

PEER-TO-PEER SYSTEM OF EXCHANGE AND CREDIT

BLUEPRINT FOR AN ENGINEERED ECONOMIC EXCHANGE ENVIRONMENT

The paper outlines, at a relatively high level of generality, the mechanics of a **system of privately issued competing currencies** on a labor standard base. Via the blockchain, each business issues its own money (IOUs) as claims on its future productive output, each currency unit standardized via a labor standard base and backed by the productive capacity and credit of the issuing business.

The economic exchange process, thus engineered, is free from the intermediation of both outside money (base money/reserves/central bank money) and bank-credit money (inside money/bank money). Economic actors swap baskets of assets **peer-to-peer**, while the system measures the creation, transfer and settlement of the credit relationships between the economic actors. The system's algorithms thus aim to cover the dynamics behind the **Credit Theory of Money** in its entirety.

Since the proposed exchange environment is purposely engineered, it is possible to include features addressing, via smart contracts, specific societal challenges such as hunger, homelessness, unemployment, inequality, negative externalities and unfunded liabilities.

MONETARY THEORIES IN FLOW CHARTS

(ACKNOWLEDGEMENTS)

The Peer-to-Peer System of Exchange and Credit is a mere restatement – using flowcharts and the capabilities of the Blockchain technology, AI, and distributed databases – of the philosophies of the following monetary thinkers:

- **Friedrich Hayek.** The Peer-to-Peer System of Exchange and Credit is inspired by Hayek’s vision of competing currencies, choice in currency and denationalization of money as the best long-term guarantee for the stability of the monetary system (Hayek, 1976). Hayek didn’t specifically identify commercial companies as issuers of currencies - Edwin Riegel did.
- **Edwin Riegel.** During the early 20th century, Riegel argued for separation of money from the state by allowing companies to issue their own IOUs during the exchange process, IOUs redeemable by the issuer for the goods and services of the issuer (Riegel, 1944, 1949). These IOUs circulate in the economy as means of exchange, instead of bank notes and bank credit. Riegel proposed a paper-based version – the so called Valun system. The Peer-to-Peer System of Exchange and Credit extends the Valun system by adding a standard of value for the Valun – in the form of a unit of unqualified labor of average intensity (an idea rooted in the labor theory of value and especially in **Karl Marx’s** concept of labor-power (Marx, 1949); **Edgar Cahn’s** “Time Dollars” (Cahn and Rowe, 1992) added further evidence for the viability of such unit of value). The IT dimension further improves Riegel’s Valun system by allowing better transferability of IOUs, by allowing better choice in currency, by allowing better controls over the amounts of IOUs issued by each issuer, and by allowing peer pressure to control the issuers using **David Birch’s** concept of “ambient accountability” (Birch *et al.*, 2016), as well as **Mani, Pentland and Rahwan’s** findings on peer pressure as a tool to induce cooperation (Mani, Pentland, and Rahwan, 2013).
- **Thomas Greco.** Thomas Greco further developed the line of thinking started by Edwin Riegel. Thomas Greco uses the terms “direct clearing of the exchange process” (“peer-to-peer” exchange transaction in the Silicon Valley parlance), the “reflux rate of IOUs redeemed by the issuer”, “co-responsibility” in credit and “affinity groups” (Greco, 2009) – all concepts from his work comprising the backbone of the algorithms of the Peer-to-Peer System of Exchange and Credit.
- **Bernard Lietaer.** Bernard Lietaer’s work on the failures of the debt-based fractional system to address key contemporary global challenges, the need for monetary reform, his vision for balance between cooperation and competition in a system of money, the needless dichotomy between the existing artificial scarcity of money vs. its potential abundance, and the specific examples of IT-engineered economic exchange transactions (Lietaer *et al.*, 2001, 2012, 2013) – it is a long list of concepts and ideas developed by Bernard Lietaer that were graciously borrowed in the Peer-to-Peer System of Exchange.
- **Silvio Gesell.** Silvio Gesell’s thinking, and more than anything practical experimentation with demurrage-charged currencies (Gesell, 1916) provided a key logical ingredient for the Peer-to-Peer System of Exchange and Credit – the Demurrage algorithm. The system couldn’t be made logically consistent without this crucial component.

DESIGN PHILOSOPHY

- **Exchange Intermediation Inevitably Brings Friction and Malfunction in the Economy**

Ever since human societies evolved from barter and gift-exchange communities into monetary economies, externally provided, exchange-intermediating tokens of various nature have been used to settle debts incurred during the exchange process, thus avoiding the huge double-coincidence-of-wants transaction costs of barter and/or the credit risks inherent in the gift-exchange.

Introducing an outside token of exchange in-between the transacting parties, however, while a huge step forward from barter and gift exchange, creates its own challenges, risks and negative side effects. An industry supplying and managing the tokens arises, with its own costs and dynamics; fractional-reserve debt-based claims eventually appear to give flexibility to the money supply to meet growth opportunities as they arise in the economy with technological progress. These features of the intermediated exchange process may cause the economy to malfunction in a variety of ways.

Currently, interconnectedness on the Internet, and the capabilities of the blockchain technology, allow clearing of the exchange process and settlement of debts on a peer-to-peer basis, challenging the existing banking industry at its very core, while eliminating the large costs borne by the economies for operation and bail-outs of a banking system, also eliminating the fragility, instability and boom-bust cycles (Lietaer *et al.*, 2001, 2012, 2013) that come with the fractional-reserve, debt-based, interest-charged nature of bank-credit money.

- **From Bank-Credit Money to Company-Credit Money**

Commercial banking is the process of creating exchange media (bank-credit money) by issuing debt-based, fractionally-backed claims on an *intermediating token* of exchange (the central bank legal tender note).

Using IT, it is possible, instead, to issue much more stable, fully-backed, debt-free, claims on the *real thing* – the real output of the economy, the real goods and services - as IOUs of the issuing businesses, thus altogether bypassing the intermediation of outside money and bank-credit money.

- **From Bank-Centric Credit Assessment to Peer-to-Peer Credit Assessment**

Commercial banks participate in *information arbitrage* – they carry out checks on the identity of borrowers and their creditworthiness, which the general public cannot do efficiently with the many strangers who issue credit.

In an interconnected, information-rich environment, however, the credit of each issuer can be re-located within economic actors topologically close to the issuer (via social graphs, etc) – an IT-enabled *morphogenesis* in credit – to allow credit assessment on a peer-to-peer basis within the peer group. Thus, in an information-rich world, the banks no longer have the information advantage necessary for the information arbitrage to work – quite the opposite, actually - it is the members of the peer group who are often vastly better prepared to evaluate their peer's creditworthiness.

- **From Government-administered Socialization of Individual Needs to Smart Contracts**

Government-administered social programs – in education, health care, etc. - start with an eligible provider (say, a doctor) providing an eligible service (say, a medical check-up), to an eligible recipient (say, a veteran). The government then goes to a commercial bank, who issues the money, as debt, to the government, so that the government can pay the doctor.

In an information-rich environment, however, with a well-developed digital identity layer, smart contracts could issue the money for the social service, optimizing the whole process and cutting the government out of the administration of key social services, making the social safety net part of the engineered exchange environment.

Unit of account

The privately issued IOUs of businesses need to be standardized via a common unit of value, so as to be interchangeable, and to allow the price system to work. The Peer-to-Peer System of Exchange and Credit is using an **hour of unqualified labor of average intensity** as a standard unit of value, because:

- money has been, from Day One, a construct designed to store and exchange labor;
- human labor is invested, in one way or another, in virtually every good and service we consume in our daily lives;
- prices quoted in that unit are easy to interpret and use anywhere around the globe;
- such a unit gives a natural floor to wages, and with the Employer of Last Resort algorithm (explained in point “d” below), eliminates much of the need for wage controls, wage negotiations (at the minimum wage level) and regulation;
- in a deeper philosophical sense, it measures the most valuable asset of them all – the time we are given on this Earth;
- it equalizes incomes world-wide at the low-income level (among participating economies);
- it drives home a very important point: that the only way to increase real wealth is to (1) make those human-operated tools smarter to replace unqualified human labor, and to (2) educate the human worker so as to elevate him into a more productive role and hence a higher pay;

Issuers of money

a. **Companies** via the Self-issued Credit algorithm.

New money is issued by providers of goods and services (businesses), as an obligation – in the form of a standardized IOU - of the issuer to redeem the IOU at par if and when the IOU is presented to the issuer for redemption. An IOU thus issued is freely transferable within the economy as money. This is in essence the currently existing working capital bank financing, only without the banking intermediation. The airlines’ air miles, the supermarkets’ loyalty points, etc., redeemable for the goods and services of the issuing business, are the early harbingers of the structured, standardized transferrable IOU used in the Peer-to-Peer System of Exchange and Credit for direct, peer-to-peer credit clearing of the exchange process in the economy.

The number of IOUs issued by each business is constantly evaluated against the quarterly revenues of the issuer (as a measure of the issuer’s ability to safely redeem all outstanding IOUs), and a simple metric - % backing – is calculated for each issuer via the **Redeem-ability algorithm**. At an average daily reflux (redemption) rate of roughly 1%, an issuer’s IOU will have full, 100% backing, if the number of the issuer’s IOUs outstanding is roughly equal to the issuer’s quarterly revenues. Should a company issue more IOUs than its quarterly revenues, its % backing will fall below 100%. All transactions are carried out in real purchasing power only, not in nominal amounts, i.e. the real purchasing power of an issuer’s 100 IOUs is equal to 100 x % backing of the issuer.

The IOUs thus issued are relocalized via the **Morphogenesis algorithm** within a network topologically close to the issuer, in order to allow peer pressure to control the issuers. An issuer whose % backing is too low can be expected to experience a wave of redemptions (as was the case with independent banking in 19th century Scotland) and to receive negative feedback and/or support from his peer network toward establishment of full backing of his currency on the system.

b. Public credit issuing agency via the Debt-based Credit algorithm.

The peer-to-peer assessment of an issuer's IOUs, however, breaks down for longer-term investment projects in new plant and equipment. For example: a restaurateur may be well-positioned to evaluate the credit risk of his/her local electrical contractor's IOU who has been fixing the wiring of the restaurant for decades, yet if that same electrical contractor decides to build a powerplant and issue IOUs for that (obligations to provide electricity in the future from the powerplant if and when presented with these IOUs) – well, evaluation of the powerplant's viability, even if the restaurateur is capable of doing it, will take economically unfeasible long time. Since everyone in the community would agree it is preferable to have the powerplant, and would want to make money by supplying goods and services towards its construction, it is in the best interest of the community then, to appoint a qualified representative – essentially a public employee – to evaluate such investment projects on behalf of the community, and if the investment risk is deemed acceptable by that representative – to issue to the electrical contractor IOUs as a loan on the behalf of all of the community for the construction of the plant. These would be **public IOUs** – obligations on behalf of the whole community, issued by a **public credit issuing officer (public banker)**. These public IOUs will then be spent into circulation by the electrical contractor in the construction of the powerplant.

Once the powerplant is up and running, repayment takes place by the borrower from his/her increased revenues, with the contractor's own newly issued private IOUs (more IOUs can be issued now by the contractor due to the contractor's increased revenues from the powerplant – while the contractor still maintains full backing on all of his IOUs – those already outstanding and those newly issued for debt repayment), into an account with the public bank.

Several significant advantages become obvious:

- Since this is a pure credit-based money system, without any outside money (specie), there is no need for prior accumulated liquidity by the public bank in order for new credit to be issued; there is no need for a bank's intermediating balance sheet against which to issue credit; there is no convertibility of credit into outside money as under the current commercial bank(credit)/central bank(specie) system. Thus, the public bank has no liabilities whatsoever, it cannot experience a liquidity crisis, it is **always ready, willing and able to extend new credit to enterprises for productive purposes**. "Public bank" is actually a misleading misnomer. "Public credit issuing agency" would be the technically correct term.
- All the borrower has to do is to increase revenues according to the business plan; once these revenue targets are reached, the public bank's software generates the borrower's private IOUs into its loan account on its own, at repayment dates, without any participation by the borrower. **All the borrower has to do is to increase revenues** so that his/her IOUs – those in existence and those newly generated for repayment of the loan - maintain 100% backing.
- In the case the borrower failed to quite reach his revenue targets, the nominal number of his newly generated (repayment) IOUs will have less than 100% backing and will lack the needed real purchasing power. Still, the public bank could issue into its loan account a greater than the initially anticipated number of the borrower's IOU, thus diluting the holdings of the borrower **and** his peer network, essentially transferring purchasing power from the borrower **and** his network into the public bank until the full loan repayment amount is reached. Effectively, the borrower **and** his network stand in line for the repayment of the loan. Using ambient accountability of borrowing circles ("solidarity lending") - even in a vastly less efficient, vastly less technologically sophisticated manner - the Grameen bank in Bangladesh saw 98% repayment record of microloans! (Douthwaite, 1996)
- Only in the case when neither the borrower on his own, nor the borrower and his peer network together can provide sufficient purchasing power for loan repayment, will the borrower be in default, with collateral repossessions and the like.

c. Providers of goods and services to be socialized on the basis of individual need via the Provider of Last Resort algorithm.

Assume we want to make sure that no one in our society goes hungry – regardless of whether or not that person contributes to society or not. Let's say we agree that we can afford to provide those in need with a loaf of bread and 500ml of mineral water a day. Here is how this can happen at point of sale: the system first checks if the buyer has enough money in his account, if not – the system checks if he can be issued a personal emergency loan. If his credit limit is maxed out, the smart contract will then generate the currency socializing the expenditure (have everyone pay for this poor person's bread and water) and complete the transaction.

The same logic could be applied for any eligible provider, for any eligible good/service, for any eligible recipient group – doctors, educators, etc. – subject to checks and limitations, of course, thus transferring a variety of social programs from fiscal into monetary policy (really into the engineered framework of the exchange environment).

The Demurrage algorithm

The operation of the Provider of Last Resort algorithm and the Debt-based Credit algorithm will likely be inflationary (both algorithms issue new public IOUs). The system measures the Consumer Price Index, and the Demurrage algorithm, via a negative feedback loop with the CPI, destroys currency to reduce inflationary pressures. Two interesting features become obvious here:

1. The burden of social programs is borne mostly by the largest corporates and the idle rich – the entities with the largest accumulated money balances - without complex, cumbersome taxation.
2. As the IOUs issued by businesses are destroyed in whichever wallets they might be when the Demurrage algorithm strikes, the backing of all privately issued IOUs will rise as the Demurrage algorithm operates. Businesses will no doubt immediately re-issue the IOUs in their own wallets, i.e. the Demurrage algorithm puts more dry powder into the hands of entrepreneurs, encouraging them to create more goods and services during inflationary times. Only public IOUs in the economy get permanently destroyed by the Demurrage algorithm, the privately issued IOUs are re-issued into the issuers' (companies') wallets.

Thus, the Demurrage algorithm favors the entrepreneurs and the poor over the idle rich.

d. Employers of Last Resort via the ELR algorithm.

The Employer of Last Resort functionality is designed to end unemployment. It allows unlimited demand for human labor at the minimum wage. If a certain activity is designated as "ELR-eligible", then those practicing it can be issued new money (public IOUs) for doing it. There will always be funding for it. Such an activity must have the following characteristics: (1) it must be in the public benefit, (2) it must be able to be carried out by people without special training, (3) it must be able to utilize labor in relatively small chunks – 1 hour, for example. Two obvious possible examples would be community work and reforestation.

Communities could appoint their local Employers of Last Resort (public employees), whose duty is to run the ELR program, by providing employment opportunities within the community for public works. There is never shortage of public works in the community – sweeping the streets, repainting and repairing public infrastructure, landscaping the public gardens, etc. A software platform within the lines of Google's Streetview can be easily adjusted to support the ELR program, with local residents pointing to jobs and tasks they would like to see done in their community, the jobs then taken/assigned to job seekers by the Employer of Last Resort.

Reforestation could be funded in a similar fashion.

Smart contracts play a crucial role in the ELR program, issuing new money in accordance with the limits and conditions set in the ELR algorithm.

EXPECTED BENEFITS OF THE PEER-TO-PEER SYSTEM OF EXCHANGE AND CREDIT

The engineering design presented in this paper can be expected to have the following benefits:

1. Separation of money from the state – reducing the risks of currency debasement and manipulation, trade wars, currency wars, shooting wars.
2. Elimination of hunger, via the Provider of Last Resort (PLR) algorithm.
3. Elimination of unemployment, via the Employer of Last Resort (ELR) algorithm.
4. Elimination of poverty, via the PLR and ELR algorithms, via easy access to credit for entrepreneurs.
5. Reduction in inequality, via the ELR, PLR and the Demurrage algorithms.
6. Reduction of indebtedness – money is no longer issued as debt only.
7. Efficient socialization of individual needs while keeping the government largely out of the administration of social programs.
8. Funding the unfunded liabilities – these will be funded by the productive economy via the money system without the government’s intermediation.
9. Pricing-in of negative externalities – issuers whose money is rejected can be penalized in a variety of ways, primarily via the operation of the Self-issued Credit Algorithm and the Demurrage Algorithm.
10. Reduction in the frequency and severity of bubbles – unproductive speculation will only be funded from existing money, not via newly issued credit; maturity transformations are happening outside of the money creation process; fractional reserves during credit creation are eliminated; indebtedness is reduced, new credit for productive purpose always available regardless of shocks elsewhere in the economy; inflation always held in check via the Demurrage algorithm and the constant bedrock price of the economy of one hour of unqualified human labor.
11. Factor price equalization across different countries, with the minimum price for unqualified labor held constant as per the Employer of Last Resort algorithm (as opposed to the rate on national sovereign debt/interbank offer rate as under the current bank debt money scenario).
12. Ease of formation of currency unions. Government’s fiscal woes and policies are largely irrelevant for a currency union based on privately issued currencies.
13. Benefits for entrepreneurs:
 - a. Self-issued working capital, no need for working capital bank debt;
 - b. Long-term productive credits do not need to be repaid as currently under the bank debt model, only revenues need to be increased.
 - c. In temporary difficulties the entrepreneur’s network of peers stands behind him/her for the repayment of the loan.
14. Topological robustness – fragility due to monoculture of money eliminated; a permaculture design principle of many competing currencies with systemic stability as emergent property.
15. Large societal costs for operating and bailing out of a banking system eliminated.
16. Return of the community, via eliminating scarcity of money and the concomitant hyper-competitiveness, via the Employer of Last Resort and Provider of Last Resort safety nets.

There is a potentially infinite number of ways to engineer the exchange process in the economy via IT, depending on what design philosophy is followed. The publicly available technologies at the moment would allow only smaller-scale decentralized applications – at the community, town, and the very small country level. It can be reasonably expected, however, that the technology will develop over time for broader-scale applications.

Our imagination, then, the captive network effects of the legacy status quo design (central bank money/commercial bank-credit money), and the large transition costs for the economy between alternative exchange environments are the only real constraints on the potential of purposely engineered exchange environments for social change.

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Appendix I: Key components and algorithms of the Peer-to-Peer System of Exchange and Credit

Identity Layer and the FaceRank Algorithm
Wallets, Incoming Filters and Proximity Matrices
The Peer-to-Peer Exchange Transaction
The Self-Issued Credit Algorithm
The Redeem-ability Algorithm
The Morphogenesis Algorithm
The Debt-based Credit Algorithm
The Employer of Last Resort Algorithm
The Provider of Last Resort Algorithm
The Demurrage Algorithm
The Tax Algorithm

The front end designs, the flow charts for the algorithms and the operation of wallets, wallet filters and other components of the system are described in the White Papers for the project.