.

Tableau 2 - Nombre d'entreprises par millésimes de Fare

Year	**Open in 2019**		**Not imputes**		**Turnover ≠ 0 and Age >0**	
Sample	**Test**	**Control**	**Test**	**Control**	**Test**	**Control**
2010	663	495 933	543	386 197	529	360 121
2011	751	571 869	593	427 042	571	396 867
2012	807	624 037	651	457 040	629	423 809
2013	912	694 300	679	489 192	650	452 246
2014	1 017	765 746	734	519 841	709	478 718
2015	1 104	832 515	825	582 267	793	533 862
2016	1 257	930 083	912	631 779	872	575 630
2017	1 425	1 062 458	1 028	691 898	988	625 651
2018	1 570	1 197 250	1 089	748 978	1 053	668 560
2019	1 701	1 442 609	1 215	784 846	1 182	699 205
Observations	11 207	8 616 800	8 269	5 719 080	7 976	5 214 669

2. Methodology

The 9 files of the Fare data enable to construct a longitudinal database whose panel structure can be a real asset for identifying effects. The panel data thus make it possible to include individual fixed effects, controlling for unchangeable characteristics of firms that can explain both their membership of a CLC and their economic trajectory, such as the personality of their manager or their customer target. In this type of model, the control group is essentially useful for measuring as accurately as possible the external cyclical variations captured by a time fixed effect. It is therefore important to obtain a control group with sufficiently similar characteristics to the test group, in order to be convinced that the variations in the activities of the firms in the test group would have been on average similar to those of the control group, in the absence of the use of a CLC.

We therefore proceed with a two-stage identification strategy. The first step is dedicated to the selection of a control group using probabilistic nearest-neighbour matching, similar to the strategy used by Quantin, Bunel and Lenoir (2021) for their evaluation of the effects of the Young Innovative Company scheme, also using the Fare file with heterogeneous entry dates into the schemes. The second step consists in applying a double fixed effect model to the final sample (Imai and Kim 2021).

a. The selection of the control group by matching

The first step is therefore to select a credible control group, in order to take into account in the estimation of the variations in activity that the CLCs member companies might have had if they had not joined the schemes. To do this, we use the matching method based on observed characteristics used by Quantin, Bunel and Lenoir (2021), in order to approximate as closely as possible the characteristics of the control group to those of the test group, in particular their turnover trajectory prior to joining the CLCs of the test firms. As the dates of entry and first observations in the Fare file were heterogeneous, we applied a matching model by cohort, defined by the first year of observation and the year of entry of the test companies. Potential

controls were thus selected on the basis of their characteristics in the year of the first observation of the test firms and the year before they joined a CLC.

We selected three times as many controls as test firms in each cohort based on their propensity score. After various tests of methods, we opted for a classical nearest neighbour model, with distance measured by propensity score, itself estimated by logit regression. However, we forced an exact match by CLC region, the control having to be located in one of the employment zones of the CLCs in the cohort, by sector of activity in 17 categories and with a creation date of more or less 5 years similar to that of the test companies in the cohort. The objective of this model is not to predict the probability of a company joining a CLC, but to select companies with similar characteristics, whose turnover would have a similar variation over time outside of CLC membership.

The matching model used to calculate the propensity score was as follows:

$$\begin{aligned} P(CLV) = {} & \text{year of creation} + \\ & \text{Sector} + \\ & \text{Legal status} + \\ & \text{Employment area} + \\ & \text{Municipal density} + \\ & \text{Turnover}_{t1} + \\ & \text{Change in turnover}_{t2\text{-}t1} + \\ & \text{Number of employes}_{t1} + \text{Number of employes}_{t2} + \\ & \text{Profit}_{t1} + \text{Profit}_{t2} \end{aligned}$$

P(CLCs) is the probability of entering a CLC. In each cohort, the three controls per test observation are selected according to how close they are to the model score, combined with the restrictive conditions discussed above. If none or fewer than three controls score sufficiently well or meet the restrictive conditions, only those controls meeting the various conditions are selected. This procedure results in a sample of 3,368 control firms for the 1,281 firms in the test group.

In order to check the contribution of this sampling method and its potential impact on the final results of the study, we also selected a random control group of 3,843 firms.

In addition, due to the high variability of turnover in the upper echelons of the distribution sector, which affects the average turnover between samples, we chose to remove the 1% of companies with the highest turnover in the first year of observation in the Fare file, i.e. a

turnover of more than €16,000. We therefore obtained a final sample of 1,268 test companies, 3,334 matched checks and 3,821 random checks.

The descriptive statistics for the different samples confirm the similarity between the characteristics of the matched and test samples, compared with the random sample (Table 5).

Table 3 - Descriptive statistics of the sample

Indicator	Test (n=1268)	PPM Control (n=3 334)	Random control (n=3 821)
Mean turnover			
t1	439 857	399 169	361 963
t2	561 248	462 000	X
Median turnoer			
t1	151 385	156 295	97 920
t2	178 925	160 565	X
Number of employees			
t1	3,8	2,6	2,6
t2	4	2,5	X
Municipal density			
1	49%	52,3%	66,1%
2	20,3%	24,6%	17,5%
3	27,8%	21,7%	15,5%
4	2,9%	1,4%	0,8%
Area			
1	9,7%	10,2%	4,5%
2	8,4%	6,8%	2,7%
3	38,1%	30,5%	2,6%
4	3,9%	3,5%	1,9%
5	15,5%	22,1%	10,2%
6	8,1%	8,5%	3,5%
7	4,6%	11,4%	35,7%
8	6,7%	6%	3%
NA	0,5%	0,9%	35,9%
Sector			
C1	11%	7%	1%
C5	3%	2%	1%
DE	0%	0%	1%
FZ	2%	2%	8%
GZ	35%	36%	14%
HZ	1%	1%	4%
IZ	21%	19%	8%
JZ	3%	3%	5%
KZ	0%	0%	3%
LZ	1%	1%	6%
MN	9%	15%	22%
OQ	7%	10%	18%
RU	7%	6%	8%
Legal status			
1 Individual entreprise	19%	25%	35%
5 Commercial society	78%	74%	62%
6 Other moral person	1%	1%	2%
9 Private groupment	1%	0%	0%

As the variable of interest in the study is turnover, we have analysed its distribution between the different samples in more detail.

Tableau 4 - Décile de chiffre d'affaire

	All observations			First year of observations			Year before joining a CLC	
Decile	Test	PPM	Random	Test	PPM	Random	Test	PPM
Min	210	-3 780	-126 030	690	-850	-28 960	690	-850
10%	42 805	36 800	26 597	33 677	30 332	18 140	37 916	32 012
20%	75 142	63 320	46 085	58 562	55 384	36 570	65 464	57 702
30%	114 037	90 523	66 170	80 361	81 255	52 110	93 190	82 488
40%	165 826	128 580	90 676	111 942	113 968	71 420	135 654	117 952
50%	238 525	178 135	127 385	151 385	156 295	97 920	178 925	160 565
60%	337 118	248 412	181 992	211 128	214 264	138 390	261 652	225 304
70%	473 080	355 424	278 607	298 981	300 976	205 846	381004	316 465
80%	746 800	550 126	463 480	463 858	449 808	336 240	588 978	503 804
90%	1 439 504	1 087 142	1 035 555	878 066	876 117	738 280	1 170 864	976 484
Max	20 590 230	39 034 140	87 537 610	14 863 570	15 466 770	15 580 730	16 288 630	31 551 810

It can be seen that in the first year of observation in the samples, the distribution of turnover of the enterprises in the test group and the matched control group is close, more so than in the random sample. The characteristics of the test and matched samples diverge more in the years before joining a CLC, without causing extreme differences, except for the maximum, showing potential divergences in evolution. Information on the year before joining is only available for the matched controls, due to their selection by cohort, and not for the random control group. However, both samples will be used to estimate the models in order to compare the results.

b. The two way fixed effect model

The identification strategy of the effect of using a CLCs uses the panel structure of the data. As the CLCs entry dates are heterogeneous and range from 2012 to 2020, a standard double-difference model comparing the test group with the control group before and after a scheme entry and assuming similar variation can not be used.

In the absence of a common entry date for all test observations, it is not possible to define when the control group would have been treated if they had joined a CLC and thus compare their performance with that of the test group after treatment. The common solution in this case is the double fixed effects model (Stevenson and Wolfers 2006; Hoynes, Schanzenbach, and Almond 2016; Goodman-Bacon 2021; Callaway and Sant'Anna 2021), which consists of adding individual fixed effects to the linear model, allowing to control for all the invariant and unobserved characteristics of individuals that could influence both their economic activity and their choice of membership in a CLC, and annual fixed effects, allowing to control for the effects of economic conditions influencing both the test and the control groups. The fixed effects thus make it possible to reduce the risk of variable omission, at least for individual and unchangeable characteristics.

Table 7 - Treated and untreated enterprises in the test group by year of observation

Year	Not yet treated	Already treated
2010	517	0
2011	560	0
2012	596	22
2013	528	111
2014	539	159
2015	534	247
2016	480	380
2017	427	549
2018	305	736
2019	132	1 038

The linear model estimated using the R package plm (Hsiao 2014) is as follows:

$$\text{Turnover} = ß_1\ \text{IdMLC}_{it} + ß_2\ \text{Characteristics}_{it} + c_i + t_t + \varepsilon_{it}$$

IdMLC is an indicator taking the value 1 when the company is a member of a CLCs and 0 when it is not. The time-varying control characteristics are

- Demographic: age, statistical category of firm size, sector of activity, legal status of the firm, number of full-time equivalent employees
- Spatial: employment area, CLCs area and municipal density in 2018

Most of these characteristics show little temporal variation, however, over ten years of observations, companies sometimes move and evolve and these changes seem important to take into account in their development process. The interpretability of the control coefficients is however rather weak, as they potentially reflect more the effect of change than that of status, sector or geographical area.

The matched control group also allows for the addition of a variable from the matching method and thus brings the control group firms closer to the test group firms with which they were matched. Thus, if each test firm does not have at most three directly dedicated control firms, we know which control firms were chosen for each cohort. This specification allows the variable T1 to be added to the model, taking the value 1 for all firms in a cohort when the test group firms in the cohort have joined a CLCs and 0 the rest of the time.

The double fixed effect model has a particular interpretation. It consists of calculating for each variable in each observation year, their deviation from the individual's mean for that variable. It thus measures the correlation between the variations of the dependent variable at the individual mean with the variations of the other characteristics of the individual at their individual mean. The addition of a time fixed effect makes it possible to remove from this first difference the annual variations of each year with that of the average of the years.

$$(TO_{it} - TO_m - TO_{mt} + TO_m) = ß(x_{it} - x_{im} - x_{mt} + x_m) + (c_i - c_{im}) + (\varepsilon_{it} - \varepsilon_{im} - \varepsilon_{mt} + \varepsilon_m)$$

It thus removes the invariant characteristics ci, since ci is constant $c_i - c_{im} = 0$, as well as their correlation with the explanatory variables and the individual and time invariant error terms. The new conditions of validity of the model are then that the covariance of the variation of the variable of interest with respect to its mean with the variation of the individual residuals varying in time with their mean is equal to 0.

$$Cov((x_{it} - x_{im} - x_{mt} + x_m),\ (\varepsilon_{it} - \varepsilon_{im} - \varepsilon_{mt} + \varepsilon_m)) = 0$$

This condition remains relatively strong, since a change in unobserved and variable firm characteristics that affect turnover, such as a change in management, may well also influence the choice of using a CLCs for example.

To test the appropriateness of using the fixed-effects model, it was compared with a simple linear model and a random-effects model, which assumes that the individual and invariant error terms are uncorrelated with the explanatory variables and therefore do not need to be removed. The Fisher test comparing the fixed effects model and the simple linear model is significant. The results of the two models are therefore different, proving that the fixed effects are not zero. Similarly, the comparison of the fixed-effects model with the random model is carried out using a Hausman test (Hausman 1978), testing the similarity between the two models. As the test is not significant, the null hypothesis of similarity is rejected and the random effect model is considered unreliable compared to the fixed effect model.

We also tested the heteroscedasticity of the fixed-effects model using a Breush-Pagan test (Breusch and Pagan 1979), which tells us that the data are heteroscedastic. Similarly, we found that the residuals of the regressions suffer from autocorrelation. These two findings prompted us to calculate the precision of the estimated parameters by taking into account individual and temporal aggregations, through the use of a correlation matrix incorporating these two dimensions (Cameron and Miller 2015; Thompson 2011), using the vcovDC function of the plm package (Hsiao 2014).

3. Results

We systematically tested the model with the control selected by matching and with the randomly selected control, to determine if this choice was important or not.

Table 5 - General results

Model	Control PPM	Random Control
Absolute variation		
Without T1	39 516 ; s.e. = 21 752	49 821 ; s.e.= 38 357
With T1	62 470* ; s.e. = 26 136	T1 non disp.
Logarithmic		
Without T1	0,11*** ; s.e. = 0,02	0,15*** ; s.e. = 0,02
With T1	0,09** ; s.e. = 0,03	T1 non disp.

The general model, with all observations, does not give significant results. There is a positive trend in the effect, but the variance is too high to be able to conclude convincingly that the effect is strictly greater than 0 and, above all, precise.

Incidentally, we also estimated the model by transforming the dependent variable, turnover, into logarithmic form. This transformation enable to estimate the variation in turnover as a function of the model's parameters. Applying the transformation to obtain the percentage of variation to the estimators obtained, we obtain an average increase of 12% in turnover linked to the use of a CLC with the matched control sample and 16% with the random sample. It is also interesting to note that the results with the two samples are close enough to be consistent, but that the matched sample gives slightly weaker effects, potentially due to the closer proximity of the company profiles to those of the test sample and therefore taking better account of cyclical effects.

This difference in significance between the absolute and rate of change results leads us to the hypothesis that despite the limitation of turnover to the lowest 99%, a high variability in high turnover, potentially without causal link with the use of a CLC, could bias the average of the absolute effects. By looking at variation, very strong absolute effects on high turnover and potentially just temporally correlated with CLC use but not really explained by it become less important and bias the estimators less.

We therefore decided to use the model on sub-samples created on the basis of company size. We selected all the companies that have ever had the chosen status, i.e. microenterprises, small and medium-sized enterprises (SMEs), intermediate-sized enterprises (ISEs) and large companies. These two categories are grouped together because of the small size of the remaining sample.

Tableau 6 - Results according to the companies size

	Control PPM	**Random Control**
Microentreprises :		
Absolute	34 064* ; s.e. = 13 884	43 501** ; s.e. = 13 645
Logarithmic	0,09*** ; s.e. = 0,02	0,11*** ; s.e. = 0,02
Small and medium companies :		
Absolute	214 811** ; s.e. = 78 312	180 710 ; s.e. = 155 973
Logarithmic	0,12*** ; s.e. = 0,03	0,15*** ; s.e. = 0,04
Intermediary and large companies :		
Absolute	-881 553 ; s.e. = 712 805	-680 716 ; s.e. = 1 028 013
Logarithmic	0,00 ; s.e. = 0,08	0,11 : s.e. = 0,11

The above hypothesis seems to be confirmed on the sub-samples. This time we observe small but significant effects for microenterprises, around €34,000 per year, but larger effects for small and medium companies, consistent with their size. The rates of change are similar, at around 10%. For intermediary and large companies, the effect becomes negative and insignificant, both in absolute terms and in terms of the rate of change, confirming the greater volatility of turnover in the upper echelons of distribution and the much less perceptible effect of CLCs for this type of company.

These differentiated effects allow us to propose interpretations of the effect of CLCs on activity. Thus, it is possible that microenterprises and small and medium companies, with smaller production volumes, benefit more from inclusion in a territorial network in terms of the internalisation of demand. Their production potentially corresponds more to activities oriented towards the domestic sector and perhaps responds more to local demand, which the CLCs are more successful in redirecting. Similarly, the effect of CLCs, even if small in magnitude, has a larger relative share in the initially smaller turnover of these companies and is therefore more easily perceptible and significant. Thus, in the context of intermediary and large companies, the marginal contribution of CLCs is potentially invisible in the face of an already very large

volume of production. Moreover, the variation in the activity of these large companies is potentially subject to important exogenous events not causally linked to the use of CLCs, but which may occur simultaneously with their use and have a strong impact on the turnover of certain companies.

In order to complete these initial results, we conducted additional analyses to study a possible differential effect of the size of the CLCs and their time of use.
To do this, we created a first variable separating the CLCs into three categories. The first is the Eusko alone, due to its number of user companies being at least twice as high as the others. The second combines the CLCs with between 400 and 500 user firms, i.e. the Cairn, the Doume and the Gonette, and the third the remaining CLCs, with less than 300 user firms.
The model is run on the whole sample, but replacing the indicator of membership of a CLC with this variable.

Table 10 - Results by CLC size

CLC Size	**Control PPM**	**Random Control**
Absolute		
Big	14 811 ; s.e. = 30 231	28 739 ; s.e. = 38 597
Medium	12 292 ; s.e. = 27 373	24 536 ; s.e. = 37 046
Small	133 249 . ; s.e. = 68 565	132 501 : s.e. = 97 754
Logarithmic		
Big	0,1*** ; s.e. = 0,02	0.13*** ; s.e. = 0,02
Medium	0,11*** ; s.e. = 0,03	0,14*** ; s.e. = 0,04
Small	0,14*** : s.e. = 0,03	0,19*** ; s.e. = 0,04
Microentreprises		
Big	21 481 ; s.e. = 25 057	31 845 ; s.e. = 25 391
Medium	31 177 ; s.e. = 22 566	40 038. ; s.e. = 22 587
Small	67 834 . ; s.e. = 36 249	76 218* ; s.e. = 35 780

With these specifications, the absolute effects observed are not significant, partly because of the smaller sample sizes for each modality of the variable of interest and the high variability within each category. However, it is interesting to note that there are significantly larger effects, both in absolute terms and in terms of the rate of change for the small CLCs members. These are the only ones for which the effect is weakly significant in absolute terms with the matched control group and in both samples for microenterprises. Although the low significance of these results does not allow us to draw very strong conclusions, we can nevertheless propose an interpretation of these differences in magnitude.

For example, it is conceivable that, contrary to popular belief, small CLCs have a greater effect on the activity of the firms using them. This greater effect could be due to a network effect. Large CLCs, by integrating many providers, potentially reduce the number of additional clients for each user firm. Thus, in a large network, consumers and businesses have more choice in how they spend their CLC units and member businesses are therefore more likely to compete to meet this demand. For example, it is highly likely that several firms will have similar activities in the network and will therefore compete for the additional customers brought by the use of CLCs, and other characteristics of the firms, such as their location, reputation or prices, may come more into play. In a smaller network, users are more constrained in their choice and the acceptance of CLCs is potentially a more important criterion for the selection of a provider or supplier. This hypothesis leads us to consider the question of the optimal size of a CLCs and its territorial coverage. For example, would a CLC covering all the businesses in a locality have any effect on its users?

Another, potentially complementary, interpretation can also be considered. Some currencies might rely heavily on social and transactions networks that are already implemented in the territory. However, the existence of prior interpersonal networks, while facilitating the establishment of the CLCs, can limit their own effect. For example, the recruitment of service providers by going up the chain facilitates the circulation of money, but does not directly provide new customers for the businesses, since the suppliers of the user businesses are recruited. The CLCs are therefore superimposed on a network of pre-existing transactions and have a weaker intermediation and internalisation effect on transactions. It can therefore be assumed that in the context of a small CLC, the difficulties of the CLCs in developing may be due, among other things, to a less developed social network. Thus, the CLCs participate more in the activation of proximities and the creation of an ad hoc community and would therefore have a greater economic impact on the members of this new community.

Although this result cannot be given the firmness of a conclusion at this stage, it does allow new hypotheses to be put forward, which it would be interesting to study in greater detail during more in-depth case studies. It also makes it possible to question the quasi-systematic study of the Eusko as a model currency, and for which this thesis was no exception. In the end, the results obtained may not be so much overestimated because of the exceptional size and location of this currency, but perhaps underestimated because of its particular territorial context and the size of its network.

Similarly, we created a variable categorising the time spent in the CLCs between the first year, the second year and more than two years.

Table 11 - Results by time in the CLCs

Time in CLC	Control PPM	Random Control
Absolute		
0-1 year	35 251* ; s.e. = 16 952	44 946 ; s.e. = 29 709
1-2 year	50 716 . ; s.e. = 29 134	56 685 ; s.e. = 38 454
+ de 2 year	35 992 ; s.e. = 31 628	50 865 ; s.e. = 57 049
Logarithmic		
0-1 year	0,08*** ; s.e. = 0,01	0,11*** ; s.e. = 0,01
1-2 year	0,12*** ; s.e. = 0,02	0,16*** ; s.e. = 0,02
+ de 2 year	0,15*** ; s.e. = 0,02	0,2*** ; s.e. = 0,02
Microentreprises		
0-1 year	27 380* ; s.e. = 12 675	33 240** ; s.e. = 12 509
1-2 year	37 466* ; s.e. = 14 781	47 001*** ; s.e. = 13 287
+ de 2 year	40 685 . ; s.e. = 21 545	55 869* ; s.e. = 22 622

As with the previous complementary results, we have difficulty in finding significant absolute effects, notably because of the small sample size within each category and the high variance of the dependent variable. The rate of change effects are significant and increasing, in similar orders of magnitude to those found in the previous model specifications. Focusing on microenterprises, the effects are more significant due to the lower variability of turnover in this sub-category, as in the original model. As before, the coefficients are not precise enough to interpret their difference robustly. However, for microenterprises at least, there appears to be an increase in the effect over time between the first and second year of use. This difference may be due to the time spent using the CLCs in the first year, as some firms may have joined in the last quarter of the year and thus observed almost no effect, while others will have already had a full year of use by the time they report. The coefficient for companies that have been members for more than two years is even less accurate than for the other two categories. Except in the full sample model with matched control, where it is much lower than that of firms using CLCs for more than one year, it remains at a level relatively close to the category that precedes it. It is therefore not possible at this stage to conclude either that the effect of using a CLCs has decreased or increased over time.

4. Discussion

In this work we measured the effect of using a CLC on the companies turnover. To do this we used the natural experiment of their self-selection into a CLC to assess changes in their turnover before and after this event.

We obtain relatively large and significant results, although not very precise, for micro, small and medium-sized companies. The magnitude of the results, in the order of €30,000 for microenterprises and €200,000 for small and medium-sized companies, should be interpreted in the light of the turnover scale declared by the companies (Table 6). Indeed, the average turnover in the first year of observation of the companies and in the year before joining the CLCs varies between €350,000 and €550,000 and the median turnover is between €100,000 and €150,000. As a result, the rate of change effects are quite high, ranging from 8% to 16% increase in turnover between the years when a CLC is used and the previous years, which are statistically significant results. This amplitude seems to us to be particularly strong, especially when put into perspective with the feelings expressed by the companies in the Mouvement Sol survey, where 59% of the companies said they had not observed any effect on their turnover and 33% declared a marginal effect. However, it is possible that companies do not perceive the link between the increase in their business and membership of the CLCs. Indeed, as mentioned above, users often do not pay in CLCs to their suppliers or providers who accept CLCs and are chosen for this. As a result, companies may not be aware that this new customer base is due to their acceptance of CLCs.

Furthermore, we only have fiscal information from firms and while the double fixed effect model best controls for unchanging firm characteristics and aggregate business cycle effects, it is possible that the uptake of CLCs is correlated with a changing firm characteristic, whether it is a change in management or production methods, an adjustment to poor firm performance or conversely an additional commitment for firms in a growth period. All of this information is missing and constitutes potential omitted variable bias, which the dual fixed effects model is not sufficient to correct.

Moreover, this lack of more qualitative information on the companies is reflected in the selection of the control group. The control group is essentially used to calculate the annual fixed

effect, which removes the effects of the business cycle from the measure. The matching model does allow for the selection of a control group with characteristics closer to those of the random sample of companies tested. However, there are unknown characteristics of the test companies that are unchangeable and that may explain their use of a CLC. These characteristics, such as a commitment to the organic production, which has been growing in recent years, or an interest in cooperating with other territorially-based businesses, may also have an effect on variations in their economic activity. The matched enterprises, although very similar in terms of known characteristics, may have different profiles on these dimensions and thus have different economic trajectories over the years of the study, and not only because of the non-use of CLCs. The use of the matched control group already reduces the magnitude of the measured effect compared to the random sample. It could therefore be assumed that a better control group would improve the measurement of annual business cycle effects and could reduce the size of the estimated coefficients. For future research, it could be envisaged to pre-select control firms for fewer CLC cases, but based on a more detailed qualitative knowledge of their territory, which would then be selected in Fare in the same way as the list of CLCs member firms.

We also decided to avoid the management of bankruptcies and attrition by keeping only the companies still active in 2019 in the population studied and therefore potentially with a more solid activity. While this choice reduced the control population much more than the test population, it potentially removed firms with declining trajectories from both sides, on which we cannot therefore estimate any effects. Similarly, the absence of associations and agricultural enterprises from the Fare file reduces the population analysed significantly and unfortunately does not allow us to generalise our results beyond the non-agricultural market sector.

Despite these methodological limitations, these results are encouraging. Indeed, such a study had never been conducted before and the question of the contribution of the use of a CLC for businesses is central, both for the actors in the CLC field, the public authorities who may choose to support this type of project or not, and for academic research, for whom these conclusions provide information that was previously lacking regarding the effectiveness of CLCs. Thus, the measurement of a significant positive effect at least for small businesses raises the question of the use of CLCs as economic development tools.

This first observation opens up the field of questioning on the network effects and the coverage rate of CLCs. For example, at what level of coverage of all the businesses in a locality or territorial community would the CLCs no longer have a positive effect? Similarly, is the use of

a CLC by certain actors in a locality and the increase in their activity at the margin to the detriment of the activity of other companies in the area? All of these questions open up new avenues of research, which we chose not to address in this thesis, but which it could be interesting to address in further research, possibly beyond CLCs to other phenomena of territorial intermediation.

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Organising Money

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Mainstream market economy literature argues that it is through productive development that societies will achieve economic wellbeing. The market economy is an "economic system controlled, regulated, and directed by markets alone; order in the production and distribution of good is entrusted to these self-regulating mechanisms" (Polanyi, 1968:26). To initiate and maintain society's market economies, financial systems perform fundamental tasks as identifying and monitoring entrepreneurial opportunities, easing exchange of goods and services, and allocating money (King and Levine, 1993); however, not everyone can access formal financial systems. Financial inclusion can be understood as the responsibility by financial institutions in offering affordable, convenient, robust, and secure financial services; this while assuring quality, open access, and the protection of the costumers (World Bank, 2018).

A recognized approach to financial inclusion is micro-credits, which got international recognition with Nobel prize winner Muhammad Yunus' and his ideas of banking of the poor (see Yunus, M., 1998). The idea of this type of credit system was to enable small enterprises to access small loans on easy terms and make use of community peer monitoring to make use of local knowledge of the members of the group (Stiglitz, 1990). Yunu's proposal has transformed in the last years, and it has been co-opted by ideas of the market economy. As research shows, if profitability is set as a priority, it is common to find companies charging

~~interest rates up to 240% a year depending in the formality of the lender (Sandberg, 2012).~~ Studies have found ambiguous results suggesting that micro-credits bring modest positive impacts (Buckley, 1997; Banerjee et al. 2015; Banerjee et al., 2015-2), extends individualists behaviours instead of adopting systemic approaches (Barinaga, 2014, Bateman et al. 2019), and presents potential exploitation on the consumers (Sherratt, 2015). Still form a market logic, more recently, there is a raise in the adoption of mobile money, which is "a pay-as-you-go digital medium of exchange and store of value using mobile money accounts"[1], for financial inclusion. Recent studies show that 71% (Muthiora, 2015) of Kenya count with mobile money services (cf Hughes & Lonie, 2007; and Morawczynski, 2009 for accounts on Kenya's M-Pesa[2]) as praised mechanisms for financial inclusion. However, still with mixed evidence of its impact (cf Wieser et al., 2019; Batista & Vicente, 2021). Beyond the mentioned concerns, research also highlight the importance of being critical to the economic ideas which are reproduced through the financial services used in context of socio-economic vulnerability (cf. Bateman, 2012; Barinaga, 2014; Mackenzie & Louth, 2020; Kemp & Berkovitch, 2020), because as Clinton (1977) warn one must "be careful of the thought-seeds you plant in the garden of your mind for seeds grow after their kind".

Considering the significance of financial inclusion and with limited institutionalized solutions, it becomes important to comprehensively study how to organize different approaches to those proposed by a market economy, one of this being complementary currencies (Seyfang, 2006; Longhurst, N., & Seyfang, 2013). Broadly speaking, complementary currencies can be defined as an agreement within a community to use a standardized unit of account as a means of payment and with the objective of incentivizing pre-defined social, economic, or environmental behaviours (Lietaer, B., and Dunne, J. ,2013; Blanc, J., 2011). Studies have shown that the use of complementary currencies can increase the economic resilience of communities since these currencies can serve as a community-based credit system that increases monetary liquidity during an economic recession (Ulanowicz et al, 2009; Stodder and Lietaer, 2016). Complementary currencies have emerged in different contexts around the world (cf. Jakob et al, 2004; Kennedy et al., 2012; Sartori, 2016; De Rosa, and Stodder, 2015), and there are some examples of complementary currencies improving's people wellbeing in context of socio-economic distress. For example, the use of a complementary currency in Brazil, increased the local commerce a 73% in twelve years of usage (Cernev & Diniz, 2020:489) and "promoted a

[1] As defined by the Financial Access Survey developed by the International Monetary Fund

[2] M-PESA is a financial innovation an innovative payment service for the unbanked where customers can use his or her mobile phone to move money quickly, securely, and across great distances, directly to another mobile phone user.

~~sense community and solidarity" amongst the users; or in Kenya the use of complementary~~ currencies increased the access to food and jobs in excluded populations (Ruddick, 2011; Barinaga et al, 2019; Ussher et al 2020).

Research has studied challenges in already developed complementary currencies. For example, Schroeder (2015) explains that there is a substantial amount of work and challenges in creating and maintaining complementary currencies which is often not recognized; Gómez and Wit (2015) write about the heterogeneous political perspectives that Argentinian designers/users had and how unresolved issues contributed to the end of these complementary currencies; and Barinaga (2020) warns about how the way complementary currencies are designed can have unexpected influences in local decision-making practises. Because of the suggested challenges of implementing (creating and maintaining) complementary currencies, there is a need to study the implementation process in situ, as it gets done. Reflecting on this phenomenon the research question guiding my study asks: ***In the context of informal urban settlements, how are economic ideas materialized through the creation and maintaining of complementary currencies?***

Depending on the use money that is prioritized – that is as payment, exchange, store of value, or standard- money can vary in their design (Polanyi, 1968). For example, some are grounded in a relational understanding of money which highlights the importance of the community relations of reciprocity and redistribution; and others on a commodity understanding of money which favours the use of currency as a commodity and its capacity as a store of future value. To study the differences in the design of money, Christine Desan's (2015) constitutional approach to money becomes relevant. Desan recognizes money as a project engineered from the start and highlights the importance of depositing the attention in the actors and relations in the constituting of money. Consequently, Desan (2015) investigates how through coercion and the control of materiality (i.e., coinage and minting) in the constitution of money, central authorities (i.e., governments) can govern populations and influence the distribution of resources. Desan's constitutional approach offers a good starting point, but it needs to be adapted to study the organization of on-the making complementary currencies, with not necessarily a clear central authority in command.

A methodological lens in line with Desan's approach on studying the process of how material elements, human actors, and their relations constitute a project (in Desan's case money) is actor-network theory. Latour (1999:375) argues that it is through the connection of these actor-

networks that one can explain the attachment of certain practices that control or interfere in one another and "no explanation is stronger (…) than providing connection among unrelated elements or showing how one element holds many others" (ibid:375). This methodological lens provides a language to investigate the strategies that leads human and non-human actors to create those connections (Callon, 1984; Latour, 2005). Moreover, it enables a discussion on translate their economic ideas by embedding them into materiality (Latour, 1999; Czarniawska & Joerges, 1996). To study the assembling of relations Law (1994:100, cursive in original) suggests one should "(…) like to tell stories and trace *histories* rather than tending to take synchronic snapshots". Latour (1996:378) defines this 'storytelling' as a network-tracing activity, where an actor defines a world view in which it "traces, delineates, describes, files, lists, records, marks, or tags a trajectory that is called a network" (ibid). The use of this sociological approach with helps us complement Desan's constitutional approach to money by studying the actors in the field who are tracing, delineating, and describing the process of an on-the making of a complementary currency.

Africa is a continent in which the challenge of economic exchange, money, and capital allocation has been approached in different ways. Even though African innovativeness is not valued enough by the mainstream western research (Adebayo, 1994; Sinclair, 2004; Mavhunga & Dessler, 2007; Mavhunga, 2017), there are accounts of African precolonial unique monetary systems (cf. Polanyi & Dalton, 1968; Johnson, 1970; Mwangi, 2002) and innovative financial practices as rotating credit associations (cf. Geertz, 1962; Ardener, 1964; Adebayo, 1994). Recent studies show that 71% (Muthiora, 2015) of Kenya count with mobile money services (cf Hughes & Lonie, 2007; and Morawczynski, 2009 for accounts on Kenya's M-Pesa[3]) as praised mechanisms for financial inclusion. Considering Kenya's context, it is not surprising to find development organizations and FinTech companies exploring ways of leveraging on local knowledge to introduce financial technologies in search of economic wellbeing and poverty alleviation (cf. Global partnership for Financial Inclusion, 2016; Pénicaud & Katakam, 2019; Fishbane, 2014; Oh & Rosenkranz, 2020).

This ethnographic study investigates an action-research project introducing a digital complementary currency in informal urban settlements in Kisumu, Kenya. In 2017, a group of

[3] M-PESA is a financial innovation an innovative payment service for the unbanked where customers can use his or her mobile phone to move money quickly, securely, and across great distances, directly to another mobile phone user.

scholars researching grassroot innovations in Kenya, became aware of the Kenyan's rotating credit associations and, with the aim of improving's people's socio-economic wellbeing, proposed some of these associations to co-create their own complementary currencies. Starting in 2018, this project, anonymized as the Grassroots Financial Innovation Project, brought together scholars from Scandinavian and Kenyan universities, local merchants from the Kibuye market in Kenya, and FinTech entrepreneurs with the goal of implementing a complementary currency in Kisumu, Kenya. Just in the start of the project, Covid-19 interfered and changed people's lives and the project's plan. The merchants participating in the project were struggling to sell their products and during the curfews the government demolished the market with the excuse of future renovations. People were suffering and the critical situation influenced the decisions and actions that unfolded during the project's coming years.

The empirical material was constructed following the tensions emerging since the begging of the project in 2017 until summer 2022, time where I achieved data saturation. Since my participation in the project in 2019 and despite the Covid-19 related travel restrictions, I have been able to gather more than 20 in-depth online and on-site interviews; more than 50 hours of participant observations of recorded video meetings; fieldwork notes of a stay of 13 days during November 2019 and a second one of 10 days during September 2020; and, project proposals, teaching materials, meeting minutes, and internal communication messages. In the tracing of *histories*, the categories of monetary ideas and claims for ownership were salient and guided the analysis of the empirical material.

The first tension that emerged in the project related to deciding between two different payment software that could be used in the project. By comparing how commodity or relational understanding of money are configured in a payment software, I investigate how is that economic ideas are materialized. By following this discussion, I theorize that a payment software favours specific economic ideas, since each software had inscribed accounting methods and algorithms which prioritize certain uses of money and affords certain behaviours. This chapters emphasises the performative effect of economic ideas in the construction of reality.

The second tension emerges from the differences that emerge in the different moments of translation of economic ideas into a monetary model that includes the payment software and the regulation of its use. In this chapter, I follow how the researchers and traders mobilized their programs through different inscription devices and financial and social resources. The

researchers made use of education and training material and their privileged access to financial resources. However, as experienced entrepreneurs and organized group, the local traders had control over their own economic practices and the final inscription of their regulation documents. In this process, I theorize on how control over the monetary configuration can be disputed and strategies that enable actors to be included or excluded in the materialization of economic ideas.

The last and final tension looks at the way in which the traders were using the complementary currency versus the behaviours that were supposed to be promoted by the monetary model. Grounded on field visits, this chapter analyses the challenges that project encountered when combining their own practices and the use of the payment software and theorises about the limitations on the configuration of money and the money in use. Finally, I reflect on the difficulties of introducing different economic ideas to populations with different backgrounds and contexts.

The aim of my research is twofold. First, I want to equip policy makers and practitioners with insights on the challenges, risks, and opportunities of creating complementary currencies for financial inclusion and socio-economic wellbeing while still allowing local people to speak on matters of their concern, since it's not possible to tell anybody how to live their lives, if one has never felt the pain before (Bradley, 2011). Second, to develop further the field of studies researching on how money is designed by looking into the dynamic process of constituting money and how the financial ideas embedded into technology and the practices of users interact.

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CCS - Review and renew

New Evidence about the Swiss Wirtschaftsring (WIR): An Example of the Deficits of Conceptual Frameworks in Complementary Currency Research

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Abstract (short)

The Swiss Wirtschaftsring is one of the few complementary currency systems that became economically significant. This contribution sheds new light on the early development of this system in the 1930s. Although the founders were adherents of the 'free economics' concept of Silvio Gesell, the WIR has its roots in a different model—the German 'Arbeitsgemeinschaften'. This part of the research is based on the evaluation of new archival sources. Furthermore, the paper provides an overview of the development of the WIR from the 1940s onwards and an interpretation of the specific characteristic of this system. The WIR is, according to the result of this study, more than just a currency—it is separate market with its own currency.

1. Introduction

In discussions on complementary currencies, the Swiss Wirtschaftsring (subsequently designated as WIR) plays a prominent role. It was founded as early as 1934, and its track record shows a high level of economic sustainability. In contrast to almost all other alternative currencies, this system attained a significant level of economic importance. In 2013, the annual turnover amounted to 1.43 billion WIR francs; nominally, this corresponds to the same amount in Swiss francs. This system has received much attention from the general public, activists, and scientists. It had, to put in terms used in social innovation theory, a disruptive effect, and it qualifies as an approach that 'aims at changing cognitive

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frames and power structures' (van der Linden and van Boers 2017, 314 in respect of other complementary currencies).

Over the years, the WIR has attracted significant interest in academic research, and in recent times even among scholars who cannot read German. One of them, Gawthorpe (2019, 344), remarked that 'the literature on the WIR currency has been rather scarce'. This, however, applies just to sources

available in the English language. As a matter of fact, there is plenty of literature about this system in the German language. In addition, useful studies of the WIR, available in English language, which provide an overall picture (as by Studer, 2006, originally published in 1998) are dated. The original intention of the present author was to present an overview of the history of the WIR in combination with a survey of the literature. But during the early stage of this project, the present author came across the name of a person who had played a role in the foundation of the WIR. It turned out that the literary legacy of this person had been archived. The appraisal of this source led to an extension of the research project. This implied the study of other primary sources and led to a definition of a new research question. At the heart of this issue lies the distinction between 'money in account' and 'money as a thing'. If it is correct that the WIR belongs to the first category, why do theoretical frameworks which belong to the second category still play an important role in interpretations of the WIR? What explains the success of the WIR if analyzed as a system that uses 'money in account'? What is the function of the rule of non-convertibility in this context? What are the implications for complementary currency research in general?

The following section—the foundation of the WIR and its early development—presents this new evidence. The second part of the historical study describes the progress of this system after World War II. Section 4 discusses the mechanisms which explain the success of the WIR, as also its problems.

For the sake of order, the following clarification may be useful. The WIR was founded as WIR-Wirtschaftsring Genossenschaft. WIR means in German 'we'; the translation of Wirtschaftsring is 'economic circle'. It is registered as a cooperative. From the 1990s onwards, this cooperative expanded its scope and developed into a bank, which offers its customers a variety of different products. The focus of the business was, and still is, small and medium-sized enterprises. The name of this cooperative was changed to WIR Bank Genossenschaft in 1998.

2. The foundation process of the WIR: New evidence

The founding history of the Wirtschaftsring highlights the relevance of the free economics theory as developed by Silvio Gesell. A short version of this narrative can be found on the website of the WIR (2022). In his book, Hervé Dubois (2014), a retired public relations officer of the WIR Bank, highlights the relevance of this heritage (see, in particular, the first two chapters, as also 40, 56, 59, 60f). Studer (2006) describes the birth of the WIR against the background of—as he calls it—'the greatest global economic crisis of modern times' (Studer 2006, 2). Furthermore, he outlines the inadequate reaction by national governments to the recession in Switzerland and elsewhere. He also mentions a few 'future-oriented private initiatives' (Studer, 2006, 8), i.e. grassroots initiatives in Switzerland, which tried to promote domestic production. Then he turns to the free-economics movement as the source of ideas which, according to Studer, led to the establishment of the WIR (Studer, 2006, 8–10). Other

authors adopt this view and place 'the origins (of the WIR) in the ideas of Silvio Gesell' (Stodder and Lietaer, 2016, 571). At this point, I think, an important element is missing in Studer's attempt to contextualize the origin of the WIR. It should be remembered that in these years, very many ideas and concepts have arisen, some of which were tested in experiments. (A Norwegian author, Björset, assembled some of these ideas in a book published in 1934; the reprint of the English version from 1936, published in 2015, serves as a reference here.)

An important part of any historic account of the WIR is that the founders, Werner Zimmerman, Paul Enz, and others, were adherents of the Gesellian ideas—this is not doubted in this paper. The question, however, is, why was the WIR project so completely different from previous attempts in Germany and Austria to put the theory of Gesell into practice? According to Dubois (2014, 27), Zimmermann himself had been involved in the free money experiment of the Austrian town Woergl. Godschalk (2012, 65f) has provided another explanation. He denies Studer's explanation that the WIR had ever been a Gesellian institution. Instead, he considers the German Ausgleichkassen / 'Arbeitsgemeinschaften' as the blueprint for the development of the Wirtschaftsring. Godschalk (1986) himself had explored these systems on the basis of the literature of the 1930s. Attempts to put this concept into practice had been declared illegal by the authorities. An important example is the description of the 'Arbeitsgemeinschaft Oberschlesien' (Argo) by Wackerzapp (1932), the 'administrative' head of a district in Upper Silesia, where one of the most important of these experiments took place. According to Godschalk (2012, 66), the idea had migrated to Scandinavia, where it was picked up by Zimmermann, Enz, and possibly some other visitors from Switzerland (with regard to the first journey, see also Dubois 2014, 27). This interpretation appears plausible, but it leaves open the following questions: How did the idea migrate from Germany to Scandinavia? What motivated the Swiss to make this trip?

The crucial hint that made it possible to answer these questions came from a small book by Schwegler. This author mentions the name of Kurt Zube. According to Schwegler (1936, 80–83) this man, originally from Berlin, acted as the representative of a German merchant, Curt Schönstein, who offered the licence for a clearing system that had already been implemented in Denmark. The name of this country had also been mentioned by Godschalk (1986, 66), though without reference to the work of Schwegler. The problem at this stage of the research process was the question whether this booklet is a reliable source. It was produced by the Neue Zürcher Zeitung and was perceived as part of an 'Anti-Wir campaign'. Dubois (2014, 47) echoes—without direct reference to the work of Schwegler—the outraged reaction of the WIR supporters in that period. Having searched the name of 'Kurt Zube' on the Internet, it turned out that the literary legacy of this activist was stored in a public archive (Eckhardt 2006).

Zube was a libertarian activist and writer who saw himself in the tradition of Stirner, Proudhon, Warren, and others (Timm 2006, 10). He had already dealt with monetary issues, particularly the monopoly of the state on money (Timm 2006, 6). This might have paved the ground for his interest in the model of Curt Schönstein.

In a typewritten document (No. 89, Bibl.d.Freien), Zube reported that he got to know the Schönstein model in January 1934. He was so enthusiastic about it that he turned offers for other jobs down. A first attempt to attract Werner Zimmermann to this cause failed. He made a second attempt after Schönstein had managed to establish the system in Denmark and travelled to Switzerland in spring 1934. Zimmermann remained sceptical, but, according to Zube, Paul Enz showed some interest.

Eventually, both decided to travel to Denmark in order to obtain an impression of 'Nordisk Clearing' for themselves. At that time, in May, the exchange mechanism had not been set up yet. That is why they made a second trip later that year (see 'Rückschau auf den WIR' WIR-Nachrichten, Nr. 1/6, 14, SWA.Basel Zq 121). Many years later, Enz (WIR Pionier 15. Mai 1959, 26. Jg., Nr. 5, 5, SWA.Basel Zq 121) remembered that he was very touched by the story of a farmer who described vividly how a loan from the newly established system helped him out of great misery.

A comparison of the respective fee structures in 1934 shows a great similarity between the Schönstein model (the 'Richtlinien' stored under No. 88 in Bibl.d.Freien), the WIR (Schwegler 1936, 11), and the Scandinavian Nordic (or Nordisk) Clearing Company (Björset 2015 [1934], 146). There is (among other fees) a turnover charge (in German, the so-called 'Standardsicherung'), which is scaled in relation to the amount of a transaction: for low amounts 5%, then 3%, and 1%, and for high amounts, ½%. With regard to the WIR, the corresponding amounts are up to 50, 250, and 1000 WIR francs, and more than 1,000 WIR francs. The WIR commenced its operations exactly with this specific rate system (Schwegler, 1936, 11). This is a kind of a 'fingerprint proof' of the 'Schönstein model'. It is very likely that Schönstein had been inspired by the original 'Arbeitsgemeinschaften' concept. Zube uses the term 'Arbeitsgemeinschaft' in a kind of advertising paper ('Das verblüffenste und zugleich solideste Vorschlag, der ihnen je gemacht wurde' No. 88, Bibl.der.Freien). The Swiss discovered the original 'Arbeitsgemeinschaften' in Spring 1935. They reprinted a detailed article about the 'Arbeitsgemeinschaft Oberschlesien' in their own newspaper ('Selbsthilfe in Schlesien' by Gustav Huhn, WIR Nachrichten, Nr. 14, 3 Mai 1935, 1–3, originally published in Deutsches Adelsblatt, Nr. 51, 11 November 1932, SWA.Basel Zq 121), in October 1935. Zube himself had certainly played a crucial role in the very early stage of this process. Without Swiss citizenship, he could not become a member of the group which founded the WIR cooperative in October 1934 (see 'Rückschau auf den WIR' WIR-Nachrichten, Nr. 1/6, 14, SWA.Basel Zq 121). This, however, was not the crucial point. The present author got the impression that Zube was a person who insisted with a certain degree of stubbornness to implement the Schönstein model exactly as it was in practice. Zube himself was a person who did not shrink from conflict (see Timm 2006, in particular, Page 9). This implied that he became just a marginalized observer of the conflicts between—as he describes it—the group of participants who were interested in getting mortgage loans and the adherents of the free economics movement. Zube did not get a permit of residence in Switzerland. He, therefore, moved to Austria. With regard to the WIR, he complained that he had invested a larger amount of money in the project, which was not recognized in any way. Even after the war, he unsuccessfully commissioned a lawyer with this case (see 'Notwendige Erläuterung zur 1. Halbjahresbilanz der WIR-Genossenschaft' No. 89 in Bibl.d.Freien; see also Timm 2006, 6).

To some extent, all this confirms the hypothesis of Godschalk (2012, 66). It would, however, not be correct to say that the WIR complies with the German 'Arbeitsgemeinschaften' model. The latter was not restricted to the private sector as in Switzerland. In 'Oberschlesien' (Upper Silesia), the driving force of the project was the head of the local district. Apart from private dwellings, they also built a road. The savings banks, i.e. quasi-public institutions played a prominent role (Wackerzapp, 1932). In Switzerland, the adoption of the Schönstein model was rather the beginning of a long process of trials and tribulations. A problematic component of this model was the 'Sparrücklage', mentioned above. It was allocated in thirds to cover administration costs, to a (savings) reserve to the credit of the buyer, and a commission to the benefit of the recruiter of new members. (With regard to the WIR see Schwegler 1936, 13; the original source, in document No. 88, Bibl.der.Freien, does not

specify whether the last component is to the benefit of the recruiter of members and/or the seller in a transaction). This last element was considered the 'motor' of the system. In that sense, it has some similarity with the demurrage, the turnover incentive which is considered as important by the adherents of the free economy approach. This may explain why Zube received a positive feedback from Enz. In October 1935, the WIR disestablished the differentiated scale of this fee, but maintained the rule (or at least part of) that it was credited to the buyer ('WIR Nachrichten', Nr. 14, 3 Mai 1935, 4). Later, it was abandoned. Schwegler (1936, 14–16, 26–29), however, criticizes this fee as well as other elements of the WIR which are not discussed here, for instance, the Bürgschaftsgenossenschaft (a guarantee-cooperative). All in all, his criticism of the WIR was well founded. One may even call the 'Sparrücklage' a Ponzi scheme. Another indication of the somewhat dubious character of the Schönstein model, as adapted by the WIR, is that Schönstein claims to have a licence for it. Schwegler (1936, 80–82) quotes from a letter, in which Zube tries to sell the Schönstein license for a significant amount of money (see, in this context, also 'Das verblüffenste und zugleich solideste Vorschlag, der ihnen je gemacht wurde' No. 88, Bibl.der.Freien and the 'WIR Nachrichten', Nr. 9, 10 February 1935, 4). Apart from the fact that Schönstein had adopted elements of this model from the 'Arbeitsgemeinschaften' concept, there was no legal basis to charge a licence fee. This part of the Schönstein model was more than dubious.

The foundation of the Wirtschaftsring should be considered an innovative process, where people with different ideas joined hands in order to create something new. The founders were flexible enough to pick up a new idea; they modified the concept introduced by Zube. The fact that they were adherents of the Gesellian ideas played a role in this context, but not a crucial one. Zube witnessed the conflict between Gesellian activists and others who were just interested in obtaining mortgage loans (No. 89 in Bibl.d.Freien). Schärrer provides details about this conflict in his review of the documents archived by the Swiss free economics association (Schweizerischer Wirtschaftsbund, SFB), a source also mentioned by Godschalk (2012, 66). Already on 24 October 1934, H.K. Sonderegger had issued an official statement of the SFB, in which he drew a clear line and rejected any kind of support to the WIR project (Schärrer 1983, 204). The differences did not only concern monetary issues; the Gesellians were also sceptical that a purely private initiative would succeed in creating a viable economic alternative. Zimmerman negotiated a compromise formula and thereby managed to avoid the final break of the relationship between the two organizations (Schärrer 1983, 204f). In order to understand the background of this conflict, it is important to take into consideration the composition of the groups concerned. Schärrer provides a detailed empirical study—based on the membership list of the Swiss free economics movement—the 'Schweizerischer Freiwirtschaftsbund / SFB'. The vast majority comprised people with an academic background, in particular, very many teachers (Schärrer 1983, 135). General attitudes and political opinions of these 'new middle classes', as Schärrer calls them, were quite different from those of the 'traditional middle classes' i.e. skilled craftsmen, and, at that time, also farmers. To a lesser extent, this applied to retailers and owners of small factories (Schärrer 1983, 135–137). In this context, it is worth noting that during the first years, the 16 founders of the WIR provided the necessary capital and, so, maintained full control of the organization. Those who joined the WIR exchange ring as participants did not become members of the cooperative (Dubois 2014, 46). Enz, Zimmermann, Haug, and the other members of this group were idealists who had been motivated by the ideas of Gesell, but they were also pragmatists. In order to attract people from the 'traditional middle classes', they avoided any kind of propaganda of Gesellian ideas. The member newspaper of the 1930s, the WIR-

Nachrichten, published hardly any information related to the free economics movement. Instead, the paper offered a number of articles about 'Arbeitsgemeinschaften' in different countries ('WIR Nachrichten'—about Nordic Claring Nr. 9, 10 February 1935, 1f, about the German system in 'Schlesien' Nr. 14, 3 Mai 1935, 1–3, about Reichenberg in Czechoslovakia Nr. 81, 12 February 1937, 3, Nr. 94, 13 August 1937, 3 and Nr. 112, 1 August 1938, 1f, about such a project in the Netherlands, Nr. 119, 2 March 1939). Generally, the focus was on 'Tausch' (barter); 'Geld' (money) hardly ever played a role in this publication (for a small exception see 'WIR Nachrichten' Nr. 105, 14 January 1938, 2f).

The success of the WIR in the initial stage was mainly because of two factors: First, a register of members which provided information about the variety of products offered. This register was regularly updated. Secondly, the organization of trade fairs. One of these events, the 1935 Christmas exhibition in Zürich 1935 was attended by 30,000 visitors (Studer 2006, 11). Apart from selling goods, people had the option to get credit by paying deposits in Swiss francs. This made it possible for private individuals to take part in these events (Studer 2006, 11). This success, but also the critical comments in respect of the viability of this scheme, prompted the authorities to keep a watchful eye on the newly-founded organization. In 1936, the WIR received a banking licence. The management had not applied for it, but the supervisory authority considered the WIR to be subject to financial regulation.

Zimmermann (1938, 35f) acknowledged Enz's diplomatic skills to reconcile different approaches. His colleague had stepped aside after four years of hard work, and was, as Zimmermann wrote, quite exhausted. He (1938, 36) described this as an activity 'against negative vibrations'. He mentioned the critical booklet by Schwegler (1936), and he complained about people who had received loans from the WIR, but lacked the idealistic spirit that had driven the founders of this exchange ring (Zimmermann 1938, 34f). He introduced Paul Haug as a substitute for Enz. All this indicates that the WIR faced severe problems. A former employee, L. Misteli, provides a profound insight into the problems of this cooperative during the period from 1937 until 1940. The WIR had granted very cheap loans to small businesses without adequate securities. The established banks became alert and launched a campaign against the new competitor (Misteli, no year, 2). The supervising authority—a banking commission—investigated the case and issued an ultimatum: The WIR had to rehabilitate its business structure financially and to appoint a new managing director. This man, Paul Haug, worked very hard, tried to raise fresh capital, restructured the organization, and negotiated with the banking commission. Unfortunately, he died after about a year in office. His immediate successors did not maintain their position for longer periods (Mistelli, no year, 3). In 1939, the cooperative was restructured. The 16 members of the cooperative had to relinquish 95% of their shares. (Many years later, the WIR compensated them for this loss.) The ownership structure was put on a broader basis. New members subscribed shares and thereby strengthened the equity base of this cooperative (Lautner 1964, 43f, Dubois 2014, 47). The capital was further increased in 1940 (Dubois 2014, 50). This implied that the group of founders, who had been inspired by the ideas of Silvio Gesell, lost their influence.

World War II severely impacted the Swiss economy. Being cut off from many of its feedstock supplies, the country had to cope with a significant shortage of goods. The WIR did not provide a solution to this problem. During the years immediately after the war, the WIR recovered only very slowly. Nevertheless, trading with WIR currency continued; the existing structure provided a good basis for an upsurge from 1948 onwards. The following section will show that the Gesellian elements

in the structure of the WIR were abolished. Taking into consideration the fact that the WIR had been quite different right from the beginning in comparison with the experiments organized by the adherents of the free economics approach in Germany and Austria (with regard to the famous case of Woergl, see Broer 2007), it remains an open question as to why the interpretation of the WIR as something closely related to this concept remains important till today. A publication of 1959 may have contributed to the creation of this myth. In this year, the WIR celebrated its 25th anniversary, and the editors of WIR Plus, a magazine distributed among WIR members, invited the founders to contribute. Paul Enz (1959) described, from his point of view, the process which led to the foundation of the WIR. He described the impacts of the recession, mentioned alternatives in different parts of the world (including 'Tauschkassen' in Germany), and paid tribute to the model of Woergl, the Nordic clearing initiative which he got to know on two journeys to Scandinavia. It is quite understandable that he did not mention Schönstein and Zube. This article contributed to the image of the WIR. It was a major reference also for representatives of the WIR like Defila (1994).

3. The development of the WIR since 1948—An overview

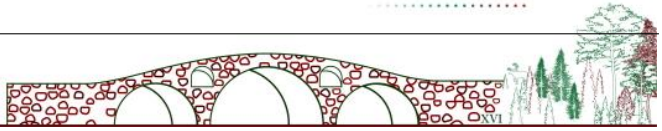
From 1948 onwards, the development of the WIR gained momentum. For the period from 1949 till 1958, the number of accounts increased from 1,070 to 11,606, and the annual turnover from 2 million to 53 million WIR francs (Meierhofer 1984, 59). This commercial success was due, firstly, to the general economic situation. Pent-up demand in the construction sector increased mortgage lending in WIR currency. Secondly, the management of the exchange ring pursued a rather pragmatic and business-oriented strategy; already in 1948, scrip was abolished and, with it, the so-called 'demurrage' (Dubois 2014, 56f). In 1952, the general assembly approved the proposal that shareholders would participate in the surplus of the co-operative. For the Gesellian advocates of interest-free money, this was a definitive break with tradition (Dubois 2014, 57f). It was still possible to acquire WIR for Swiss francs. Finally, a so-called 'silent' participation account allowed the payer to decide what share of a bill he or she wanted to settle in WIR currency and/or in Swiss francs (Dubois 2014, 58). In contrast, the regular account entitled its holder to advertise his or her products in the WIR paper, but implied the obligation that a certain percentage of a bill was due in WIR currency (Lautner 1964, 46f). In 1958, the pendulum swung back from business orientation to a focus on the principles of the WIR. The circle of participants was restricted to what had been the core of this project—small and medium-sized businesses. Larger suppliers and private participants, who were not related to a participating business, were excluded. One of the founders of the WIR, Werner Zimmermann, opposed the latter part of this decision taken by the general assembly (Dubois 2014, 59). This conflict indicates a collision of two very different concepts—Zimmermann considered alternative money as a means to connect a larger group of people against the idea of a clearing system where credits and debits had to be in balance. This implied that private participants who did not offer anything for sale had to leave this circuit. The discrepancy between pursuing short-term economic objectives on one hand, and maintaining basic principles on the other, characterized the development of the WIR in the following years as well. Throughout the history of this organization, the circumvention of restrictions to convertibility was an issue. However, during the 1960s and early 1970s, the WIR money developed, quasi-officially, into a free-floating currency. After serious conflicts and a change in management, it was decided that this was against the rules of the WIR. Members failing to comply faced sanctions (Dubois 2014, 64–74). Of course, trading of WIR currency against

Swiss francs at a discount continued, but this happened under the table (see, for instance, the survey of IGW-HSG 1994, 30). This reform was the basis for a healthy development over the following years. In 1975, more than 21,000 members participated in the system, turnover exceeded 200 million WIR francs, and a better mix of trades offered more opportunities.

During the 1980s and 1990s, the WIR achieved high growth rates. Turnover skyrocketed to 1 billion WIR francs in 1987 and 2 billion WIR francs in 1991 (Dubois 2014, 72 and 74). In 1995, this figure reached its all-time high with 2.5 billion WIR francs (Dubois 2014, 81). What had happened? Between 1988 and 1994, interest rates in Switzerland were extremely high. Borrowers had to pay for second mortgages in Swiss francs 8% p.a. in the early 1990s, whereas the WIR charged only 1.75% (Dubois 2014, 96f). The WIR had to adapt to this situation and increased its equity in 1991 (Dubois 2014, 74). This, however, proved to be just a first step to finance future requirements. Additional capital increases followed. Whether the policy of the WIR management was appropriate in this unusual situation is still an open question. A study carried out by the Hochschule St. Gallen in that period reveals that a relatively high proportion of WIR participants was dissatisfied with the service of the exchange ring. A total of 7,263 participants took part in this inquiry: 28% of the respondents considered their expectations to have been fulfilled, 51% as partially fulfilled, and 21% not fulfilled (IGW-HSG 1994, 12). The level of participant satisfaction was higher among official participants in comparison with 'silent' participants (IGW-HSG 1994, 13). Nevertheless, the majority of participants, i.e. 68%, answered the question 'Would you join the WIR again?' with 'Yes' (IGW-HSG 1994, 13; for an appraisal of this study, see also Dubois 2014, 80).

The problem was that the incentive to borrow led to the creation of a large quantity of alternative money. Borrowers consequently exerted pressure on contractors to accept this alternative form of money and found themselves in the uncomfortable position to find payees who accepted this unwelcome form of money. It has to be borne in mind that the largest part of money creation took place via the financing of construction projects. Though only a part of such a project was financed in WIR currency, say 20%, this involved relatively large sums of money, which had to pass through a bottleneck. In order to get the job, contractors had to accept this form of payment and feed the currency into a circuit. Based on the available information, it is not possible to make a judgment, but the question remains as to why the management of the Wirtschaftsring did not increase interest rates (above the rate of 1.75% mentioned by Dubois 2014, 97). This would have reduced the demand for WIR loans, and, at the same time, generate a surplus in order to self-finance the impending increases in equity.

The management decided to take a different route. This was the beginning of a new stage in the history of this organization. In the 1990s, the WIR began to offer 'classic' bank products—members did not have the possibility to open a current account or deposit their savings in Swiss francs with this institution. This was just the first step to a comprehensive restructuring process. As mentioned, the WIR ring creates most of its currency by providing loans for construction projects. This, however, was just a small part of the overall financing of any project; till 1999, another bank had to provide the larger first mortgage in Swiss Francs. From that year onwards, the WIR offered this service itself. In order to display this new strategy, it adopted the trade name 'WIR Bank' in 1998. A feasibility study substantiated this process (Dubois 2014, 120). Studer argued that business sectors which made use of the WIR facility (construction, hotel and catering, retail business) offered no prospects for growth. For other sectors, like care for the elderly or subcontractors, the WIR ring had nothing to offer



(Studer 2006, 53). He concluded that the WIR ring would 'run into a cost-price squeeze…'. (Studer 2006, 54). Studer (2006, 38) interpreted the WIR as 'primarily a marketing tool rather than a financial tool'. Certainly, cost factors should always be taken into account (see the discussion of transaction costs in respect of complementary currencies by Schroeder 2015). In this context, the following aspect is worth noting. Dubois (2014, 96) observed that it was not possible to buy information technologies 'off the peg' in order to meet the very specific requirements of this organization. Of course, to develop appropriate software is expensive. Entering traditional banking business turned out to be very successful. It became far more important than the traditional activities of the WIR ring. The question arises as to whether the WIR ring has become, or is becoming, a function of the business strategy of a normal bank. The management of this new institution underlines the relevance of the WIR exchange system for the entire organization (WIR 2018b, 10). Dubois (2014, 91) emphasizes that as in the past, only small and medium enterprises which participate in the ring hold the capital and vote in accordance with the principle one member = one vote.

In 2015, mortgages and other loans in WIR currency amounted to 3.04 billion WIR units. Turnover continued to drop significantly since the mid-Nineties; it amounted to 1.35 billion WIR units in 2015 (WIR 2016, 3, 32). A press report (Heim 2018b) mentions this as one reason why the WIR abandoned the status of a 'silent' participant. This annoyed some important participants, in particular, in the building sector. This aspect was documented in a TV report (SRF 2017) which presents also an interview with a currency dealer; according to this report, the purchase price for 100 WIR Francs was 65 Swiss Francs. As a reaction to the problematic situation of the WIR a number of reforms were undertaken, as, for instance, modified terms of participation in the exchange ring, which led to 'lively discussions' (WIR, 2018b, 10). In recent years, the heart of the problem was that with interest rates being close to zero, the WIR could not offer its loans at a reduced interest rate any more. Due to the fact that the WIR had no refinancing costs, the WIR had been able to offer them with lower interest rates than comparative products in Swiss Francs. Therefore, the inflow of newly created WIR currency got stuck. This period has come to an end by now.

4. Beyond the veil of money: About the economic rationale of the WIR

The previous sections have shown that Gesellian ideas exerted only an indirect influence on the early development of the WIR; they had no lasting impact on the structure of this system. Two aspects are important in this context:

- First, Gesell (1991) exhibited a preference for scrip, whereas the WIR uses a clearing system. At this point, it is important to highlight the fundamental difference between 'money in account' and 'money as a thing'. It is not necessary to delve into the long history of these different forms of money. (A short reference to a popular work in this field, i.e. Graeber, 2014, shall suffice in this context.)

- Secondly, the issue of (non)convertibility was not Gesell's concern. He had envisaged a monetary order that would replace the existing one without considering that different forms of money would—for a transitional period, at least—exist side by side.

This section will demonstrate that these two issues are closely related to each other. The different forms of money as a thing, like scrip and coins, are means of payment that allow anonymous

exchange. Cryptocurrencies today, too, fulfil this function. With this form of money, it is easy to circumvent the rule of non-convertibility. At this point, it is important to emphasize that thinking about the WIR was, and still is, very much influenced by the work of Gesell. A prominent example is the work by Stodder (about his interpretation of the WIR as a Gesellian institution, see Stodder 2009, 4). This author provides valuable evidence that shows the countercyclical development of business activity in this system—during cyclical downturns, turnover in WIR currency increased (Stodder 2009; also Stodder and Lietaer 2016). The focus of his analysis lies on the stock of money and its velocity. He applied macroeconomic theory and interpreted the role of the WIR—apart from being a commercial bank, it plays the role of a central bank.

In contrast to this approach, it appears to be more appropriate to proceed directly from the functions of the WIR in order to model the behaviour of the relevant actors, i.e. the WIR and its participants in an appropriate manner. Basically, the WIR offers an alternative form of exchange and provides a source of finance. Studer (2006, 26, 29) highlights the importance of the WIR as a marketing instrument. Furthermore, it offers advantages for liquidity management. It requires further research to better understand the interdependency of these different functions.

Better use of otherwise unused capacities is an aspect that will be discussed here in some detail. Non-convertibility was finally established by the WIR in 1973 (Dubois 2014, 66, also 64). Dubois (2014, 64f) reported that prior to the introduction of this rule, the WIR market had degenerated to a market of cheap products. However, over the years, the WIR currency was always traded at a rate below par. This is relevant a) in times of recession and b) with regard to capacities geared to peak demand. The problem of businesses during a recession is that prices are too low to cover costs. Depreciation and wages do not decrease to that extent (with regard to the recession of the 1930s in Switzerland, see Tanner and Studer 2012, 648–650). Reaching breakeven point is a challenge. There is a similar kind of reasoning as regards capacities geared to peak demand. Hotel rooms are a classic example. During low season, managers may sell them cheaply, hoping that this would contribute to a positive annual result. The WIR offers a chance to yield a (higher) profit, because holders of this currency have only limited possibilities to spend it, and might, therefore, welcome such an offer. This practice is not in line with the conditions of participation (Bank WIR, 2022b, C. 3. b.), but does happen frequently (see a recent newspaper report by Bircher-Sults and Ertle 2021, Dubois 2014, 65).

The significance of the principle of non-convertibility is closely related to the observation that turnover in such a circle is generated 'at the expense of outsiders' (Studer 2006, 41). Dubois provides a nice story which illustrates this—as Lautner (1964, 51) called it, 'numerus clausus'. Dubois became witness to a conversation between two restaurant owners. One of them mentioned that he pondered joining the WIR ring in order to better utilize the capacity of his business. The other strongly advised him against doing that. He himself, he added, had had very bad experiences—it was so difficult finding suppliers who accepted payment in WIR currency, which caused liquidity problems. Working with two currencies was time consuming and not worth the effort. Dubois, back in office, checked the account of this restaurant owner, and was quite surprised. The man had generated six-digit annual income figures and had no problems passing this money on. In addition, he had obtained a loan in WIR currency to finance his kitchen facilities (Dubois 2014, 113). The rule 'Don't trust your local competitor' applies in this context. Broadly speaking, this type of exchange system allows a better utilization of capacities. For restaurants, hotels, or cinemas, it is an alternative to sales.

For financial experts, the balance-sheet of the WIR Bank offers a highly interesting read. For experts in complementary currencies, such a source is terra incognita. Legal requirements anywhere in the world stipulate that values must be accounted in national currencies (with regard to Switzerland, see the Obligationenrecht, in particular, Art. 957a, 4 and Art. 958d, 3). The WIR Bank observes this rule in respect of foreign currencies like the euro. The tricky thing is that the WIR currency does not have an (official) exchange rate; it is non-convertible. Hence, the items in WIR currency (ISO Code CHW) appear in some of the categories both on the assets as well as on the liability side of the balance sheet beside items in national currency (ISO code CHF). The totals (indicated in CHF) include also items in CHW; they are assumed to have the same value as items in CHF. Of course, in this context, the rule mentioned above (WIR 2022b, C. 3. b.) that prices should be the same in CHW and CHF is quite important.

The legal framework in Switzerland is relevant not only for devising financial reports. It has various other implications for the way in which the principle of non-convertibility is applied in practice. This rule may be suspended in probate and insolvency proceedings (Mayer-Ladner 1999). Furthermore, it is an issue in respect of fiscal issues. Values in WIR currency may be declared at a lower value for tax purposes (Ettlin 2016). An attempt of the WIR Bank to restrict the activities of a broker who offered a currency exchange (WIR against Swiss francs and vice versa) by stopping him from advertising this service was not successful—the Swiss federal tribunal dismissed the lawsuit (Bundesgericht 2000).

To sum up, frameworks focusing only on monetary aspects are inappropriate to explain a system like the WIR. Schroeder (2020a) has suggested a broader theoretical approach which distinguishes between elements that facilitate connectivity and the boundaries of such systems. Money (here 'money in account') is essential in respect of connectivity. Other aspects are the various possibilities to advertise products, the application of new technologies, social gatherings like the regional associations of the WIR—to mention just a few examples. However, it is equally important to ask: Who is not supposed to be connected? Non-convertibility is of central importance in this context. Territorial aspects are relevant, too—the WIR is restricted to Switzerland. Membership is open only to businesses and their employees. The assemblage of these different elements characterizes what may be called a traditional complementary currency. Fully convertible currencies fall into a completely different category.

5. Conclusion

Although the founders of the WIR were adherents of the ideas of Silvio Gesell the historic analysis has shown that his theoretical ideas never had a significant impact on the structure of the WIR. The few elements adopted from this theoretical framework were removed before the success story of the WIR began. Although the WIR differs in some respects from the 'Arbeitsgemeinschaften' model, it can be traced back to these German systems.

It must be emphasized that the WIR, as many other complementary currencies, uses money in account. The use of cash, as preferred by Gesell, is not suitable for these systems, because this would make it very easy to circumvent the rule of non-convertibility. The relevance of this rule has not been well understood by many scholars. Although there are still many open questions in respect of the functioning of this system, it is quite clear that it facilitates trading at a value level that differs from the main economy. Unlike fully convertible currencies, the WIR is a separate market with its own currency.

This observation is not only relevant in respect of the WIR. Discussions about complementary currencies in general suffer from an undifferentiated use of the term "money." Blanc (2021) provides an example is his critical review of a book by Bazzani about the Italian barter system Sardex. Only an understanding of this specific form of 'money in account' allows an interpretation of such systems. In this context it is remarkable that the Gesellian free economics experiments of the 1930s receive much more attention than the Arbeitsgemeinschaften, although the latter were important too. (Descriptions of the latter, as by Godschalk, 1986, are hardly ever quoted.) May be, it is the power of the pictures, in particular the images of colourful scrip notes, which are sometimes even used as a symbol for complementary currencies in general that determines preferences of researches in this field. Another explanation is that such systems gain prominence when the established capitalist economy is in recession which was not the case in recent years. Actors in this relatively young field of research should become aware of such factors. Thinkers like Gesell, also the anthroposoph Steiner, Zimmermann in Switzerland as well as the right-wing founders of a predecessor organization of the Arbeitsgemeinschaften had roots in the German life reform movement. Some of the founders of the WIR lived in a land commune (Schatzacker) inspired by some of these thinkers (see Rindlisbacher 2022 for a critical appraisal). This movement had and still has a somewhat ambivalent character. On one hand, it produced social innovations, on the other one has to admit that the scientific quality put forward by the protagonists of this movement is often of poor scientific quality (as observed by Wedemeyer-Kolbe 2017, 38). Organizers of the discourse in complementary currency research should be aware of this wider context of alternative money movements.

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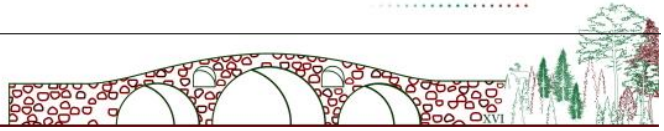

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TAKING BERKSHARES LOCAL CURRENCY DIGITAL

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[1]

Abstract: *BerkShares, the local currency for the Berkshire region in the Northeastern US since 2006, is designed to keep more of the region's wealth circulating locally while fostering local exchange. Alongside existing paper notes, BerkShares, Inc. released a digital currency app in March, 2022. This practitioner's report discusses the design, rollout, and usage to date of the digital BerkShares app beta, as well as its potential for local economic transformation. In addition to expanding participation with the currency, the broader aims include shaping a resilient, more sustainable regional economy, establishing a model other communities can emulate, and providing digital infrastructure that could augment the economic impact of future cash assistance in the area.*

Keywords: *Local economy, supply chain resiliency, cryptocurrency, climate change adaptation, universal basic income*
JEL: *O35 (Social Innovation)*

1. Introduction

BerkShares have served as the local currency for the Berkshire region, located in the US Northeast, since 2006. For community members and local businesses, choosing to transact in the local currency is a choice to keep more of the region's wealth circulating locally while fostering interpersonal connections and local exchange. The local currency is issued by a membership-based nonprofit, BerkShares, Inc., with membership open to residents of the defined economic area. Building on this established program, BerkShares, Inc. has as of March, 2022 introduced a digital currency app beta alongside the existing paper notes.

The Schumacher Center for a New Economics, a non-profit think-and-do tank based in the area, has been integral to the BerkShares program since 2006 as well as a number of precursor initiatives in the region. Local currencies form one part of a broader vision for a just and regenerative economic transformation for which the Center advocates. It continues to support BerkShares, inc. in research and development capacities, including coordinating the partnership which led to the development of the digital currency and mobile app.

2. Historical Background

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Local currency in the Berkshires has roots in earlier experiments with community financing, crowdfunding, and local business coupons in the town of Great Barrington, in the southern Berkshires. This began with the Self-Help Association for a Regional Economy (SHARE), established in Great Barrington in 1982. SHARE was a community-driven loan collateralization initiative created in reaction to the increasing concentration of the banking system among a few dominant centers, resulting in small communities across the U.S. seeing money being transferred to far-away financial hubs. The rise of centralized banking had diminished the relationship component of lending in which lenders could incorporate community-based context into loan calculations, such as a person's character and reputation, along with an understanding of the likelihood of a business to succeed locally.

In this context, SHARE helped collateralize productive loans to small business ventures which otherwise might have been refused for lack of collateral or might have been presented a prohibitively unaffordable interest rate. Local SHARE members made interest-earning deposits in a local bank, which were then pooled and used to collateralize loans to local businesses the membership knew and trusted, and which met a series of social, ecological, and financial criteria. SHARE depositors lived in the same community as the business owners they supported—bringing a human face back to lending decisions. During its eleven years of operation, SHARE collateralized 23 loans with a 100% rate of repayment (Schumacher Center, n.d.).

Taking inspiration from the visibility of SHARE, other businesses launched their own self-financing scrips to raise funds from customers for their own productive activities, bypassing the need for a bank loan. Deli Dollars and Berkshire Farm Preserve Notes became recognized illustrations of alternative community financing in the area: custom scrip purchasable at a 20% discount (i.e., a $10 note was sold for $8) and redeemable at issuing businesses at future dates (Schumacher Center, n.d.).

These initiatives helped to highlight the idea among the community to buy local and supported independent businesses. This ethos, of which these experiments formed one part, perpetuated throughout a period as opposed to what later came to be known as "the Walmart effect" noted in other regions of the U.S. Elsewhere, multinational corporations arrived in small towns and outcompeted local businesses due to the lower prices that their size, scale and tax advantages provide. Once competition had disappeared, communities would be left dependent on a few multinational firms who have little accountability to the given community (Hoffman, 2019).

In contrast to this national trend, Great Barrington and other towns of the Berkshires are still largely characterized by the presence of small, independently-owned shops in walkable town centers, as well as a lively farm-to-table food culture. The Berkshires are a mostly rural region of less than 150,000 residents, featuring remarkable natural beauty and mountainous

landscapes. These characteristics, combined with the unique place-based identity, are part of the area's enduring charm and attraction for visitors coming from urbanized areas.

Given these dynamics and the success of simple-yet-effective experiments like Deli Dollars, the Schumacher Center collaborated with the Southern Berkshire Chamber of Commerce in 1991 to develop Berk-shares, a coupon program for downtown Great Barrington businesses. Shoppers received scrip that encouraged them to return at a later date for a three-day redemption period after the high tourist season. That program ran in the late summer of 1992, 1993, and 1994. As community members grew increasingly familiar with the concept of transferable notes redeemable at multiple participating businesses, momentum began to build around issuing a regional currency year-round.

In 2006, after several years of discussions between community members, organizations, think tanks, and local banks, the Schumacher Center received a grant enabling the development of BerkShares currency as a year-round, local alternative to the US dollar. To further promote the initiative, pamphlets were distributed throughout the region that contained a directory of businesses accepting the currency. Participating businesses put stickers in their storefronts, proudly displaying their support for the program. National media coverage of BerkShares from the first few years has captured the sense of pride and enthusiasm displayed by participating business owners in the local currency program (Schumacher Center, 2022).

Today, BerkShares paper notes can be acquired at one of nine participating community bank branches and are used as cash at hundreds of local businesses. The BerkShares' value is fixed to the US Dollar, and all BerkShares in circulation are backed by UD Dollars held on reserve at area community banks. At any given time over the past several years, there has been approximately $130,000 to $140,000 USD-equivalent of BerkShares out in the economic area. Business participation in that time has fluctuated between 350-400 businesses, and includes a broad spectrum of participant organizations: farms and farmers markets, a grocery co-op, toy stores, boutiques, bakeries, medical and dental practices, auto mechanics, tree cutters, artists, non-profits, and more (BerkShares, Inc., n.d.). In downtown Great Barrington, residents and visitors can walk into a participating Bank branch to take out BerkShares, shop for groceries at the Co-op and seasonal farmers' market, have lunch at a locally-owned cafe, and patronize Main Street boutiques using only BerkShares— and all within a ten minute walking radius.

The partnership with area community banks has been integral to BerkShares' endurance relative to many other contemporary programs in the US. The association lends added credibility to BerkShares, and the FDIC insurance on the accounts which back the local currency gives users added confidence regarding the security of the underlying assets. BerkShares, Inc. also maintains community engagement through its Business of the Month series, social media, farmers' market tabling, and occasional events.

3. Taking BerkShares Digital

The decision to introduce a digital format for BerkShares was taken in mid-2021 by the BerkShares, Inc. board and with the endorsement of the Schumacher Center. The long-term trend away from paper cash toward cards and digital payment instruments, and the continued development of blockchain technology, both contributed to the rationale for a digital format even before the onset of the COVID pandemic.

A number of blockchain-based groups had approached BerkShares, Inc. over the years to take the currency digital. But it was not until the International Red Cross recommended Humanity Cash, a social enterprise startup headed by C.E.O. Fennie Wang, that a prospective partner offered an approach that upheld BerkShares' vision, local values, and connection to the community banks, as well as the currency's stable, non-speculative nature. The Danish Red Cross, which runs an Innovative Finance & System Change program, had studied America's local currency initiatives while working on blockchain-based community currency projects in Africa. Adam Bornstein, Lead for Innovative Finance & Systems Change for the aid group, explained that what sets Berkshares apart from many other U.S.-based currency experiments was the transformative vision guiding it, as well as an emphasis on keeping the money circulating by encouraging proprietors to spend the notes they take in (Schreckinger, 2022.)

The approach agreed upon with Humanity Cash built on these characteristics while iterating on the paper currency model. The startup would take on the up-front costs of developing the app with the intent to license the underlying technology and service model to other communities interested in their own digitized local currency.

One final precondition to using blockchain technology was that the application would have to be ecologically sound. To meet this requirement, it was decided to design digital BerkShares to be interoperable with different blockchain networks, and to select the Celo blockchain for the beta launch. As a proof of stake blockchain network, the Celo network claims to be far less energy-intensive than leading proof of work alternatives, such as Bitcoin. The Celo network is operated by a non-profit committed to carbon-neutral operation through offsetting which directly furthers regenerative carbon capture (Celo Foundation, 2021). The app's interoperability also provides a degree of flexibility into the future as blockchain continues to evolve.

Having addressed these major concerns, the project moved forward into a design research phase. Conducting user feedback sessions with participating business owners and community users in the summer or 2021, the Humanity Cash team identified several aspects of the current

paper note program that a digital currency and mobile app might improve. The most salient findings concerned two key issues for participating businesses:

1. Proximity of visits to participating bank branches

2. The relative costs of accepting BerkShares for payment

While cash has been a ubiquitous and technically simple mode of payment, the realities of accepting a complementary paper currency had been shifting given long-term consumer payments trends and the effect of the pandemic. As a result, multiple businesses now described having to physically take paper BerkShares to a physical bank branch to cash out as an extra effort. As a mostly rural area, proximity can matter a great deal in this respect: towns including Williamstown and North Adams, for example, are relative commercial hubs in Berkshire county which are nevertheless 30+ minutes driving-time from the nearest BerkShares-participating bank branch. It was well established from past BerkShares, Inc. outreach efforts that businesses in the area which did not bank with or operate near a participating bank branch were less likely to participate for this reason.

On the second point, several businesses also relayed some dissatisfaction with the former exchange rate (0.95 US Dollars to the BerkShare) as an undue burden on business' bottom lines. The exchange rate was originally set as a built-in disincentive discouraging cashing BerkShares out back to USD, thus encouraging recirculation and stimulating the growth of overall BerkShares in circulation. Participating businesses knowingly accepted this arrangement for the sake of the program and the potential impact on the area economy. But, as time went on, some businesses were unable to fully recirculate the disproportionate amount of BerkShares received— the issue familiar to local currencies generally of "pooling." Relatedly, several respondents also reported that, over time, the ethos and understanding of the program had somewhat drifted from area economic transformation towards that of a local discount program.

On the other hand, fees associated with debit and credit card processing—methods of payment which had increased in frequency for local businesses since the pandemic—had also climbed. For smaller area businesses, rates had risen to as much as 2.7% to 4% per transaction, representing wealth leaking outside of the region for relatively little value from the perspective of individual businesses.

Taking all of these findings into consideration, opportunities were identified to address in the design both the proximity issue of using paper notes as well as the relative costs associated with accepting BerkShares compared to other payment methods.

The resulting design of the BerkShares app enables local in-person payment transactions using scan-to-pay QR code technology from a smartphone. The look and feel of the new BerkShares app was designed to reflect the visual elegance and references to local culture which have helped make BerkShares a point of pride for locals in the Berkshires. These include portraits of Berkshire area heroes and the works by local artists which adorn the paper currency.

In addition to facilitating payments and hosting a gallery of participating businesses, the app interface enables users to load up a BerkShares wallet from any verified US bank account. Similarly, businesses operating within the designated economic area are also able to withdraw USD and expiring the associated BerkShares tokens. This takes the need for physical bank branch visits out of participation, lowering geographic inhibitors to participation throughout the wider Berkshire area.

The decision was also taken by BerkShares, Inc. to adjust the exchange rate, valuing BerkShares one-to-one with the US Dollar, and replacing the previous 5% exchange rate to a 1.5% exchange fee for both the paper as well as the digital currency. This change effectively removes the blanket "discount" some consumers associated with the local currency—although participating businesses are still free to offer BerkShares discounts at their own discretion. For small businesses, the change makes BerkShares a cost-effective alternative to burdensome credit and debit card processing fees which is comparable to Venmo, the Paypal-backed mobile payment processor, but with the added benefits including keeping money local to the region and highlighting independently-owned businesses.

The digital BerkShares app beta has brought blockchain technology to "Main Streets," offering an alternative medium of exchange which is non-speculative and which does not rely on the notorious ecological footprint which has made popular cryptocurrencies such as Bitcoin so contentious. Users of digital BerkShares can rest assured that the value of BerkShares tokens remains stable, fixed 1:1 with US Dollars, and that tokens remain backed by insured US Dollar reserves held by the community banks. By leveraging emerging blockchain technology in this manner, BerkShares can service digital payments at a lower cost to businesses than credit or debit card networks while encouraging more of the region's wealth to recirculate locally. And by using the proof of stake Celo blockchain, digital BerkShares does so while avoiding the high carbon footprint of proof of work cryptocurrencies.

4. Rollout and Usage

In the first five months of usage, from the beta release of the BerkShares app in late March, 2022 until the end of August, 2022, organizations and individuals are recognizing the potential positive impacts of local currency for the region — and also the relative cost-

advantage of this alternative to steep card processing fees for small business. This section will describe the beta launch and outreach effort, characterize the makeup of organizations participating, and summarize the usage volume of digital BerkShares tokens to date.

The release of digital BerkShares was marked by a virtual event recorded at the well-known Mahaiwe Theater in downtown Great Barrington. Outreach has involved an interpersonal approach, with three Schumacher Center staff dedicated to the app rollout and funded by a grant specific to this purpose. Business outreach has focused on participants with the paper currency, but has also involved outreach to new businesses. Onboarding a new business typically includes one or more on-location visits to educate the business owner and staff, guide them through the app setup and bank account linking processes, and to demonstrate use of the app at the point of sale.

Public awareness efforts have included earned media from local and national news outlets, tabling at farmers markets and other community events, posters and select print advertising. Posters and ads feature illustrations of the app and local currency alongside the headlines "Shop Local and Pay Local" and "Local Currency Goes Digital." Posters were displayed by participating businesses and in points of local foot traffic, and the ads ran in local print media. Earned media consisted of one round of local coverage upon the release of the app and further news coverage after digital BerkShares had begun to gain traction with several dozen businesses, including within a local farmers' market.

In the first five months of the app beta, 80 area businesses and non-profits have elected to participate by accepting digital BerkShares as tender. These organizations vary somewhat in size, industry, and past participation with the local currency. Many organizations participating are small, owner-operated businesses such as farms, stores selling things like clothing, home, or specialty goods, personal service providers, and restaurants. Several, such as the Berkshire Food Coop and Hawthorne Valley Farm Store, are mid-sized businesses with dozens of employees. Many are consumer-oriented, though several also provide business services, such as a printing shop, a marketing practice, and a compost service.There are also a number of non-profits which serve the region and accept donations in digital BerkShares. Roughly half of the 80 organizations participating in digital BerkShares are new to the local currency, and the remaining half have been participants prior to the app rollout.

There were, as of August 28, 2022, 35,904 digital BerkShares (B$) tokens currently active among the user community. Compared to the recent average of B$ 130,000 paper notes in circulation, this represents an increase of over 25% in total for the local currency in circulation since the beta launch.

Unlike the paper currency, all digital BerkShares transfers are registered publicly on the Celo blockchain, giving a greater view into the volume and frequency of overall transactions. As of the same date, there have been well over 1,000 transactions involving digital BerkShares tokens: 295 BerkShares wallet load-ups from US Dollar accounts, 767 peer-to-peer BerkShares transactions, and 51 withdrawals from BerkShares wallets back to USD. While the rate of transactions has been volatile over this period, the weekly volume of transactions has generally risen steadily over the five-month period as both the number of participating organizations and the total volume of tokens have steadily grown. This indicates habitual usage among the user base beyond the initial impetus of the beta launch promotion.

5. Learnings to Date

Through outreach, set up, training and troubleshooting alongside many of the participating organizations, Schumacher Center staff have gained user feedback on the relative strengths and challenges of the digital BerkShares program for both area businesses as well as individual users. This has also led the Schumacher Center, BerkShares, Inc. and Humanity Cash to collectively identify opportunities for the further development of app features which could enhance the experience of participating businesses as well as individual users, enhancing the value proposition for further adoption. This section will reflect on several challenges and opportunities relevant to this program which may be transferable to other like-minded efforts.

Business owners who choose to participate in BerkShares generally do so because of the positive vision put forward for local economic transformation, and because it is perceived as a community-minded action businesses in the area can take. That said, there are a number of practical factors that impact an individual business owner's decision whether or not to participate.

As discussed above, the relative financial costs and "time spent" associated with participating are two important factors. One of the primary strengths of the digital BerkShares beta from the perspective of area businesses has been the adjustment of the exchange rate, which some participants viewed as complicated, and its substitution with the flat 1.5% exchange fee. The fee's cost advantage relative to credit and debit card processing, now a popular payment option, has been a compelling factor in new businesses' decisions to participate. The comparison also informs the way digital BerkShares is described through press and marketing as a "small-business friendly alternative" to other payment providers, further bolstering the currency's community value proposition.

The beta rollout has also highlighted several factors which inhibit more widespread and regular use of digital BerkShares for local transactions. As the beta app was designed as an alternative to in-person cash exchanges, these factors concern opportunities to expand the use-

cases of digital BerkShares into other prevalent payment scenarios. The two most important include:

1. The ability to send and request payments remotely, rather than only in person, by enabling users to search an address book of users, similar to other apps like Venmo

2. A desktop version of the business account profile, for finance managers or bookkeepers to more seamlessly integrate digital BerkShares into daily business operations, such as paying vendors digitally and downloading CSV reports to import into bookkeeping software

The second opportunity is especially important for bringing more mid-sized and larger area businesses to the app, as they tend to have more complex procurement and payment processes that have become more automated since the introduction of BerkShares paper notes in 2006. Both features will require additional development resources not in the scope of the beta app.

6. Potential for Economic Transformation

Since its inception, the mission of BerkShares, Inc. has been to shape a resilient, more sustainable regional economy by promoting local exchange and production. Local currencies are one tool for area economic development which can aid in building community wealth, regional self-reliance, and sustainability.

By its design, BerkShares fosters more interpersonal exchange and privileges local production, encouraging recirculation and reinvestment within the community. In this way, BerkShares empowers each of us to help sustain and grow local business while keeping our money circulating locally. Issues in the broader societal context also underscore the value of a community-oriented approach to regional economic development. Escalating global crises of widening inequality, the disruptions of the pandemic, and the increased awareness around the threat of climate change, all lend credence to BerkShares, Inc.'s calls for greater economic self-sufficiency and for a regional approach to economic resiliency and community wealth building that includes import replacement.

Several activities have been identified by BerkShares, Inc. as opportunities to use the digital currency and app to achieve this vision. These can be broadly classified under two themes:

1. Community economic development activities to shape a more resilient and sustainable regional economy

2. Establishing infrastructure to demonstrate a more impactful alternative in public and/or philanthropic cash assistance

Digital BerkShares can provide a platform for such transformative community economic development practices. With greater app adoption, entrepreneur training and community supported industry can be organized around BerkShares participation, as has been done at points in the past, with richer and more accessible data (Schumacher Center, n.d.). When a substantial-enough reserve is pooled, a portion of funds backing BerkShares could also be responsibly invested by our community banks in the form of productive loans that fill procurement gaps, furthering production and service provision currently being imported from outside the region. Productive loans provide the recipient with the capability to produce goods and services for market with a value in excess of the loan, thereby creating new economic wealth in the community.

This citizen-driven model can guide us in creating new employment opportunities, helping to alleviate poverty and make the rural Berkshires a viable choice for young people to make their home. This import replacement approach is informed by the concept elaborated by urbanist Jane Jacobs in *Cities and the Wealth of Nations* (Jacobs, 1984). For rural regions like the Berkshires, such an approach offers the promise of developing employment opportunities that would enable younger adults to stay or move back to slowly-declining home towns.

An added benefit of digitized currency in this regard is the potential for richer data and insight to inform such an economic development approach. At scale, BerkShares transaction data could be analyzed (in an anonymized and transparent format) to identify such local procurement gaps—products and services currently being imported from outside the region. In the future, regular reports from BerkShares, Inc. could highlight potential areas of import replacement opportunity for resident businesses or prospective entrepreneurs.

Second, local currency holds significant promise for augmenting the positive impact cash assistance distribution (public or private) can have on a defined economic area. Onen study in the US has shown how public financial assistance in the US tends to be disproportionately spent at big box national and international retailers — in this specific case, 53% of all Supplemental Nutrition Assistance Program [SNAP] funds — as opposed to locally owned and operated businesses (Bolen and Wolkomir, 2020).

Alternatively, a cash assistance model through local currency could create structural resilience in local economies. With a built-in incentive to recirculate funds locally, cash assistance through local currency could strengthen local supply chains and help counter monopolistic consolidation.

A BerkShares UBI pilot, though still only in proposal stage, has garnered the interest of MIT researchers, who have expressed interest in studying this regional impact of cash transfers via local currency. A plan to advance a Universal Basic Income (UBI) pilot like that in nearby Hudson, NY has been proposed by a group of area non-profits including BerkShares, Inc. Unlike any UBI program to date, however, money dispersed in BerkShares would not

disproportionately seep out of the region to the likes of Amazon and Walmart. Instead, it would recirculate within the local economy with the intent of creating the sought-after multiplier effect. This intervention's theory of change is that, by generating an estimated local multiplier effect of up to $4 of economic activity for every dollar spent (de la Rosa and Stodder, 2015), cash assistance in a local currency would better "lift all boats" in a given area than if done via US Dollars.

The expanded features and usability for mid-sized and larger businesses discussed above is a practical precondition to such a UBI pilot in order to meaningfully assist families in need of financial support. That said, a new partnership with human services non-profit Multicultural BRIDGE, one of BerkShares, Inc.'s UBI proposal partners, indicates how this concept may be implemented on a small scale.

In July and August of 2022, Multicultural BRIDGE has distributed B$ 5,875 to support 126 food-insecure families to spend at local farms and markets, demonstrating how the local currency can augment the impact of cash assistance in the area at small-scale. By directly connecting recipients with area food purveyors and growers, this creates a more circular economic model than US Dollars or chain store gift cards, as had been used by Multicultural BRIDGE previously. In this way, the spending is simultaneously meeting individual needs while directing that spending to local farmers and grocers, who are incentivized to recirculate BerkShares within the community.

7. Conclusions

Over a year-long design and development collaboration, BerkShares, Inc, Humanity Cash and the Schumacher Center successfully introduced a digital currency to our area. The BerkShares mobile app leverages blockchain technology to offer a competitive digital payment alternative to business and conscious shoppers in our local area. Over five months, a number of businesses have successfully adopted the app and integrated it into their existing practices, participating community banks have become comfortable with this new arrangement, and local and national press has taken notice.

BerkShares, Inc. and the Schumacher Center view this beta application as the beginning of a longer-range plan. Our organizations now seek to continue developing the BerkShares application to make it attractive and user-friendly for a wider set of businesses, and to advocate for local currency as a tool of regional economic resilience and community wealth building, including the case for cash assistance through digitized local currencies. Local currencies such as BerkShares have the potential to harness collective desire for social and economic change at a more human scale—empowering everyday people to shape and direct the economic futures of their own communities.

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Paying salaries in local currency: legal alternatives

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Keywords: Local currencies, employee remuneration, legal alternatives.

ABSTRACT: In general, countries legislations prohibit the payment of salaries or wages in amounts that are not denominated in fiat currency. This is a measure to protect the worker. In this sense, the article aims to analyze the legal alternatives available so that Municipalities and companies would pay the remuneration of their employees, or parts of these remunerations, with local currency. It will also be investigated which amounts received by employees fall within the concept of salary or not, according to Brazilian legislation. Furthermore, the legal provisions that oblige remuneration to be paid in fiat currency will be analyzed and, as an alternative, the possibility of companies and municipalities to sign contracts with their employees for the acquisition of local currencies, in which employees would voluntarily opt for the purchase of an amount of local currency with part of their salary, in exchange for incentives. Finally, practical cases will be examined in which employee remuneration is made using local currencies.

1. What is local currency and the challenges to improve its circulation in municipalities

Local currencies, as well as their best-known species, social currencies[1], are complementary currencies, which allow "localities and regions to create real wealth in

[1] Social currencies, as an alternative means to facilitate access to social rights provided for in article 6 of the Federal Constitution of 1988, are "alternative instruments or payment systems created and

their local economy by combining unmet needs with underutilized resources. They are a way for wealth that is produced locally to benefit local people rather than being appropriated by distant companies" (LIETAER and HALLSMITH, 2006). An aspect that differs one currency from the other is its issuing agent, as the local currency can also cover those currencies issued directly by the Municipalities, acquiring an official character for being linked to the public power, regulated by law, while the social currency is usually issued by community banks, being associated with social projects and third sector organizations (CABIDO, 2021). However, both aim to function as a complementary currency to the Brazilian national currency, the Real, being characterized, therefore, as complementary and not as substitutes.

In addition, they aim to strengthen the local economy of small neighborhoods or municipalities by increasing monetary circulation at the local level, causing a retention of wealth in the region where it is valid, thus having an economic bias that implies the fight against the evasion of money and wealth of the territories, especially with regard to household consumption. Still in the conceptual aspects of local currencies, other characteristics are highlighted: they are not legal tender, that is, no one is obliged to use or accept local currencies; operate legally in more than 35 countries; they are controlled by the communities themselves; circulate only in a certain geographic region and the system must work in an anti-cyclical way (CABIDO, 2021).

In Brazil there are more than one hundred social currencies in circulation[2]. Regarding examples of local currency issued by the municipality itself, there is currently only the Froes in circulation, issued by the Municipality of Bonfinópolis in the state of Minas Gerais. However, the municipality of Resplendor, also located in the state of Minas Gerais, has recently sent to its City Counsil the Bill n. 16 of September 5, 2022, which intends to establish a local currency, issued directly by the Municipality of Resplendor.

Although local currencies are not legal tender, it is essential that the local community accepts them so that they can function as an instrument for the economic and social development of the region (FREIRE, 2011, p.26). This acceptance is only

managed by users themselves through non-profit associations, based on economic activities based on the cooperation and solidarity of the participants of a given community" (FREIRE, 2011, p.7)

[2] Available in: <https://www.terra.com.br/economia/operacoes-cambiais/operacoes-empresariais/alem-do-real-brasil-tem-103-moedas-sociais-em-circulacao,4955b8356e35f310VgnVCM4000009bcceb0aRCRD.html#:~:text=Palma%2C%20Santana%2C%20Maracan%C3%A3%2C%20Par,ligada%20ao%20Minist%C3%A9rio%20do%20Trabalho>. Accessed on: September 14, 2022.

possible through the recognition of the legitimacy of this instrument, thus emphasizing the importance of the law in its regulation regarding the creation of rules that discipline the local monetary systems.

Furthermore, it is essential for the success of such coins to create a mechanism for putting them into circulation. This can occur through the action of the citizens themselves, who choose to exchange fiat currency for local currency, however, in Brazil it has been more common to put it into circulation through incentives from the municipal government, especially through the payment of assistance benefits. On the other hand, other possibilities have been debated as a means of putting such coins into circulation and encouraging their use, like the payment of salaries in local currencies which can be an important means of promoting the massive use of such currencies in municipalities.

2. The concept of salary in Brazilian legislation and the obligation of its payment in fiat currency

The various transformations of production processes and the consequent exploitation of work meant that workers no longer accepted barter as labor consideration. Faced with this new reality, remuneration became to be made in currency, and in general, these remunerations are known as remuneration or salary.

Remuneration comes from *remuneratio*, from the verb *remuneror*. The word is composed of *re*, which means reciprocity, and *muneror*, which means to reward. The word salary comes from the Latin *salarium*. This word comes from salt, from the Latin *salis*; from Greek, *hals*. Salt was the payment method for the Roman legions; later, other means of payment of wages were used, such as oil, animals, food, etc.[3].

Brazilian legislation suggests different meanings between salary and remuneration. This is because remuneration is understood as the gender of the payments due to the worker as a result of the provision of the service or the employment contract itself. The salary would be the most important part among the payments made to the employee, which is the price paid for the workforce made available to the employer[4].

[3] MARTINS. Sérgio Pinto, **Direito do Trabalho.** 28ª ed. São Paulo: Atlas S.A. 2012. p.231.
[4] DELGADO, Mauricio Godinho. **Curso de Direito do Trabalho.** 18 ed. São Paulo: LTr. 2019. p.842.

The set of what the law calls remuneration is composed of the set of base-salary, salary complements, gueltas[5] and tips. It is not included in this concept, for example, the amounts paid to the worker with the purpose of indemnifying losses perpetrated by the employer and of reimbursement of expenses arising from the service.

It is also important mentioning the existence of payments that are not considered as part of the labor relation but that are related to the employment contract, since they do not have the power to remunerate the employee, but occur through the employment relationship. Included in this category are stock options, the right to use images, among other institutes.

The payments referring to the salary, in accordance with article 457, §1, of the Consolidation of Labor Laws (CLT): “The salary includes the stipulated fixed amount, legal bonuses and commissions paid by the employer. "

In addition, it should be clarified that in the legal doctrine the expression salary can have several complements, which individualize its application in each situation. In this regard, for the present study, it is necessary to highlight the main expressions that complement and expand the concept of salary.

The law establishes the minimum salary, which is the minimum value due and paid directly by the employer to every worker, including rural workers, without distinction of sex, per normal day of work, and capable of satisfying, at a given time and region of the country, their normal needs for food, housing, clothing, hygiene and transport (Art. 76, CLT).

Salary can be calculated per unit of time, which considers the time spent to perform the service or the time that the employee is available to the company, whether in hours, days or months. It so happens that the calculation per unit of time must be based on the minimum salary or the legal minimum salary proportional to the time worked, according to court precedents guidance[6].

According to article 458 of the CLT, the salary can be considered in two different ways:

[5] Gueltas are premiums paid by suppliers to third-party employees as a sales incentive. Gueltas are similar to tips as they are amounts paid by third parties unrelated to the employment relationship.

[6] Court Precedents 358 of the TST's SDI-1. MINIMUM SALARY AND SALARY FLOOR PROPORTIONAL TO THE REDUCED WORKDAY. POSSIBILITY. If there is a contract to fulfill a reduced working day, less than the constitutional provision of eight hours a day or forty-four hours a week, it is lawful to pay the minimum wage or minimum wage proportional to the time worked. (DJU, 14-3-2008).

> Art. 458. In addition to payment in cash, salary, for all legal purposes, includes food, housing, clothing or other "*in natura*" benefits that the company, by virtue of the contract or custom, usually provides to the employee. In no case will payment with alcoholic beverages or harmful drugs be allowed.

The payment of the salary can be made, therefore, (i) in cash or (ii) in *in natura*, being certain that the proportion between these two forms of remuneration must respect the rules imposed by the legislation.

The salary paid *in natura* is the legal possibility of replacing the money, in which the employer makes utilities available in favor of their employees. It is worth mentioning that it is not the preferred method, and payments *in natura* occur when there is a contractual agreement.

Salary utilities are goods susceptible of economic appreciation that could be acquired by employees through the salaries received, but which, through an agreement with employers, are offered to them as a substitute for money[7].

The possibility of paying the salary in cash or in *in natura* is limited by article 82 of the CLT, which determines that at least 30% (thirty percent) of the minimum salary must be paid in cash, that is, a maximum of 70% (seventy percent) of the salary can be paid through *in natura* goods (the so-called “utility salary”). Examples of utilities that can be paid for *in natura* are: clothing, food and housing.

In any case, according to the CLT, salaries must be paid in the country's fiat currency:

> Art. 463: The payment of the salary will be made in the fiat currency of the country.
> Sole paragraph: The payment of the salary made in breach of this article is considered as not made[8].

It is important to understand that the main purpose of cash payment is to avoid the truck system, that is, payment in vouchers, coupons, bonuses, etc., and also payment in foreign currency. Martins[9] explains that the basis for using the currency is that the salary cannot be subject to fluctuations in the currency of another country, in addition to the employee having to pay a discount when selling foreign currency.

[7] MARTINEZ. Luciano, Curso de direito do trabalho. 7ª. ed. São Paulo: Saraiva, 2016. p. 806.
[8] BRASIL. Decreto-lei nº 5.452, de 1 de maio de 1943. Aprova a consolidação das leis do trabalho. Available in: http://www.planalto.gov.br/ccivil_03/decreto-lei/del5452.htm Accessed in: August, 15th, 2022.
[9] MARTINS. op. cit. 2012, p. 237

However, the sole paragraph of that article is criticized, since the nullity of the salary paid in disregard of the legal system generates the need for a new payment, however, this type of sanction violates the good faith of the contracts and could imply enrichment without cause.

In view of all the above, the next chapter intends to discuss mechanisms for payment of salaries (or components of salary) through local currencies, in accordance with Brazilian legislation that regulates labor relations.

3. Legal alternatives

3.1 Payment of utility-salary in local currencies

As explained before, it is possible to pay salaries in utilities, which are goods of a different nature from money.

Given that utility-salary is intended to meet the individual needs of the worker, the CLT brought some examples such as food, housing, clothing, hygiene products and transport (except for the one destined for commuting to and from work). It so happens that the list is not exhaustive, therefore, there are possibilities to include other utilities.

In practice, there are specific cards (tickets) that are used only for certain utilities. This is the case, for example, of food cards, which are only accepted in places where food is sold, and the purchase of alcoholic beverages is prohibited. There is also the restaurant card, pharmacy card, credit cards intended for utilities that the worker would have to spend part of his salary to acquire them.

This card, commonly used by companies as utility-salary, is made and distributed by card operators who make it available through companies to be used by their workers.

In view of this scenario, although social currencies cannot be used as payment of the employee's base salary directly, there is a legal possibility for this payment to be made through the salary *in natura*. In these circumstances, the employer has the discretion to choose the means he wants to pay the utility salary.

Among the items that can be provided through the utility-salary using local currency, the payments for food expenses deserves special attention. After the reform of the labor legislation in 2017, the payments for food expenses was not considered as part of the salary anymore. Therefore, under the terms of article 467, §

2 of the CLT, the amounts, even if customary, paid as subsistence allowance, food allowance, its payment in cash, transport vouchers, prizes are not included in the employee's remuneration.

In addition, in the case of food, as a utility, the salary cannot exceed, respectively, 25% (twenty-five percent) and 20% (twenty percent) of the contractual salary.

The payment of food allowances to employees is quite widespread in the corporate culture in Brazil, therefore, its payment in local currency would be an important instrument to enhance its use in the municipal territory.

3.2 Payment of gratuities and bonuses in local currencies

Gratuities are amounts paid voluntarily to the employee as a way of rewarding a certain fact. With the 2017 labor reform, premiums, gratuities and bonuses are no longer recognized as an irreducible part of the salary, as was previously the case.

The payment of bonuses is not obligatory: it is made spontaneously by the company, based on previously established criteria. Likewise, there is a requirement for the participation of employees, as this must occur voluntarily.

The bonuses can be granted by the employer to the employee through goods, services or cash value and are linked to personal factors of the worker such as productivity, which allows payment in local currencies. In this regard, according to article 457, § 22 of the CLT:

> §22. Bonuses are considered to be payments granted by the employer, up to twice a year, in the form of goods, services or cash value, to an employee, group of employees or third parties linked to their economic activity due to performance superior to that ordinarily expected in the year of your activities.

In this type of remuneration, even if carried out using local currencies, there is an incentive for the employee. This is because the local currency is backed by the country's current currency, with no financial loss, making the employee feel encouraged to achieve goals.

Thus, according to the law, it can be concluded that the employer can pay a premium to the employee through local currencies, once the requirements set out in the aforementioned paragraph are met.

3.3 Contracts with employees for the acquisition of local currencies

The Bill no. 16 of September 05, 2022, of the Municipality of Resplendor, in the State of Minas Gerais, brings in its article 2 important mechanisms to encourage the use of the local currency of the city, which is intended to be implemented through the aforementioned bill. See:

> Art. 2 The Municipality of Resplendor, with the help of the Local Monetary Council, shall encourage the use of the Local Currency of Resplendor, through the following actions:
> I – Payment of assistance benefits made by the Municipality of Resplendor through the Local Currency of Resplendor.
> II – Institution of the Resplendor Local Currency Purchase Program for the municipal civil service, establishing incentive mechanisms for voluntary adhesion to this program by municipal public agents;
> III – Payment of suppliers of goods and services to the Municipality of Resplendor through the Local Currency of Resplendor, with preference being granted in bidding procedures to those who voluntarily accept to receive part of the payment in Local Currency of Resplendor.
> IV – Support, including through tax incentives to be established through specific legislation, for the implementation of the Resplendor Local Currency Purchase Program by private employers, which establish incentive mechanisms for voluntary adherence to this program by their employees;
> V – Support, including through tax incentives to be established through specific legislation, to companies located in the Municipality of Resplendor that make part of the payment of their suppliers and employees through the Local Currency of Resplendor.
> VI – Allow the extinction of tax credits and other debts to the Municipality of Resplendor by the Local Currency of Resplendor.

For the purposes of this article, it is important to highlight what is contained in item IV of article 2, which provides for employers the possibility to adhere to the Resplendor Local Currency Purchase Program, including through tax incentives to be established by the municipal government. Through this program, employers could encourage their own employees to buy local currency with part of their salary, for example, by guaranteeing them the payment of their salary in advance. Thus, if their employees agreed, they would receive part of their salary in Real and part in local currency, corresponding to the part they chose to buy in local currency directly from their employer.

Conclusion

In view of the above, it can be observed that in Brazil there is a relevant difference regarding the concept of salary and remuneration given by the Law. In this sense, the salary is understood as the most important portion paid by the workforce made available to the employer. On the other hand, remuneration can be understood as the totality of payments made to the employee as a result of the employment relationship, including salary.

The discussion of this paper aimed to demonstrate how the Brazilian legislation is positioned in relation to the characterization of the salary and the forms of remuneration to the worker, in order to understand in the end about the possibility of payment of remuneration parts in local currencies.

With the study, it became clear the need to pay the employee's salary only in fiduciary currency, as provided for in art. 463 of the CLT. The purpose of this article is to protect the employee from variations that could occur due to exchange rate variation. However, it is possible to pay part of the salary with utilities.

In view of this, it is possible to use local currencies as a form of payment of the salary *in natura*. This is because the CLT provides non-exhaustive examples of what could be used as payment of the salary *in natura*, and there is, therefore, the possibility of including other utilities. To this end, it is proposed to use local currencies to pay, for example, food aid, pharmacy, among others. It is noteworthy that the current use of local currency in a virtual way, enables its promotion and facilitates the direction of utility.

In addition, it was possible to differentiate the other forms of remuneration described in the legislation, such as premiums, gratuities and bonuses. It was found that the bonuses, as mentioned, are a liberality of the employer and do not have an obligation, being a good option for the use of local currencies as a form of remuneration in individual employment contracts.

In the end, an innovation created by the Municipality of Resplendor was analyzed, which allows the payment of the salary itself with local currencies, based on a contract for the purchase and sale of local currencies, signed directly between employee and employer.

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