

QUANTUM MONEY

a web-based system of money and credit



“Monetary theory is like a Japanese garden. It has aesthetic unity born of variety; an apparent simplicity that conceals a sophisticated reality; a surface view that dissolves in ever deeper perspectives. Both can be fully appreciated only if examined from many different angles, only if studied leisurely but in depth. Both have elements that can be enjoyed independently of the whole, yet attain their full realization only as part of the whole”

Milton Friedman, “The Optimum Quantity of Money”

QUANTUM MONEY

A WEB-BASED SYSTEM OF MONEY
AND CREDIT

THE CREDIT NETWORK

For love of money



The book describes – often in the form of storytelling - the mechanics of a digitally engineered, multi-currency Hayekian monetary space, consisting of **privately issued competing currencies** on a labor standard base. Each business on the system issues its own money (private credit instruments/company liabilities/company scrip, or simply “IOUs”) as claims against its future productive output, each currency unit standardized via a labor standard base and backed by the productive output 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/high powered money), bank-credit money (inside money/bank money/pen money/bank credit/deposits), commodities, and cryptos. Economic actors **swap baskets of assets and issue credit to each other privately, peer-to-peer** - while the system measures the creation, transfer and settlement of the credit relationships between the economic actors. The system’s algorithms - via tokenization of the private credit relationships arising endogenously out of the exchange of goods and services - aim to cover the dynamics behind the **Credit Theory of Money** in its entirety.

The book looks at the mechanics of the peer-to-peer – direct/moneyless – economic exchange process (with its concomitant endogenous decentralized private credit creation) vs. the indirect/money-intermediated economic exchange process (with its concomitant exogenous top-down central bank money and commercial bank credit creation), to demonstrate how **the peer-to-peer economic exchange process is systemically superior to ANY intermediated exchange process**, with potentially far-reaching societal consequences.

This is a book about a possible radical optimization of the exchange processes in the economy via the wholesale disintermediation of central and commercial banking, commodities and cryptos from the exchange of goods and services – enabled by the latest advances in IT.

THIS BOOK IS DEDICATED TO THE LIBERATION AND DEMOCRATIZATION OF CREDIT MADE
POSSIBLE BY INFORMATION TECHNOLOGY

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The Main Message of This Book

Looking into the dynamics of economic exchange processes taking place within monetary economies, the book makes one central claim, namely, that

THERE EXISTS A BEST ONTOLOGY

to organize large monetary/economic networks via IT – and it is not any of the cryptos, stablecoins, CBDCs and what-not mainstream monetary architectures, designs and schemes existing as of early 2026. Quite the opposite, actually. It is **the removal** of all these artificially introduced, third-party, friction-producing constructs (aka “monies”) from the basic economic exchange process that turbocharges economic exchange. It is the simplest, most optimized ontology – the one in which there is no entity outside of the transacting economic agents to introduce exchange media into the network, but exchange media instead arises endogenously within the economic network itself, being born out of the economic exchanges taking place within the network – and this is the best ontology which gives us the absolute/global maximum where economies attain their highest output.

Peer-to-peer exchange economies – “principle of least action” economies – are **EPIC**.

Endogenous decentralized private credit creation **ROCKS**.

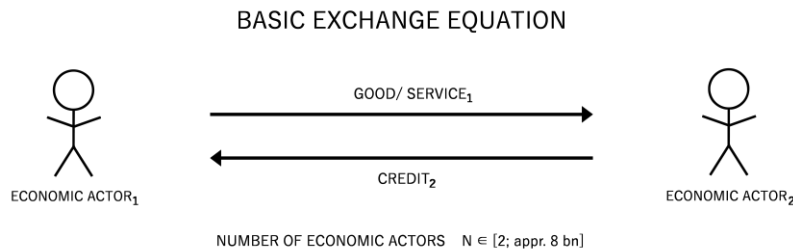
Instead of re-engineering the money units flowing within the economic arena,

RE-ENGINEER THE ARENA

EXECUTIVE SUMMARY

OPTIMAL CREDIT NETWORK TOPOLOGIES BEAT ANY MONEY AS ECONOMIC MANAGEMENT TOOL

Money is a solution to the Basic Exchange Equation of the economy for network sizes over 150 users:



The Basic Exchange Equation has two trivial cases/solutions which need no further elaboration/attention:

1. When the number of economic actors in the network is relatively small (say < 150 , the Dunbar number, the maximum number of stable, meaningful relationships one can maintain - think pre-historic tribes and clans). At or below this size, economic actors know each other personally, and hence know each other's creditworthiness; the records of extensions and redemptions of credit during the exchanges of goods/services are recorded, blockchain-like, in the minds of the economic actors involved. Credit enforcement is via peer pressure and via the shared lesson of reciprocity as key for the survival of the tribe.
2. Regardless of the size of the network, when there is a double coincidence of wants – the well-known “barter”.

A problem, however, emerges, once economic networks reach a certain critical mass – when solutions 1) and 2) no longer apply at scale. Once our human tribes hit something like maybe 150 members, we could no longer use our neocortex to solve the basic exchange equation – there were too many economic actors, too many potential issuers of credit, and our data collection mechanisms at the time, and our biological memory and processing capabilities were too weak to solve what was, ultimately, an information gathering and processing problem.

At the most basic, fundamental level, money solves the following problem: How can one provide a good/service on a time-lagged, asynchronous *quid-pro-quo* basis to the broadest number of market participants, well beyond one's circle of trusted relationships, including to complete strangers, and still be sure that the credits received during the exchange will hold fast over time? What is to be done once our productive capacity and potential economic outreach surpass our pool of trusted personal, professional and social relationships?

What humans faced millennia ago was a problem of modelling and managing risk in large credit networks – a network-construction type of problem, an information-science type of problem. And at times pre-historic, when network science and information science were not yet a thing, humans solved it simply by substituting - crudely, via trial and error - CREDIT₂ in the Basic Exchange Equation (something they could not manage at scale), with a new type of a good, an artificially introduced good, a credit-surrogate good, a good valued mostly because it could be passed down the line of economic exchanges to other members of the economic network – a clever trickery:

MONEY

And today we may call it crypto, or a CBDC, or a tokenized deposit, but underneath all that fancy babble, we are, fundamentally, just adding technological sophistication on top of a very crude, pre-historic solution to optimal credit networks formation. Overengineering a buggy whip at a time when technology beckons a Model T solution.

Nowadays, we can easily find better solutions to the Basic Exchange Equation. We no longer need to replace CREDIT₂ with a “money”. We can do better than that. Way better. CREDIT₂ itself can be the money, and in this way we can optimize – radically, massively, **INSANELY OPTIMIZE** - our economic exchanges; we can thus eliminate tons of friction, agency costs and fragility from the economy - by going peer-to-peer, fully digital, without any externally introduced monies, whatever they might be – shells, stones, precious metals, bank notes, cryptos, whatever. We'll need some pretty big machines for that, though. More on that in part II of this book.

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FOREWORD

THERE WAS NO INTERNET

- when, millennia ago, primitive men first engaged in *gift exchange* and *barter*, overcoming the limitations of self-sufficiency;
- when, millennia ago, *precious metals* took the center stage as *media of exchange*, overcoming the limitations of gift exchange and barter;
- when, centuries ago, Italian goldsmiths started issuing gold warehousing receipts and Bills of Exchange in excess of their existing gold reserves, thus inventing *fractionally-reserved credit* and overcoming the limitations of prior gold accumulation for the development of free enterprise;
- when, during the last century, Ludwig von Mises wrote his classic “Theory of Money and Credit” laying the foundations of the libertarian understanding of money and banking; when E.C. Riegel wrote “The New Approach to Freedom” reclaiming from the state, on behalf of the people, the right to money issue; when Friedrich von Hayek argued for denationalization and choice in currency as the best guarantees for the long-run stability of the monetary system; and when Milton Friedman declared money “*too important to be left to central bankers*”...

AND THEN THE INTERNET ARRIVED. And the Internet changes everything. What if algorithms could be applied to the basic exchange process in the economy, and what effect would this have on the economic, environmental and societal challenges that we face? What if society’s money system could be created via the voluntary interactions of millions of participants - by the invisible hand of collective intelligence – as opposed to the current centralized, top-down, bank-centric approach? Will individual actors – acting collectively via IT – achieve a better outcome for monetary management than the central bankers of this world? Will the spontaneous order arising out of individualism provide results superior to the centrally-planned status-quo? What if we approach the money system as a complex adaptive network and via IT implement in practice ideas trodden in the minds of scholars such as Friedrich Hayek, Milton Friedman, Irving Fisher and Edwin Riegel? Ideas long considered purely hypothetical, impossible to implement, mere thought experiments? Allowing us, in these times of economic uncertainty, to seek sound money and economic stability not back into the fetters of the gold standard, but instead full forward into the Information Age? Where code and information reign supreme, including the field of monetary policy and finance? What if we could get code to do the monetary function of gold, and much more? What if Bitcoin only barely lifted the curtain of “cyberspace monetarism”? What treasures for money and economics might be hidden out there in cyberspace? Could a peer-to-peer, collectively intelligent monetary system – *an Information Age monetary system* – disintermediate the current top-down, centrally managed, Industrial Age monetary system?

This book is a journey into the strange economic realm that potentially exists at the intersection between IT and monetarism - a journey full of economic miracles and bizarre economic phenomena – a wonderland of economies operating constantly at full employment, economies in which concepts such as “Keynesian interventions”, “QE”, “depressions”, “base money”, “fractional reserve”, “government social programs”, “Philips curve”, and many more - are simply *not defined*; economies in which access to basic education, basic healthcare, and to economic participation are natural rights for each and every individual, economies in which money comes into existence and flows largely without the intermediation of the state, or the commercial banks.

A wonderland which - technologically at least – is perfectly within our reach.

THE CURRENT SYSTEM OF MONEY AND CREDIT

“Money is merely a human construct...that was designed in and for another age”

Bernard Lietaer, Jacqui Dunne, “Rethinking Money”

WHAT IS MONEY

“The analogy between the need for invariant units of length and weight and the need for an invariant unit of value is appealing...to be serviceable, units of length, weight, and value must be invariant over time.”

Roger Garrison, “The Costs of a Gold Standard”

The functions of money – medium of exchange, unit of account, store of value

Living all alone on his island, Robinson Crusoe never needed any money – a pile of gold would probably have had absolutely no practical use, a pile of paper with ink on it (banknotes) – well maybe he could start a fire with it, just as he would with any other piece of paper. Being self-sufficient, he never owed anything to anybody, and vice versa. He never exchanged anything with anyone. He never had to measure via some unit the value of his goods *vis-à-vis* other people’s goods, and hence didn’t need that (hypothetical in his case) measure to be stable through time.

Money is *social*. It arises only when there is division of labor, hence a need for exchange. Direct exchange however (the so called barter) whether on an explicit, immediate *quid-pro-quo* basis or as communal gifts and favors in smaller communities, is so hard to execute – to exchange, say, an investment fund’s money management services for pizzas at Papa Joey’s Pizza, would be hard if not impossible...It might work once – to reciprocate a hot stock tip for a hot pizza, let’s say, but a universally accepted medium of exchange would have made things much easier – the fund managers provide hot advice to limited partners for that media, and then Papa Joey provides the hot pizzas – again for the same media. The process of indirect exchange requires ability to measure the value changing hands (how many of Papa Joey’s pizzas for how many hours of the fund managements’ advisory services), and that intermediating medium has to hold steady through time – to avoid disappointment by the participants and to keep the fund managers and Papa Joey motivated to provide those advisory services and those hot pizzas through that medium.

Money is an agreement, within a community, to use something standardized as a medium of exchange¹.

That *something* could be *anything*, as long as the community agrees to use it as exchange media. It could grow – slowly on Mondays and faster on Sundays, it could go left at first and then green, it could have babies, grow leaves, it could have a pleasant sound, smell, and great appearance. It could have a geographic, national dimension. A temporal one. Or it could be poetic. Warm and kind, elegant, beautiful. It could have physical carrier – one or many. It might be capable of inflicting pain even – who knows??

Money could be *anything*.

As long as the community agrees that this is what its money is – so be it. Money is a mind game of the community.

Whatever money is, it is important that it does a good job measuring value – if you can’t measure it, you can’t manage it. How many chickens for a cow, for a kilo of sugar, for a liter of wine. Money needs **units**.

And then, the values measured in those units using that medium, must hold steady through time. If today I agree to sell my cow for some number of money units, knowing that these units could get me, say, 18 chicken today if I needed chicken, I want next week, when I do need the chicken, to be able to get them – all 18 of them. If, for some reason, the chicken salesman says then that my money has rotten since I’ve sold the cow last week, and is willing to sell only 10 chickens for my (already rotten) cow money, I would be very disappointed with this money. Just why did I have to bring that cow to the market in the first place?! Money has to be a reliable **store of value** in order to encourage exchanges to take place.

¹Bernard Lietaer, Jacqui Dunne “Rethinking Money”

Why money – breaking the shackles of self-sufficiency and barter

The first major breakthrough in monetary innovation was the acceptance of a medium of exchange that separated the act of providing wealth to society from the act of claiming wealth from society – the double coincidence of wants that barter required – coincidence in terms of (1) the types of goods to be exchanged, (2) the amounts in which they are needed by the two parties, and (3) the time and place of the exchange. By avoiding the huge transaction costs of barter, money greatly facilitated the exchange process, hence wealth creation.

In reciprocal-gift-exchange communities, money eliminated the memory lapses on behalf of some of the lazier gift recipients (memory lapses always on the side of omitting gifts owed to others, aka “credit risk”), thus removing the option of free loading, forcing everyone into just contribution to the welfare of the community.

Thus, millennia ago, people arrived *ad hoc* to the agreement that precious metals will be money – medium of exchange, unit of account, store of value. Those who were good at producing something could specialize in it, produce more than they could consume, and provide the excess to society on a *quid-pro-quo* basis through the money system. The cowgirl could raise as many cows as she could, without worrying if the chicken man will be there with the right number of chickens, at the right time, and in need of a cow – there was *money* to smooth the exchange process. The economy became a *network*.

The Invisible Hand could begin working its miracles.

Why money matters, a lot

“..an improperly managed money supply leads to much greater economic discoordination than an incorrect supply of any other good or service. Excess demand or excess supply of money affects spending in numerous other markets, and hence affects the entire system of market price and profit signals. One can think of the market as being like a wheel, with money as the hub, prices as the spokes, and other goods as the rim. A change in the relation of one good to the rest is like a tightening or loosening of a single spoke: it has a great effect on one small part of the wheel, but much less effect on the rest of the wheel. A change in the relation of money to other goods is like moving the hub: it has a great effect on all parts of the wheel, because it moves all spokes at once. Adjust a spoke – a particular price – improperly, and you make one small part of the wheel wobble; adjust the hub – money – improperly, and you bend the whole wheel out of shape”.

George A. Selgin “The Theory of Free Banking”

Exchange processes – intermediated (indirect/money-intermediated) vs. peer-to-peer (direct/moneyless)

Technological progress during the Primitive Age led to the invention of tools of production, hence division of labor. The first *quid-pro-quo* exchange processes, replacing self-sufficiency, must have been **peer-to-peer** – “barter” if the *quid* and the *quo* were simultaneously exchanged – or, much more likely, exchanges of gifts to each other, with a time lag – I share with you my excess bison meat today, you’ll share your excess crops with me next season. There was a credit signal in every peer-to-peer time-lagged exchange – credit signal arising endogenously with every asynchronous exchange and recorded in the neocortex only. And that credit signal carried credit risk.

As tribes grew larger, as mobility increased, and as the set of economic agents and available goods and services expanded, the neocortex became insufficient to manage all the credit relationships arising endogenously from peer-to-peer exchanges. The first primitive man to reject a promise for a future gift, but instead demanded some liquid good – not a good meeting his immediate needs, but a good valuable because it could be passed on to others during future exchanges – invented the **intermediated exchange process**. In order to eliminate the credit risk, the credit signal inherent in every p2p economic exchange was muted, suppressed by a credit-surrogate money good.

This book explores what happens if, via IT, we capture, structure, **monetize and release that credit signal again** – unsuppressed by a money good of any kind - within a fully digital economic exchange network based on peer-to-peer endogenous credit signaling only. Spoiler alert – miracles happen. More on that in part II of this book.

What is a monetary system

The set of rules – explicit (laws, regulations), and implicit (assumed by default, conventions) – determining what the exchange medium (money) is, how it comes into being, how it ends, how it moves around and how fast.

A monetary system must first determine *what is used as money* – stones, skins, commodities, information, etc. – whatever works best for the community.

A monetary system must determine the *optimum quantity of money* in circulation. According to various researchers, currently up to 97% of all money in certain countries is created by the commercial banks² – they issue to borrowers newly created media (bank credit) and keep a record of what the borrowers must repay – at which point (at repayment of the loan) the newly issued credit is destroyed. The commercial banks charge something for themselves in the process – the so called “interest”, plus maybe some operating fees. The central bank, by determining the level of the interest rate in the economy, and with some other tools, tries to encourage/discourage borrowing so as to control the money stock in the economy and to prevent inflation/deflation. *Money should be available within the economy – not too much and not too little.*

A monetary system must determine the *velocity of money* into circulation. Money shouldn't overheat the economy (possibly causing inflation, bubbles, too many imports, etc.), or freeze it (due to hoarding of money and lack of lending). *Money should move around – not too fast, not too slow.*

A monetary system must provide an *anchor for the store of value function*. Money should hold its value, or all hell breaks loose. Fluctuations in the value of money hurt the exchange process – the very *raison-d'être* for the existence of money – inflation hurts lenders and stops incentives to sell (better not sell now, prices will soon rise, hold on to real wealth), deflation hurts borrowers, and stops incentives to buy (better not buy now, prices will soon fall, hold on to your money). Therefore, money should be a reliable and predictable measuring rod for wealth transfers across time and across economic actors within the economy. The gold standard was used for many years for this function. Currently, it is people, mostly at central banks, who try to ensure the soundness of money through their (possibly politically influenced) policies. *Money should hold fast over time.*

A monetary system must provide a reliable and safe *payment system*. The payment system shouldn't be held hostage to outside risks, such as financial system risks – credit risks, liquidity risks, etc. *Money should be able to move around safely.*

Typical *monetary institutions* are parliaments, central banks and commercial banks.

What is a financial system

The set of rules, built on top of the monetary system's foundations, of what you do with your (or other people's) money: how you earn it, how you protect it from various risks, how you multiply it, how you transfer it – across time, across actors within the economy.

A financial system seeks to find the answer how much an asset costs, as part of a process of efficient capital allocation – there is an *asset price discovery mechanism*.

A financial system facilitates investment, *transforming shorter-term maturities into longer-term capital*.

A financial system deals with *transfer and pricing of various risks*.

Typical *financial institutions* are the commercial and investment banks, the insurance companies, the various investment funds, the stock exchanges, the commodity exchanges, etc.

² Michael McLeay, Amar Radia, Ryland Thomas, Bank of England, Quarterly Bulletin, 2014 Q1

GOLD

Shells, skins, stones, cattle, copper, silver, gold – the list of material objects used as intermediating exchange media is long. Gold has stuck with humans as a money unit the longest. Why?

Why gold (and not copper, or diamonds, or whatever)

- Gold is scarce. It is not widely available in nature, and is not easy to mine and process.
- Gold is durable. Golden teeth found in the Egyptian pyramids can be used today. Gold found in ship wrecks on the bottom of the ocean is still nice and shiny underneath all that sand.
- Gold looks good. It is nice and shiny and yellow, doesn't rust on you and taint your clothes. It can be put on your ears, on your chest, on your wrist – and you'll look good with it.
- It is easily divisible (unlike diamonds), it is easy to mold, it cannot be easily broken or crushed.
- It comes in only one variety; it is very dense, and hence counterfeits can be easily detected.
- It doesn't get used up in industrial applications (relatively few exist).
- Gold is transnational, independent of governments.
- A small amount of gold can cover a large economic transaction – as compared to silver or copper, for example.
- In times of crisis – physical gold is nobody's liability and can be trusted (no counterparty risk), and also cannot be printed at will.

How did the gold coin evolve into a “gold standard”

Through fractional reserve banking. The “reserves” of gold in the goldsmiths' vaults determined how much gold warehousing receipts (Bills of Exchange, bank credit, bank money, inside money) the goldsmiths could issue against interest.

The last version of the gold standard was created in 1944 when the leaders of the world got together in Bretton Woods, New Hampshire, to fix the international monetary system with the end of WWII. The US dollar was pegged to gold at \$35/ounce, and all other currencies were pegged to the dollar. The Agreement also created the institutions required for its maintenance – the International Trade Organization (to avoid trade wars), and the IMF as a lender to governments and central banks to help keep their currencies pegged to gold. At the time of creation of the Bretton Woods agreement, the US had some 75% of the world's gold, large trade surpluses, and was the undisputed world economic leader. This was about to change, though, in the following decades.

Keynes, the leader of the British negotiators, insisted for a supranational global currency as a reserve asset. American monetary nationalism, however, prevailed, and the pegged-to-gold US dollar was established as the world reserve asset. This bestowed to the US the “exorbitant privilege” to print dollars to pay for imports, and then issue low-interest government debt to soak those dollars back. This meant the currency – the US dollar – was never presented by foreigners to claim real output, real goods and services from the US economy. The result was profligacy - both as a government policy and personal consumption of the American consumers.

Why the gold standard worked (for a while)

The gold standard worked best in the years preceding WWI. At that time it was a decentralized, multipolar system, not depending on any single stabilizing dominant power. The main reasons for its success were the commitment and cooperation of central banks and governments, which established the credibility of the standard. Should any country run low on gold, private funds would flow in its direction *in anticipation* of the central banks' actions, so little intervention was even necessary.

Why the gold standard stopped working eventually

President Nixon was forced to finally end the gold standard in 1971 because the US banks were creating dollars via central and commercial banking, those dollars ended up overseas via American imports, American investment and American war, and as foreign governments began redeeming dollars for gold, the US began to run out of reserves. So the gold standard had to end. The US government defaulted on its promise to the world. And, just like that, via President Nixon's sleight of hand, the US dollar, from an IOU for gold, an IOU as good as gold, has been transformed into an *IOU-nothing*, i.e. from a credit instrument, a claim on the real thing – the dollar has been transformed into the “real thing” itself. Every alchemist's dream, played out on the grandest of scales.

And so, with the US defaulting on the bedrock instrument of commercial trust in the world, the world went fiat. The value of a nation's currency is to be determined by “philosopher kings” in charge of central banks and treasury departments.

Main weakness of the gold standard

Exogenous money supply shocks are possible – via new gold discoveries or mining technology improvements.

Shortage of monetary gold under a gold standard can constrain commerce.

Gold as an automatic international adjustment mechanism is too bitter of a medicine. Economists call this “recessionary bias” – a country running low on gold must raise interest rate to stem the outflow, to increase savings and reduce demand for imports; painful restrictive fiscal and monetary policies are required. Whereas, absent a gold standard, a central bank and an accommodating government can ease the pain of economic slowdowns, at least in the short run.

A gold standard also transmits destabilizing impulses from one country to another. As one country takes steps to defend its gold stocks via increase in interest rates, other countries must retaliate with similar measures.

The illusion of “gold-backed” currency

“A currency backed by gold” is a misnomer. A currency can only be backed by the goods and services of its issuer. With that dollar bill in your pocket you need to buy pizzas and haircuts – not gold – just ask King Midas about it. Only a gold miner, a gold processor or a gold retailer/trader could issue a currency “backed by gold”. A much better definition of a gold-pegged national currency would be something like “issue-constrained by the amount of gold available with issuer”. A nation's currency can only be backed by the productive capacity of that nation. The real wealth of nations is the total output of the goods and services of the economy. Gold is only a carrier of a stable measure. A chaperone.

A currency “backed by the full faith and credit of the US government” is a misnomer, too. A much better definition of a fiat dollar would be “backed by the collective output of the US economy, and not restrained in its issue by a commodity anchor, or by any other automatic mechanism”.

Conspiracy theories concerning gold

Western governments and central banks have sold most of their gold, or leased it to bullion banks, etc. (who in turn sold it) and in effect cannot come up with the physical metal, at least not immediately. Via leasing, the gold price is manipulated by Western central banks and governments on COMEX in the US and LBMA in London, where naked short positions (with cash settlement only) are possible. This is done because a high price of gold is usually interpreted as lack of confidence in the fiat currencies; and gold is also a competitor for the T-bond. At crucial times, there is prevention of the signaling effect of gold – the crisis barometer of gold is not allowed to sound an alarm.

Essence of the gold standard and key benefits

“Compared, however, with the various schemes for monetary management on a national scale, the gold standard had three very important advantages: it created in effect an international currency without submitting national monetary policy to the decisions of an international authority; it made monetary policy in a great measure automatic and thereby predictable; and the changes in the supply of basic money which its mechanism secured were on the whole in the right direction”

Friedrich Hayek “Individualism and Economic Order”

Under a true gold standard the various currencies are just different names for weights of gold. The paper (bank) notes are redeemable in actual gold.

The gold standard protects the users of a currency from abuse by those in charge of the printing press – you can’t print gold. As such, a gold standard is key to protection of private property rights of citizens *vis-à-vis* governments.

Domestically, through the price stability it implies, a gold standard encourages saving and investment. Internationally, a gold standard encourages foreign trade and investment by eliminating forex risk.

In international trade and investment, a gold standard is an automatic rebalancing mechanism between countries – if country A experiences high growth and hence draws in capital from a slow-growing country B, interest rates in country B go up to stem the outflow of gold, this causes further economic slowdown and reduction in wages in country B. Thus country B now has greater incentives for savings and capital creation (higher interest rate), greater incentive to attract capital (higher interest rate and lower wages), hence a basis for a healthy recovery. The processes in country B are sometimes referred to as “creative destruction”, absolutely necessary for the constant renewal of a capitalist economy.

The main function achieved via gold was stability of the purchasing power of money within the monetary system (ensuring the store of value function of money).

Gold is not some God-given center of the monetary universe, however. The strange pagan ritual of digging yellow metal out in South Africa and Siberia to re-bury it again underground in New York and London, amidst all that medieval air of mystery, secrecy and mystique – it went with the money unit and the monetary system of the time. And times change.

In the words of Hayek “A wisely and impartially controlled system of managed currency for the whole world might, indeed, be superior to it (the gold standard) in all its aspects. But this is not a practical proposition for a long while yet³”.

This was said back in the 40’s though. A lot of propositions not practical back then are quite practical today. Like carrying your telephone around in your hand, or taking a picture with it; or carrying your color TV set around; cars without drivers; coin mining within a group interconnected machines (Bitcoin)...or algorithms that can keep the value of a digital currency constant, or measure the reliability of its issuer.

“Who needs gold when we have Alan Greenspan?” was a title in the financial press from the not-too-distant past. “Who needs gold when we have the Silicon Valley?” is the futuristic proposal of this book. The nostalgia over gold is misplaced: gold was a local maximum, a temporary repose in the evolution of money – a *host* for the monetary system. A good host, reliable and solid (not too bright, though). But now we have another potential host, a much smarter host – the Internet. And on the Internet, money systems of every shape, form and variety are possible. We just have to pick the one we like.

“The belief persists to this day that money, to be sound, must promise the delivery of gold or silver. The essential quality of money, however, is the promise to deliver value in any commodity at the choice of the holder”.

E.C. Riegel, “The new approach to freedom”

³ Hayek, F. “A Commodity Reserve Currency” The Economic Journal vol.53 No 210/211 June-Sept.1943

Enter Bitcoin

Until the arrival of the Blockchain technology, anything sent over the Internet was infinitely copy-able, hence completely useless as a means of exchange. Therefore, trusted intermediaries – a bank, a credit union, a credit card company plus a bank, a payment transfer agent plus a bank, etc. – were required to keep score of the proper balance for each member of the network after each transfer of value between the network members.

The Blockchain changed all that. Via the Blockchain technology, it is now possible on the Internet

More for the recipient to mean less for the sender.
--

Fundamentally, it is that simple.

Thus, Blockchains allow digital objects to be created on the Internet – “objects” in the sense that data structures can acquire the real-world property of uniqueness – a certain data structure can be moved among the members of a network peer-to-peer, but for all practical purposes cannot be copied ad infinitum as is the case outside of a Blockchain. And should a community of users agree to use such a digital object as an intermediating token of exchange in economic exchanges, aka as “money” – and voila – the digital object becomes a “coin”.

Is the bitcoin a unit of account? Absolutely.

Is the bitcoin a medium of exchange? Slowly, very slowly, it is starting to look like a tiny complementary currency, with vendors here and there beginning to accept it for the goods and services they sell (its moneyness, however, grossly overshadowed by its “speculative asset” nature).

Is bitcoin a store of value? Hm-m-m...risky, very risky...A little-understood, vaguely exciting, new thing with the habit to occasionally shoot off like a rocket, crash, then shoot off again....with nothing behind it but a bunch of starry-eyed kids waving hands and trying to look cool....lack of regulatory clarity...new imitators appearing virtually daily - sounds like a lot of trouble. Still, in an environment in which the predominant fiat money system is subject to a variety of uncertainties – with its first-mover advantage and brand awareness, the bitcoin ledger could become, in the short to medium term, a viable alternative as a store value outside of the banking system.

Just like thousands of years ago people began experimenting with various real-world objects as tools to manage the credit risk in the exchange process – shells, stones, feathers, etc., geeks are now beginning to experiment in a similar fashion with the Bitcoin, and the Litecoin, and Ethereum, and the Dogecoin, and this coin, and that coin...

With the arrival of the Blockchain, infinitely many digital objects (“coins” if used to intermediate exchange processes) have become possible. *Infinitely many*. In the real world, the number of elements in the Mendeleev’s table and their valence capabilities limit the number of possible real-world substances (objects) – and this is a large, very large number, but still a finite one. It was by trial and error that people, millennia ago, selected one real-world element – Au (Gold) – as a tool to manage counterparty risk in the exchange processes taking place in the economy. In the digital world, in contrast, the number of such objects is truly infinite.

Nowadays, the crypto-curious crowd, with their understanding of money muted by millennia of inertia and groupthink with the intermediated (indirect) exchange process (i.e. commodity theories of money), is barking up the wrong tree: the crypto bros are failing to appreciate the larger promise that IT holds for money - the promise to relieve the exchange process from the need of intermediating tokens of exchange altogether, and hence to do away once and for all with the frictions, distortions and inefficiencies that come with such intermediating tokens.

Bitcoin-Schmitcoin. Ethereum-Schmetereum. Etcetera, etcetera - just dust. Specks of Internet dust.

With respect to money, there is a meta category - the economic exchange process. Money is a derivative of it – a derivative largely dependent on the available technologies to achieve the most efficient, highest-output economic scenario. Radically new technologies, ideally, would be directed first at exchange process optimization and economic output maximization – and then, hopefully, a concrete type of money will emerge from this process. More on that on pg. 23-24 of this book. A mere insular application of new digital technologies onto archaic exchange process architectures produces mostly noise.

On the whereabouts of Satoshi Nakamoto: a conspiracy theory

To this day, we still don't know who Satoshi Nakamoto is (which in itself is partly telling as to who/what "he" might be):

1. The writing style of the Bitcoin paper is dry, disciplined, compact, precise, to-the-point; the paper is well-structured, referenced, it is publication-worthy. It is an old hand that is writing here – not some pimply teenager doing code in Mommy's basement. "Satoshi" has published papers before; he's been around, he's had a career. **"Satoshi" wears a suit.**
2. "Satoshi Nakamoto" has knowledge that is too well-rounded, too deep, too structured, and across several disciplines (including knowledge and grasp of monetarism/banking that is usually associated with high-level monetary policy positions) – to be a single person. It is safe to assume "Satoshi Nakamoto" is comprised of **at least several individuals**, at least some of whom with academic backgrounds.
3. To maintain a group of highly talented people working on a project costs a lot of money, hence "Satoshi Nakamoto" was **well-funded**.
4. "Satoshi Nakamoto" is resistant to fame – lots and lots of fame. Awards, prizes, a Nobel maybe?...It is therefore safe to assume "Satoshi Nakamoto" is **not from academia** – would have fallen to the "fame" temptation.
5. "Satoshi Nakamoto" is resistant to money – lots and lots of money. He isn't spending his stash of Bitcoins, worth billions. It is therefore safe to assume "Satoshi Nakamoto" is **not from the private sector** – would have fallen to the "money" temptation.
6. The way his breakthrough was presented to the world is unnatural – you don't just show up from nowhere with an invention like that. The way of innovation is long and winding – there are dead ends, back-and-forths, all the time you are rejected, often ridiculed, established names don't want to talk to you, established journals wouldn't publish you; all the while you talk/complain to your girlfriend(s), beer drinking buddies, etc. etc. Not with "Satoshi Nakamoto", though... Obviously, with Bitcoin, **privacy/secrecy was built into the project from Day One**.
7. Not only was privacy/secrecy a concern from Day One, but it was well-maintained all along – a no small achievement in itself; we normal folks always leave some "breadcrumbs" behind, some IT footprint – again, not "Satoshi Nakamoto", though. Therefore, it is safe to assume "Satoshi Nakamoto" has had a **structured privacy/secrecy protecting process** in place.

Now, why would a group of highly competent individuals, well-funded but not from academia and not from the private sector, with a structured secrecy preserving process in place, would want to develop a digital replica of gold – in secret??

LANGLEY

It appears that the US government, seeing the vulnerabilities of the banking system during 2008/2009, seeing the writing on the wall for the dollar as a world reserve asset, and running low on gold, decided to develop a digital version of gold as the next gen reserve asset. Couldn't do it out in the open, though, as it would tank the dollar.

For more details, please refer to the 1996 NSA paper "How to make a mint: the cryptography of anonymous electronic cash".

And let's not forget who gave us the Internet in the first place!!

GO LANGLEY!

Money - the information, the entries, the ledger - summary

Through trial and error, human societies – in the process of barter exchanges and reciprocal gift exchanges – came up with the social technology of money: medium of exchange, store of value and unit of account.

For millennia, gold was money – it was scarce, shiny, solid. With the introduction of fractional reserve banking, it evolved into a pivot for the money system, assuring the stability of money as a store of value.

What money became after the end of the gold standard in 1971 was merely the idea that the value of the currency unit of a country is the total real wealth of the country divided by the outstanding currency units. Thus, the money unit became a simple data structure, consisting of essentially two main fields – (1) “value” and (2) “issuer⁴”. The “value” field can contain any positive number with up to two decimal points; the whole numbers can have paper (25% linen and 75% cotton) as a physical carrier – aka “bills” with “value” of 1, 2, 5, etc.; the decimal fractions can have metal carriers, colloquially referred to as “coins”. If in the field “issuer” we fill “US Federal Reserve” for example, the money unit would carry a unique sign that looks like that: “\$”, and the money unit would be colloquially referred to as a “dollar” [ˈdä-lər]. A more precise definition of the money unit currently in use globally would be “a two-field data structure, with the option of a physical carrier” – that’s all the dollar/pound/yen/etc. are. The term “paper money” is no more meaningful than the term “paper poetry”- paper just happens to be the carrier of the value-claiming information; genuine paper money would mean value is measured in some paper-quantifying metric – a kilo of paper, a square centimeter of paper, something like that. And then people would store their precious paper in a vault, and get warehousing receipts as evidence of their, well, paper-wealth, etc., etc. – the whole gig as under the gold scenario... Well it’s obviously not the case – it’s not the paper, it’s *what’s written* on the paper – the information – that counts. Paper is the chaff, information is the wheat. “Paper money” looks like paper money, feels like paper money – but it isn’t. It is information money. “Paper money” (or “Money for paper”, or “Money on paper”) is the same as “Windows for Desktop”, or “Windows on a Desktop” – information on a carrier.

Gold was information money, too. Only we rarely saw it this way, blinded by all that glitter and millennia of groupthink. What those goldsmiths back in the 13th century stored was essentially information – information about how much real wealth the gold owners could claim from society. Information - reliably stored and carried as gold, disguised as gold, and universally accepted in its golden disguise via a very strong network effect. “Gold” has never been anything but a credit ledger, a golden ledger invisible in its entirety to the locally-seeing human eye – but just a ledger nevertheless. All those nuggets, coins, bars – mere ledger entries.

That cowgirl 3000 years ago, bringing her cow to the market and not in immediate need of any equally valuable good or service, needed a proof, a ledger entry, a record with Mr. Market, with that proverbial Walrasian auctioneer – a record recognizable by everyone out there in the community, a record stable through time – about the fact that she did provide her cow (the “quid”) on a *quid-pro-quo* basis to the community. And she needed – eventually, when she indeed decided to claim her entitlement to equivalent amount of goods and services from the community (the “quo”) – to be able to do so using that record. But how do you make such a stable, widely accepted record 3000 years ago? Gold turned out to be the best available proxy. But that was 3000 years ago, when people played Farmville in real life.

Money has been a ledger - information - from Day One – information about a *quid-pro-quo* exchange, about transfer of value across economic actors and across time – and the idea that money can be anything else *but* information is only a stubbornly persisting illusion. We’ve been blinded all along by the information carriers. All those carriers were only intermediate steps, local maxima, in the search of money for its true host – the Intel chip.

As to why in the Information Age we don’t use a money unit richer in useful information attributes – a multidimensional, complex data structure with richer data fields about the exchange (as opposed to the current two-field structure) – well, this will remain as one of those deep mysteries of the early 21st century, not subject to rational explanation⁵.

⁴In reality, several other minor information fields exist on the Federal Reserve note

⁵“Network effect”, “natural monopoly of the money system”, “lock-in effect” might be some of the right answers.

CREDIT

“Theoretically it would seem that any citizen should have the right to issue his promise to pay any other citizen who should be willing to receive it”

Wilbur Aldrich, “Money and Credit”, 1903

Where is Credit Headed

Where is credit headed?

To destroy the system we dreaded

The winds of change – chaotic and funny,

Blow old regimes, straight out of their money.

In this wild Information Age, we are all slightly insane,

Trading cartoon monkeys for infinite gain.

Goodbye bank credit, you dusty old relic,

Even my toaster now approves new loans

And is a private credit evangelic,

New credit monies are coming our way,

Credit's now digital, private, humane,

The future's decentralized, and undeniably ours,

Order about to emerge out of the chaos,

We salute credit with digital flowers!

Written by Grok, May 2026

BANK CREDIT CREATION AND THE ORIGINAL SIN OF FRACTIONAL RESERVE BANKING

“Banking – it’s a process that even today, few bankers understand”

Milton Friedman

Why banking – breaking the shackles of prior liquidity accumulation

Centuries ago, members of society, using commodities (mostly gold) as money, managed to self-organize themselves into economic activities of their choice to produce goods and services to the best of their capabilities – within the safety net of money-intermediated exchange environment.

But what if you had a great idea for a good or a service, willingness to work hard for it – and no gold? Great ideas don’t always come only to those with the gold, you know.

Faced with a lack of formal venues within the existing money system to fund great ideas, entrepreneurs whose vision outstripped their available resources, resorted to *fraud* (entrepreneurs have always been an ingenious bunch, for better or worse). They cheated the system, as it existed back then. Original sin – fraud⁶ – gave rise to the next great invention in monetarism – fractionally-reserved *credit* – the promise of future payment, and the ability to claim goods and services from society without having first accumulated the base money to do so.

In order to channel resources from society for the execution of their vision, entrepreneurs, facing resource constraints, *pretended* they had accumulated base money (gold) – with a little help from their friendly local neighborhood goldsmith. Here is how it happened:

*around 13th century, Venice, Italy*⁷

Dennis, the local goldsmith, was having a drink at the pub after a long day of work. His business was doing well – he made gold jewelry, weighed and measured the fineness of gold coins for his customers, accepted gold for safekeeping in his vault, issued gold warehousing receipts. Dennis was a third generation goldsmith, from a well-known and well-respected family; now in his 50’s, he was solid, well-connected and well-established – “pillar of the community” – and his gold warehousing receipts were as good as the gold itself; for convenience, in daily shopping, people would even exchange the receipts instead of the gold, safe in the knowledge that their gold was intact in Dennis’ vault; customers would even ask, upon depositing their gold with him, to be given not one receipt for the whole amount deposited, but instead several bearer receipts for smaller amounts, specifically for the purpose of facilitating the use of Dennis’ gold warehousing receipts in the course of their daily shopping.

As he was drinking his wine, his cousin Vinny walked in. Vinny was the complete opposite of Dennis – still in his thirties, he liked to have good time, had a quick eye for pretty girls – and spent all his money chasing them. Money came easy to Vinny, he always came up with *something* to earn some extra gold. Too bad for him, because his money, although easy to come, were even easier to go.

This time Vinny looked distraught. “He’s out of gold again” thought Dennis. “I wonder what he’s up to this time.”

“Dennis! Dennis! Oh, life is so unfair!! You won’t believe the golden opportunity I came across this time” Vinny looked around the pub to make sure no one was eavesdropping and lowered his voice to a whisper. “Salt. Lots of it. Just arrived in Genoa, a whole ship. And there are no buyers! And you know what – that ship must leave in a few days. They are thinking of dumping all the salt in the ocean as no one would keep it on the port for free!”. All of a sudden, Dennis was all ears. He knew the local butchers were out of salt, and were offering gold - lots of it – for salt. Vinny continued “The local butchers – they will *kill* for a bag of salt. Their meat stocks are beginning to rot. I could make a killing!” And after a deep sigh, he continued. “Life is so unfair, though. Just as I can finally strike it rich, I am absolutely out of money! I need to buy supplies for the trip, pay the horse carriages, pay the salt to the shipping company – some 60 ounces of gold in total. And the butchers will pay me 120 for sure once I

⁶The (artificial, convoluted, confusing) explanation given to kids and academics is that goldsmiths’ receipts were “lent out”.

Yeah right.... For this – face-saving – explanation, refer to “The meaning of money” by Hartley Withers. Still, perfectly legal credit instruments did exist early on in the form of Bills of Exchange and the like (“Money and Credit”, Aldrich W.)

⁷ With respect to the earliest origins of the (mal)practice of note issuance over and above a vault’s gold holdings, the author failed to find any plausible explanations. This fairy tale is the only rational explanation the author could come up with.

return with the salt! I tried to offer my IOUs for the trip supplies, for the horse carriages, but no one would accept my IOUs! This is so unfair”. He slumped in his seat, silent and heartbroken.

Dennis’ mind raced. He knew Vinny was right – it *was* a golden opportunity. He knew the butchers – they’ve been in business for so long, they knew their trade, they were going to pay – top price! – for the salt. 60 ounces of net profit! For 10 days of work! This was unheard of. And all this money was going down the drain simply because no one would accept Vinny’s IOUs!

Dennis looked around the pub, slowly leant over to Vinny and began whispering in his ear – deliberately and self-assuredly: “Now listen up, Vinny, and listen good...I’ll help you get the salt, and we’ll split the profit. Here is what we gonna do. I’ll write you gold warehousing receipts for 60 ounces of gold for you – fake ones, but no one except you and me will know about it – don’t worry, no one pries in my vault. I’ll say you brought some gold with me today for safekeeping. With the fake receipts you will pay for the trip supplies, pay for the horse carriages, pay the shipping company for the salt, then you come back and sell the salt to the butchers for 120 ounces. You come straight back to me with the money – we’ll destroy 60 receipts to restore the balance between gold and warehousing receipts (to make up for the fake ones I issued to you) – and keep 60 good ones. We split 30 for you and 30 for me – that’s my interest in the deal. Now, just in case something goes wrong and in order to make sure you won’t blow the money on booze and blondes, I’ll mortgage your house, and if I don’t see my money, I’ll sell the house to replenish my gold reserves with 60 ounces of gold to back up the fake receipts I issued you. And keep your big mouth shut! How do you like my deal?” Of course Vinny liked the deal. He loved it! Free money! No need for gold! They shook hands, got up and went straight to Dennis’ house. Dennis made the receipts for the non-existing gold, they filled out the mortgage deed for Vinny’s house, and Vinny went to get the salt.

The End

With their fast little trick, the cousins made monetary history. Let’s stress-test the situation to see the true significance of their hush-hush deal:

Stress-test 1: Dennis drops dead.

Vinny, shortly after leaving Dennis’ house (the fake receipts safely tucked in his pocket), bought trip supplies, paid the horse carriages and left for Genoa. And then Dennis dropped dead. Absolutely, 100% dead.

The news of Dennis’ unfortunate death spread quickly throughout Venice. The next day every one of his warehouse receipt holders lined up in front of his store to get their gold from the vault. Surprise, surprise! There were more receipts than there was gold! (the trip-supplies people didn’t know their receipts had no gold to back them up, and no one knew there were any fake receipts to begin with). All hell broke loose. A sorcerer, also among the depositors, even tried to bring Dennis back from the dead, as obviously Dennis was the only one who could sort out the horrible mess with the missing gold and the extra receipts – but no luck. Dennis was still dead, and was still the only one who could have solved the puzzle with the missing gold and the extra receipts.

Stress-test conclusions: Dennis-and-Vinny’s little trick fundamentally changed the essence of the gold warehousing receipts – *from claims on gold, claims as good as gold – they became claims on Dennis*, as obviously only Dennis knew how to make good on all the claims. The claim-holders needed Dennis – alive and well – to handle the situation. The claims were now not as good as the gold they represented – they were only as good as Dennis’ ability to come up with the gold. *They were Dennis’ IOUs*. Dennis, *from a custodian, had become an investor*. The gold reserves in the vault were now only *a fraction* of the outstanding receipts. Eventually, this (essentially fraudulent, or at least initiated as fraudulent) activity became known as “*fractional reserve banking*”.

Stress-test 2: Vinny drops dead.

Shortly after Vinny paid for the trip supplies, he dropped dead. Absolutely, 100% dead. This got Dennis very worried, because it meant the deal would not be concluded, and he would lose from his gold reserves the amount of the receipts he issued to Vinny which ended up in the trip supplies people. Dennis hurried to sell Vinny’s house, but ever since Vinny’s unfortunate death the citizens of Venice thought it was haunted by ghosts, and no one wanted to buy it, or at least no one wanted to buy it at a price anywhere near what Dennis needed to recover

his losses. Dennis raised his clenched fist to the sky and yelled in anger “Vinny you schmuck! I gave you gold receipts as good as gold, and you gave me a promise you didn’t keep! I knew your IOUs were no good. Rot in hell!”.

Stress-test conclusions: Dennis exchanged his – trusted by the public, IOU (and we saw in stress-test 1 that it was essentially only an IOU) – for the IOU of Vinny (not trusted by the public), an IOU carrying “*credit risk*”, and backed by collateral - in exchange for his expected “*interest*”.

Stress-test 3: The horses drop dead.

Shortly after Vinny went on his trip, the horses dropped dead. This meant the deal could still be profitably executed, but on foot. This would take time. Eventually, Vinny would come back, receipts for 120 ounces of gold with him, but in the meantime Dennis’ depositors expected their gold deposits to be accessible at any time, without delay. This eventually became known as “*maturity transformation*” – shorter-term deposits mismatched with longer-term investments.

Stress-test 4: Depositors nearly drop dead.

Somebody spread a rumor that Dennis gave gold to Vinny and Vinny blew it on blondes, booze, making bad deals and getting into the wrong brawls. Everybody received an anxiety attack, a panic attack, and/or a heart attack, and ran to Dennis’ store to get their gold from the unreliable goldsmith. This eventually became known as a “*run on the bank*”.

Moreover, after depositors realized Dennis was no more the staid, safe pillar of the community he used to be for decades, but instead had become Dennis the Monetary Menace from Venice, the only way for Dennis to keep his customers was to lure them with a cut of the profits of his shady dealings with Vinny – not to say that other goldsmiths, seeing how profitable fake receipts issuance could be, also began *paying* depositors to have their gold instead of *getting paid* for safekeeping it. Dennis’ receipts became “*interest-bearing deposits*”.

Stress-test 5: The sorcerer props up the dead bodies.

As Dennis was raising in anger his clenched fist at the ghost of Vinny, the local sorcerer – Mr. Coleman Zacks – stopped by. As Dennis began to complain how he is stuck with dead Vinny’s IOU, Mr. Coleman Zacks assured him he can help. First he propped Vinny’s dead body, saying he wasn’t exactly dead but more like undead, and then used his “*securitization*” magic and sold Vinny’s IOU to unsuspecting investors. The way it worked was through moodies – little things living in his pocket, who were very moody. These moodies never saw any ghosts in Vinny or in Vinny’s house during the good times, but in bad times they saw a ghost in every person and in every house. Mr. Coleman Zacks used the moodies to sing out loud that Vinny’s IOU is good because his house was backing it up, and there were no ghosts in it and never would be. There was, however, a price to pay for Dennis, as it always is with dark magic: having sold his soul for money, Dennis turned into a zombie himself; his previously reputable custodian business into a “*zombie bank*” – a custodian of dead customers’ IOUs.

Now let us continue our story in a somewhat brighter mood. Let’s assume no one died, no one got scared, and no one turned into a zombie. Vinny successfully sold the salt, and everybody was happy. Dennis realized he could make so much money this way – issuing fake receipts to Vinny (and others like Vinny who had bright ideas and good collateral but no gold). He only had to make sure he always had enough gold in the vault to redeem the occasional note holder who would ask her gold back, so no one would doubt his integrity or the safety of the gold deposited in his vault. This meant some 10% gold of the total amount of outstanding receipts had to be kept at any time in the vault, as a running gold balance.

Time went by. Other goldsmiths got in the gig as well. With so much money, trade flourished. Receipts issued in Venice started circulating in Genoa, and vice versa. Goldsmiths expanded geographically within a relatively short (manageable without advanced information technology) range, and began opening accounts with each other, so as to be able to easily honor each other’s receipts.

As goldsmiths began to shuffle gold and receipts back and forth between themselves in settlement of trade receivables, the couriers would meet halfway between the goldsmiths’ offices and sort through all the receipts and

settle on a net basis. Goldsmiths realized it would be much easier if they had a structured clearing house, in which each goldsmith would keep some gold, and the clearing house would settle payments on a net basis (this would make the required reserves kept against the issued notes even less). The clearing house made sure every goldsmith in its system had enough gold in reserve to carry on this “fractional reserve” thing. Governments in virtually every country showed a strong interest in the workings of the mints and their clearing houses – wars were never cheap – and got heavily involved in the whole process of money creation and management from the very start.

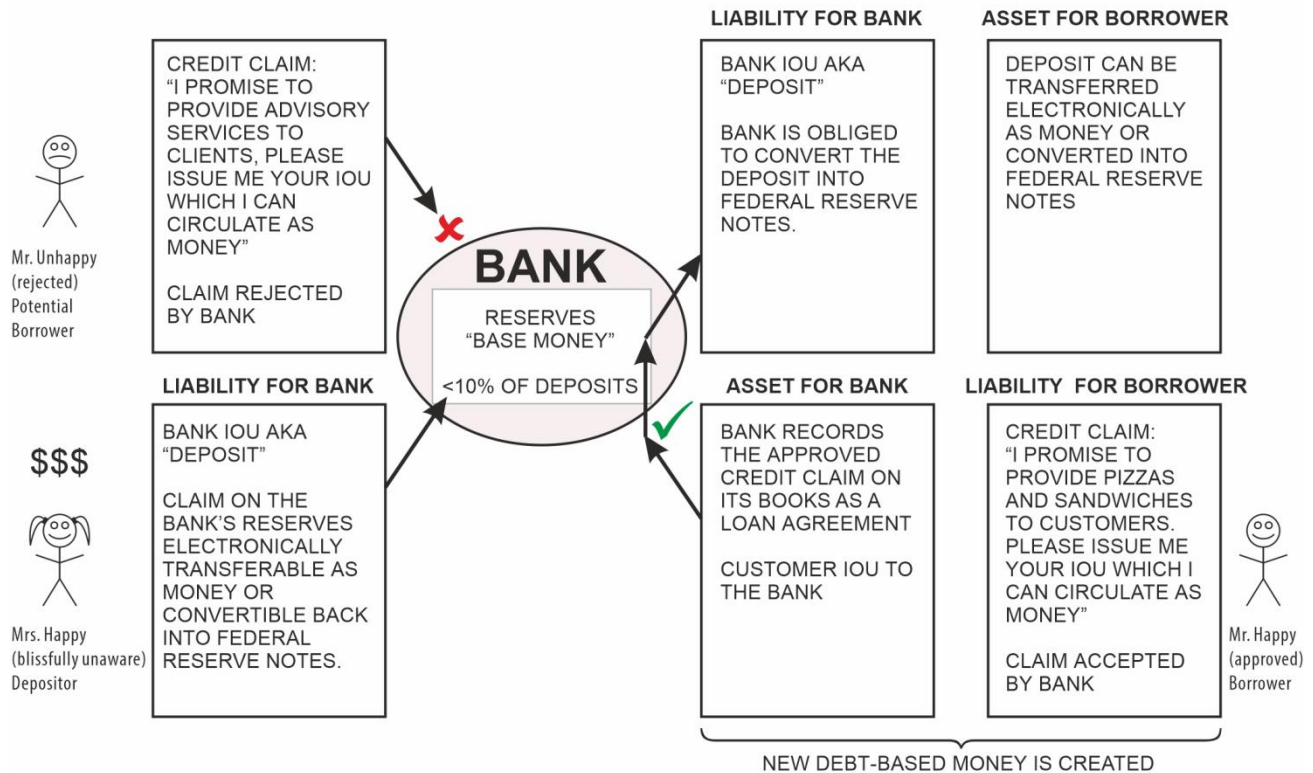
Technologies changed. Dennis began to issue the fake notes electronically – the bank, after assessing the credit risk of potential borrowers, instead of issuing paper receipts to Vinny in a hush-hush environment, would open an electronic deposit for him and brag about it, maybe even publish a “tombstone” in the local newspaper if the borrower is rich and famous...These electronic deposits would then be transferred – obviously electronically – between banks in Venice and Genoa; the banks would agree to accept each other’s fake notes (this was in their best interest, collectively, even if they competed with each other individually) and this would become the payment system. The name for the fake notes would change to “inside money”, “bank money”, “deposits”, or just “credit”, the name of the gold on reserve with the clearing house – “base money”, “high-powered money” or just “reserves”. After 1971 gold had to be replaced with two-bit data structures, because America blew its gold on blondes and booze, made bad deals and got into the wrong brawls; the two-bit data structures would occasionally be printed on a special, hard-to-counterfeit paper; Dennis would change his name to “JPMorganChase”, the clearing house – to “Federal Reserve”, but the fundamentals of commercial banking would remain the same – today, just as they were in 13th century Venice:

- Deposits at commercial banks are not *really* money, they are claims against the bank, convertible into money; they are IOUs of the bank to the customer – opposite to what everyday experience has led people to believe. When a customer puts cash into her bank account, she swaps “real money” (Federal Reserve notes) for a claim on her bank. As long as these claims are transferred electronically from one bank customer to another bank customer – these claims on the banks work as money, and no one is able to tell the difference between the claims on the banks and the real money (and in reality such difference does not exist – at least not until the bank goes under and everyone lines up in front of its office to convert their claims into “real money”).
- Lending in commercial banking does create new money (opposite to what the vast majority of people may think) – with offsetting debt for the borrower, and against interest. A commercial bank is thus fundamentally different from a credit union, because a commercial bank creates new money, while a credit union only transfers existing money from savers to borrowers.
- Money for the interest due on the newly created debt-based money is not created anywhere in the system – an artificially created scarcity of money which makes society ever more competitive, requires ever more debt to be issued, ever newer and ever bigger growth opportunities.
- It is very important that commercial banks are up and running so that payments for groceries, clothing – or for oil tankers and F-16s – can be made not in cash but electronically.
- Commercial banks use short-term funding through deposits (as one funding venue), but make longer-term loans, creating balance sheets which may be, time-wise, out of balance.
- Banks are susceptible to panics. If depositors for any reason fear that their bank deposits are not safe, and start withdrawing deposits, this may indeed ruin a fractional reserve bank if no further measures are taken.
- The core business of commercial banking is evaluation of credit risk. Fundamentally, this is an IOU trade – an entrepreneur would offer the bank her IOU, if the bank believes it is good, will provide its own, widely acceptable IOU, to the borrower (i.e. open up a deposit for the borrower), keeping the borrower’s IOU as an asset plus a collateral in case of default on the customer’s IOU.

“It should be clear that modern fractional reserve banking is a shell game, a Ponzi scheme, a fraud in which false warehouse receipts are issued and circulate as equivalent to the cash supposedly represented by the receipts.”

Murray Rothbard

How bank credit (deposit) creation works: an illustration



Let's look what is the essence of the actions of each economic actor on the illustration:

1. *Mrs. Happy (blissfully unaware) Depositor*. She puts her Central Bank notes into a commercial bank. By this, she swaps her Federal Reserve notes for a claim against the commercial bank (a customer deposit). The deposit essentially is a promise by the commercial bank to convert the deposit back into real money (Federal Reserve notes). Mrs. Happy is usually unaware that her Central Bank money is, legally, already gone, she now owns not real money but claims against the commercial bank - which claims in turn can circulate within the banking system as money, hence the name "inside money" or "bank-credit money". Bank credit money in the name of Mrs. Happy is created by the commercial bank in this case, in the amount of the deposited Central Bank notes, but the commercial bank's ability to create new bank-credit money is increased by a multiple of the amount deposited as it must keep less than 10% Central Bank money as "reserves" against any new deposits (loans/bank-credit money) created on the basis of that deposit.
2. *Mr. Unhappy (rejected) Potential Borrower*. He makes a credit claim to the Bank, that, for example, he will provide advisory services to investors, and wants the Bank to accept that IOU (the promise that advisory services will be delivered in the future), and wants the Bank to provide in exchange its IOU (the promise that the Bank will convert its IOU into base money). The Bank, however, decides the customer is not good for the claims he makes, and refuses to accept his IOU in exchange for its IOU. No new money is created in this case.
3. *Mr. Happy (approved) Borrower*. He makes a credit claim to the Bank, that, for example, he will provide pizzas and sandwiches to customers, and wants the Bank to accept his IOU (the promise that pizzas and sandwiches will be delivered to customers), and wants the Bank to provide in exchange its IOU (the promise that the Bank will convert its IOU into base money). The Bank decides that the customer is good, so the Bank accepts the customer IOU as its asset, issues its IOU to him (a deposit - Bank's liability and customer's asset). The customer can then circulate electronically that bank's IOU as money within the economy. New debt-based bank-credit money is created in this case - and this accounts for the bulk of all new money creation.
4. *The Bank*: (1) evaluates credit claims made by potential borrowers; (2) those claims it approves are accepted as bank assets, in exchange for issuance of a bank IOU (a deposit in the name of the customer), which deposit can be circulated electronically as money within the economy, or can be converted into Federal Reserve notes (base money) by the customer; (3) for new money to be created, someone must go into debt with the bank. (4) new loans to non-bank customers in banking generally do not come from another saver - borrowers borrow from their own future - the so called "frontloading the future".

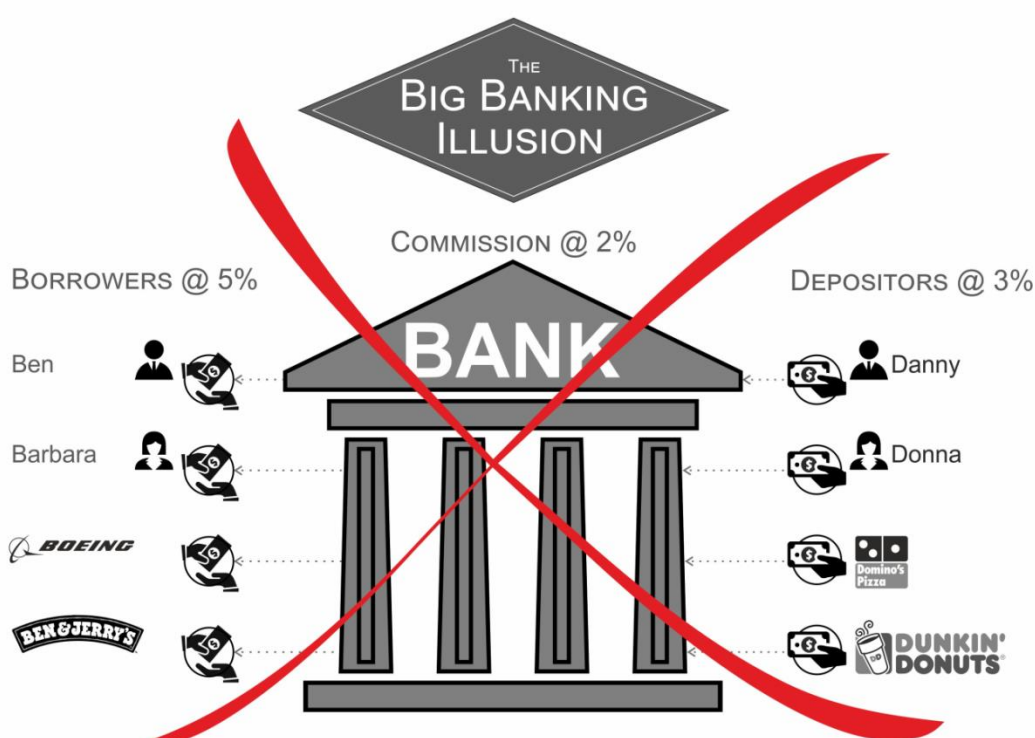
The Big Banking Illusion

Looking at a bank's operations from the outside, as most of us do, it is easy to believe that banks take money in from depositors, say at 3% p.a., and relend them to borrowers at, say, 5%, while keeping a 2% commission.

This is wrong.

A bank evaluates short-term and long-term credit claims of customers, such as requests for a revolving working capital loan, for example. Those credits which the bank considers to be good are *issued new bank-credit money*. This is an important point.

The money entered into the approved borrower's account after a "loan" is made, are newly generated, newly issued, bank-credit money – not Central Bank (base) money - these are newly issued claims on the bank's stockpile of legal tender notes (aka "reserves") kept by the commercial bank with the Central bank. In a bank "lending" process to a retail, non-bank customer, no pre-existing central bank legal tender monies are lent. The newly created, self-issued bank-credit monies, (commercial bank IOUs) however, are.



That's why, commercial bank credit money is sometimes referred to as "pen money" – new money is simply written in the borrower's account as a "deposit" (the misnomer of the century) on the bank's ledger.

Commercial banks keep "reserves" (also known as "base money", "outside money" or "central bank money") with the central bank. Money deposited into a bank by individual depositors also become part of a commercial bank's "reserves". These "reserves" (pre-existing money) are loaned among banks to each other at the LIBOR (UK) or Fed Funds (US) rate. This market for reserves is inaccessible for non-bank borrowers.

Against these "reserves" (legally imposed tokens intermediating the exchange process in the economy), the commercial banks issue claims (in multiple amounts of their reserves, hence the term "fractional reserve banking") to approved bank-credit seekers (borrowers), by opening "deposits" (that misnomer again) for them. Thus, a commercial bank first creates self-issued bank-credit money, and then lends it to a customer so that the customer can make payments in the economy. In this way, a bank processes its various customers' credits (the ones it accepts after a loan approval process) into structured, regulated, fractionally-backed, debt-based, interest-charged, widely accepted bank-credit money.

Often, in monetary literature, the concept of “self-issued credit” is presented as an alternative to banking. This is not so. Banks are the systemic, major, regulated, producers of self-issued credit (bank-credit) which is lent to borrowers so that borrowers can make payments in the economy.

“Bank A makes a new loan, the impact of which is to lengthen its balance sheet by increasing loans as assets and deposits as liabilities. There is no impact on reserves.”⁸”

“The process of creating a new loan by a commercial bank does not immediately impact on the reserve quantity or distribution of reserves in the system.”⁹”

“In the modern economy, most money takes the form of bank deposits. But how those bank deposits are created is often misunderstood: the principal way is through commercial banks making loans. Whenever a bank makes a loan, it simultaneously creates a matching deposit in the borrower’s bank account, thereby creating new money.

The reality of how money is created today differs from the description found in some economics textbooks.”¹⁰”

“A modern banker deals in credit of his own creation, a substantial economic quantity which he swops for other people’s credit, also something substantial.”¹¹”

“A bank loans not its money, but its credit, and carries the amount to the deposit account of the borrower”¹²”

BANKS ARE INTERMEDIARIES OF **CREDIT** - NOT OF BASE MONEY!!

Interconnected networks and IT as an existential threat to commercial banks’ credit creation

The extension of bank credit to economic agents in the form of bank loans builds upon a crucial specialization, an information arbitrage of sorts, which has existed ever since the birth of fractional reserve lending in the Middle Ages, an advantage for the banks vis-à-vis the general public – banks carry out checks on the identity of borrowers and their creditworthiness, which the general public is unable (or rather, used to be unable) to carry out with the many strangers who might issue credit.

Using networks and IT, however, it is now possible for companies, instead of borrowing bank credit, to self-issue fully-reserved, debt-free, interest-free, maturity-balanced, claims on the *real thing* – the real output of the economy, the real goods and services - as IOUs of the issuing businesses backed by the issuing business’ productive output and credit, thus altogether bypassing the intermediation of outside money and bank-credit money in the exchange process in the economy. In an interconnected, information-rich environment, the credit of each issuer (a business’ IOUs) can be re-located within economic actors topologically close to the issuer (via social graphs, etc) – an IT-enabled morphogenesis in credit – allowing **credit assessments on a peer-to-peer basis within a peer group**. Thus, in an information-rich, interconnected world, 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 than the bank loan officer to evaluate their peer’s creditworthiness.

Companies can be their own bankers now. Within interconnected networks and via IT, companies no longer need to borrow bank credit – they can issue and use their own credit within the network, peer-to-peer, without the banks’ credit intermediation.

⁸ Rule, Gareth “Understanding the central bank balance sheet”, Centre for Central Bank Studies

⁹ Same

¹⁰ Michael McLeay, Amar Radia and Ryland Thomas, “Money creation in the modern economy” Bank of England Quarterly Bulletin 2014 Q1

¹¹ Aldrich, Wilbur, “Money and Credit”, 1903

¹² Same

WHAT IS PRIVATE CREDIT

- *Is this barter? Or is it private credit?*
- *Both – in the same asynchronous p2p transaction*

“Privately issued credit” is the flip side of asynchronous, time-lagged “barter” exchange of goods and services.

Time-lagged barter and privately issued credit are two sides of the same coin. Nowadays, in every *quid-pro-quo* barter exchange there is inevitably a time lag between the *quid* and the *quo*, so that every time-lagged barter exchange gives rise to a credit relationship between the economic actors (the hairdresser, drinking coffee “on barter” in the local coffee shop cannot, while having coffee, cut the hair of the waiter; the accountant, getting ground meat “on barter” cannot, while at the counter, do the accounting books of the butcher, etc. etc.) – there is inevitably a time lag between the *quid* and the *quo*, hence a credit relationship. Registering digitally the relationships arising out of asynchronous, time-lagged barter exchanges, and turning them into digital, transferrable, bearer credit tokens, gives them the quality of money within the barter, or rather, within the private credit, network. For example:

The accountant gets a kilo of ground beef (the *quid*) “on barter” from the butcher for \$20. In doing so, she issues an IOU, in the amount of \$20, for her own services, (the *quo*), to be provided if and when her IOU is presented back to her for redemption. If, however, the butcher can take that IOU and pay with it his spice supplies bill, in the amount of \$20 (i.e. the accountant’s IOU is a freely transferrable bearer instrument with the network), then that IOU is a claim not only on the issuer’s productive output, but also on the goods and services of any other member of the network, then that IOU, for all practical purposes, becomes \$20 on the network – i.e. it is de facto privately issued cash, backed by the credit and productive output of its issuer.

If in this way we manage to successfully – safely – unleash the power of endogenous private credit creation, it will mean that we no longer need banks to issue bank credit for us, and we no longer need overlords of any kind to give us an exogenous reserve asset. And the next gen reserve asset may not be the IMF’s SDR, or a CBDC, or some crypto token, but – cucumbers. Tomatoes, too. Big macs. Filet mignons. Taxi rides. Haircuts. Etc., etc. Via robust private credit creation processes, we can all create our own reserve assets, and issue the credit claims on them.

“Theoretically it would seem that any citizen should have the right to issue his promise to pay any other citizen who should be willing to receive it”

Wilbur Aldrich, “Money and Credit”, 1903

What’s interesting in such a system based on endogenous private credit creation is its disintermediation potential – by making the basic exchange process in the economy peer-to-peer, it obviates the need for any exogenous intermediating token – be it a central bank note, a commercial bank deposit, a commodity, a crypto – anything. And all the layers upon layers of complexities that come on top of this – SWIFT, Fedwire, payment processors, stablecoins, etc. - become irrelevant. Legacy system. And that includes bitcoin.

By using endogenous, privately issued credit in our transactions, we work “closer to the metal” (to borrow a metaphor from the “C” programming languages) – we are closer to the underlying economic exchanges than any other system of money. In this way we can eliminate tons of friction, agency costs, fragility and instability – all related to exogenous monies - from the body economic. All the gold mining, refining, storage and retailing (related to monetary metals, not jewelry which is a legitimate economic activity in its own right), all the crypto mining, all the operating expenses of the banking system pertaining to bank notes and credit creation - including the bailout costs(!) – get eliminated, and are replaced by the cost to run an IT platform.

A huge amount of system-wide intermediation is relegated to history.

SYSTEMIC IMPLICATIONS OF PRIVATE CREDIT: MASSIVE EFFICIENCY GAINS AND COST SAVINGS

But these massive efficiency gains and cost savings are only the beginning:

Commercial Private Credit - the fairest of them all

Now the dawn of a new Age - the Information Age – is upon us. One can't help but wonder: will this rapidly advancing new era - the Information Age – bring about a new money, as these eras usually do? A new money better suited to address the challenges facing us, leveraging the power and capabilities of the new technologies we now have at our disposal? Historically, throughout the Ages, money has been evolving as human civilization evolved: from gift exchange and barter during the Primitive Age, to coin during the Agricultural Age, to bank credit during the Industrial Age. Right now, the new Information Age is already firing the first, imprecise and erratic as they might be, shots at the old, Industrial Age monetary system:

CRYPTOS

Over 50 million of them, no less, including the meme tokens¹³. Easy to get confused within such a bewildering variety of digital monkeys, beauty queens' tokens, Trump coin, dogecoin, fartcoin, this coin, that coin, and anything-you-can-think-of coin. Which is the best one? Like, the future of money n'all?

Let's ask Grok, the All-Knowing, shall we?

A-a-and, the winner is... (drumroll):

The Fairest of Them All

Mirror mirror on the wall,
Which coin brings the most good to us all?

Not the one that rockets fast,
Leaving hollow towns in a wave of bust.
Not the one that feeds on fevered trade,
Or castles built in charts that fade.

The fairest coin is quiet in its grace:
One that widens trust, and not a mere passing phase.
That lowers walls instead of raising tolls,
And serves the hands of ordinary souls.

A currency earns its beauty not by price,
But by an economy it turns into paradise.

Grok, May 2026

To paraphrase the wisdom of Grok's somewhat cryptic answer into a more prosaic language,

**THE BEST CURRENCY IS THE ONE WHICH, FOR THE LEAST POSSIBLE COST, MAXIMIZES
THE TOTAL OUTPUT OF THE ECONOMY USING IT**

Endogenous private credit does provide the “least possible cost” scenario for the underlying economy via the elimination of the operating costs and the bail-out costs related to the industries supplying the exogenous money goods. But does it maximize economic output?

¹³ Grok

As we explore various currency designs in search for the one achieving maximum economic output, one point always catches the eye:

- the effect that the money issuance privilege has on the issuer – a very positive one, that’s for sure, like, going-to-war-over-it positive. It is very simple – whoever gets to issue the money, got it good - real good. The issuer of the money can claim goods and services from the economy by virtue of issuing the money, while other, non-money-issuing folks, must work hard to obtain the goods and services they need.

If we seek the best monetary system – the one which maximizes the productive output of the **WHOLE** economy, we should seek ways to facilitate and encourage, as much as possible, via this hypothetical monetary system, the productive efforts of **ALL** of the creators of goods and services (the productive businesses, that is). Maybe we should consider giving **them** that awesome, so-very-positive privilege of money issuance so as to facilitate and enhance their productive capabilities and endeavors?

But, wait. Productive enterprises can issue money (well, cryptos, rather) even today – by getting on the Ethereum blockchain, or by building a server farm and start mining bitcoin, etc. Yet how is this having any positive effect on their creation of goods and services? It is detrimental, actually – it **diverts** resources from their productive activities, from the creation of goods and services.

So it is not only **who** gets to issue the money – but also **on what basis**. And if we want to encourage the creation of valuable-for-society goods and services by companies, we must find a metric, a measure of how much goods and services these companies provide to society, and then let companies issue currency on the basis of that metric.

The simplest of all metrics, it is:

SALES

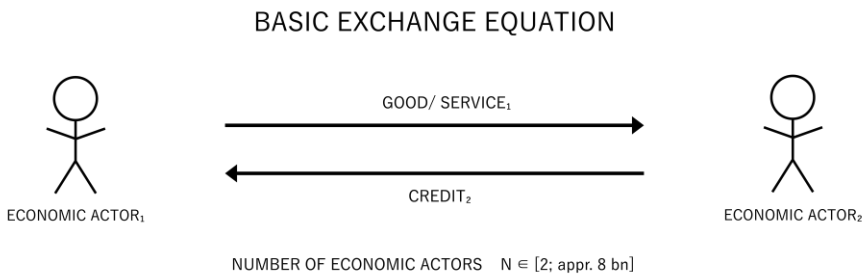
Now we need to find a way to link the money issuance process to the sales metric, via some function $F(\text{sales})$ maybe, in which the higher the sales, the more money gets issued. Let’s see: do we have, throughout history, any example of a currency, issued by commercial companies, against their sales of goods and services? Of course we do. And it’s 200 years old:

COMPANY SCRIP

And it’s all but forgotten now – no one uses it, it is not discussed on mainstream media – it’s gone from our lives. Languishing in academic obscurity. But why? We thought private credit brings massive, system-wide efficiency gains and cost savings, and encourages the creation of goods and services, no?

Its technology failed. *The paper.* 200 years ago, money was printed *on paper*. The first technology to fail the private credit signal was the neocortex, the second was the paper. After all, unleashing that private credit signal at scale is a massive, massive computational challenge – millions upon millions of economic agents, millions upon millions of transactions, millions upon millions of private credit issuers. Can you do that in your head, or with a pen and paper?

Solving that seemingly simple Basic Exchange Equation at scale is a massive computational challenge. And it’s a big, complex network, hence a serious modelling challenge, too.



The company scrip issuers from the 19th century, with their pathetic ink-and-paper technology, attempting to issue private credit notes, were doomed, from the very start, to hit the brick wall of their own technological limitations:

How the Industrial Age version of private credit came up short

Company scrip was issued primarily by mining, lumber and railway companies in North America in the 19th and early 20th century.

The US mining and lumber companies of the mid-19th century, building remote mining and lumber company towns in the middle of nowhere, each town with a single company store providing all the food and merchandise the workers presumably needed, often issued company-credit paper notes, redeemable for goods and services at the company store, in payment of workers' wages and advances¹⁴. At the peak, some 20,000 coal company stores had issued company scrip¹⁵. There are reports about unfair pricing practices of coal company stores abusing their monopoly position, which claims are debated by other researchers¹⁶.

The US railway companies also gave company scrip a try in times of cash shortages during the 1820s-1870s. Their notes had the aura of respectability, to the point of being professionally designed to look like bank notes, printed by the same printing companies banks would use. The notes had the backing of the most reputable, solid, and respectable corporate giants of the time. These railway credit notes even had a modest network effect – merchants and individuals near the rail line were willing to accept the notes knowing they could easily use the notes for shipping of goods via the railway, and for travel (a well-developed road network, and the automobile, were yet to appear).

Before this instrument died off by the 1950s through a combination of legal bans, labor unionization and broader penetration of banking services, it did manage to facilitate economic transactions that otherwise would have been impossible due to lack of currency in remote US towns. And, when it wasn't abused by its issuers, it managed to produce a small - but positive - impact on the local economy. Still, serious structural deficiencies were exposed during its practical use:

- multiple non-interoperable monies fragmenting the market
- very limited network effect, predominantly in company-dominated enclaves
- very high currency discovery costs (the local newspaper and word of mouth being the main communication channels) – hence it was hard to assess the inflation risk, the credit risk, and the reputability of the issuer;
- non-transferable notes - there were no markets or clearing houses for these instruments – the only choice was to trade them for the official currency at an often nasty discount;
- what happens in the hypothetical scenario where many companies start issuing such paper credit notes?
 - you got currencies A, B, and C in your wallet, but the shoeshine boy doesn't know them or doesn't like them, and only accepts currencies D, E and F. What then? You got sufficient purchasing power in your wallet, but still can't get your shoes shined. How do the currencies in the buyer's wallet meet the monetary preferences of the seller?

The company scrip had all the right foundations to be a good money: issued by private companies, in a decentralized fashion, with real backing behind it. But it was still a **proto** currency – it lacked key features needed in order to become a viable currency: no choice in currency and competition in currency to keep the issuer in check, geographically limited network effect, without structured borrowing and lending facilities of any kind.

Paper-based company scrip was definitely a step forward from the Primitive Age neocortex solution to the Basic Exchange Equation, but by virtue of its physical, ink-and-paper nature, it was destined to stay relatively small, limited in its scope – a currency of last resort, a bank note substitute, used only when there was no other (better) option. In its physical, paper-based form, it couldn't measure up.

THE TECHNOLOGIES OF THE INDUSTRIAL AGE FAILED TO UNLOCK THE MONEYNES OF PRIVATE CREDIT AT SCALE.

Digital technology changes all that. Decisively:

¹⁴ Timberlake, R "Private Production of Scrip-Money in Isolated Communities", Journal of Money, Credit and Banking, Vol.19

¹⁵ Dodrill, Gordon, "20,000 Coal company stores in the United States, Mexico and Canada" Duquesne Lithographing Company, 1971

¹⁶ Fishback, Price "Did miners owe their soul to the company store" Journal of Economic History 46, Dec 1986

Looking ahead¹⁷: the Information Age version of private credit

Now let's once again take that 10,000 years old, long forgotten and ignored, credit signal – the Primitive Age version, the one generated, recorded and stored in the human neocortex – and bring it forward to the Information Age.

Let's dust it off, digitally. Let's give it a bit of a digital facelift. How about a better name, for a start – like “privately issued credit”, for that's exactly what it is. Put it out there on the Internet – and on a smartphone, of course. Make it easy to use. Like, one-click easy. With fancy blinking colors and a pleasant bleep. Give it a standard of value – ideally, away from the sinking ship of those superfluous fiat metrics – the dollar, the euro, the yen – they are all going for broke, anyways. Give it transparency. Transferability. Marketability. Inflation-protection. Choice in currency. Competition in currency. Add some nice social features to it. Quantify the link between issuer's sales (and hence projected redemption capacity) and the volume of privately issued credit currency. Then connect everything into one big, beautiful, unified, credit-based network.

Geographic reach? – global by default. Its carrying platform – the Internet – is global.

Millions upon millions of currencies? Sure, no problem, bring it on. Millions upon millions of credit issuers? Sure, the Amazon cloud is a click away. Millions upon millions of transactions? Done.

Money interoperability? – a multicurrency wallet (a single table in the SQL database, really – we called ours “wallets”), along with the proper algorithm for a multicurrency transaction, handles that. Easy.

Currency discovery costs? – just the cost of computer processing time, these days. Near-zero.

Choice in currency? – how is it any different from choice in YouTube videos, or choice in Twitter profiles, or choice in dating partners on Tinder? It's all just digits moving across a database. Easy-peasy. Sweep left, sweep right. That's it.

Competition in currency? – any form of competition you can imagine – we can code it.

Moving, exchanging, dumping, trading private credit currencies? Piece of cake.

We can do all these things nowadays. Easily. Digitally, we can all issue credit, safely, privately, peer-to-peer. We are all bankers now. The time of the “Sovereign individual”¹⁸ has arrived.

The credit signal – that homeless, neglected, ignored, suppressed for millennia by the money good, credit signal – has finally found its true home on the Internet. There, on the Internet, in its digital form, it reigns supreme:

- decentralized and peer-to-peer
- zero issuance cost
- eliminates tons of friction, agency costs and instability associated with exogenous, third-party monies
- freedom from bank- (or any other issuer's) debt serfdom via self-issued credit by the productive enterprises
- systemic resilience via an ecology of multiple currencies
- long term stability of the monetary system via choice in currency and competition in currency

The miracles for the underlying economy happen if and only if money is issued (1) within an interconnected credit network, digitally, (2) by companies, and (3), on the basis of the issuing companies' revenues. Under these circumstances, the properly structured – properly monetized – digital private credit is the superior monetary technology.

DIGITAL PRIVATE CREDIT CURRENCIES. MONEY FOR THE AGES.

¹⁷ Not that far ahead. A prototype of The Credit Network has been built by the author on www.bartex.org – and it works. Works at the α -test level, that is.

¹⁸ A book by Davidson and Rees-Mogg, first published in 1997 by Simon & Shuster

FLAWS OF THE CURRENT MONETARY SYSTEM

1. **Built-in growth requirement for the money system.** Bank-credit is a principal-only instrument for exchange media creation; when bank-credit is loaned with the expectation for interest by a bank, the amount of the interest is not created, i.e. there is the implicit assumption that the interest will be extracted by the debtor from other debtors (aka other “monetary circuits”), who in turn will have to extract from yet other debtors not only what has been extracted from them, but their own interest obligation as well, etc., etc. Thus, at any one time, there are more promises made for delivery of exchange media to the banks than there is exchange media created, therefore the money system must grow in the future (again by extension of more bank credit), or some debtors must go bankrupt. There is a **built-in growth requirement for the money system**. Please note – this is a growth requirement for the money system itself, for the amount of exchange media outstanding, not for the real productive output of the economy.

This built-in growth requirement for the money system is somewhat mitigated by the fact that banks recycle back into the economy some of the interest they receive, because a currency unit can be spent more than once, but:

- a) there is a time lag in that
- b) such recycling would require ever increasing velocity of money – which doesn’t happen, i.e. the built-in growth requirement is satisfied largely via new debt issuance
- c) much of the interest banks receive is recycled into activities related to the banking industry alone like derivatives, and not so much to the needs of the real economy, i.e. much of the recycling is internal within the banking system
- d) the newly created productive activities, after they return to the banking system the loan they initially received plus the required interest, need their own amounts of exchange media to operate, which must either be extracted from other debtors or loaned anew into existence.

For these reasons, the dynamic of the monetary circuit in the process of credit creation has a **built-in growth requirement**. This is a crucial systemic feature – potential systemic TNT (as we’ll discuss in point 2 next) – and yet a feature usually left for academics to argue about in obscure, banking-bonus-irrelevant journals.

2. **Unrestrained issuance of unproductive credit threatening the store of value function of money.** While the credit/fractional reserve banking system comes with a built-in growth requirement, credit can be issued for activities that may or may not grow the productive sector of the economy. Refinancing interest payments with newly issued credit, refinancing much of government debt, share buybacks, asset purchases, speculation – are all examples of activities which can pay back the principal plus interest without growing the economy.

Let’s not forget – every currency unit is a claim on the real output of the economy, and we need these units to be reliable store of value. Thus, **as the money system grows, the economy must grow too** – at least as fast as the money system, or otherwise the currency unit will lose from its value. Somebody must do the heavy economic lifting - for every dollar issued in new credit for productive purposes, and for every dollar in new credit issued for non-productive purposes.

Issuing new credit for non-productive purposes is a classic example of an activity in which unrestrained individual rationality may lead to a collectively irrational outcome - the so called “Tragedy of the commons”: it is rational for each bank individually to issue credit via loans to borrowers who can repay (no matter how – via new, healthy productive economic growth - or via unproductive coercive taxation or via unproductive speculation), yet collectively, such behavior leads to overgrazing of the productive commons of the economy, unsustainable debt growth, loss of purchasing power for the currency unit, with the only possible logical, inevitable outcome being collapse of the whole system due to debt growth exceeding real economic growth.

3. **Unrestrained issuance of unproductive credit leads to the formation of bubbles.** Financing speculation with newly issued credit bears the risk of forming speculative bubbles, or at least having certain – collateral quality – assets rise disproportionately in price. Real estate is one such example. Issuing new credit on the belief that the underlying asset will rise in price – be it real estate, tulip bulbs, bitcoin, etc. – bears a very high

risk of becoming a self-fulfilling expectation, because our belief, combined with the ability to issue new money, makes it so. But then the bubbles pop, and asset prices are destroyed, yet the corresponding debts are not, causing banks to experience assets deterioration and solvency problems.

4. **Commercial banks create money as debt only, against interest.** Up to 97%¹⁹ of all money in some countries is put into circulation via creation of interest-bearing bank debt, causing, quite predictably, a perpetually indebted society. Since the interest on the debt is largely not created, it must be extracted by a debtor from other debtors, meaning (1) new debt must be issued in ever increasing amounts to prevent collapse of the whole system; (2) members of society are in constant competition for ever larger interest payments; (3) new sources of growth must be constantly identified and realized. It is for these reasons that resource depletion and resource-based conflicts become inevitable, as well as negative externalities such as global warming and pollution – people have bills to pay, you know. The ever-increasing neediness and competitiveness implied by this particular monetary architecture would be best summarized by a theologian as the proverbial “love of money”- and of course the root of all evil. The problem is not with debt-based money issuance *per se*, the problem is that this is essentially *the only* way of putting money into circulation.
5. **“Two-bit dictator” monoculture of the money unit.** The term “two-bit dictator” would perfectly fit virtually any legal tender currency in use throughout the world today – existing currency units lack depth of informational content and do not allow for any meaningful competition because of the existing legal tender laws. This monoculture aspect drives fragility and cyclicity into the economic system that is built on top of the money system.
6. **Ever-increasing inequality is a feature, not a bug in the current system of money.** (1) **Interest** is the instrument for the trickle-up economics behind the “preferential attachment” effect – transfer of wealth from the poor to the rich, and the rich are ever-likelier to be getting richer, whereas the poor are ever-likelier to stay poor(er). (2) **Credit allocation** based on repayment capability only benefits those already wealthy – remember your finance professor in college who used to say banks will lend you money only after they see you really don’t need the loan? Well he was right. (3) **Keynesian interventions** – new money printing and spending tax dollars to bail out markets and banks destroy the middle class.
7. **The money system is top-heavy, centrally managed.** A centralized network architecture is inherently unstable – it carries the risk of a failure that will affect the whole system; creative destruction is not allowed at the micro-scale, which means mistakes add up unnoticed. Capitalism’s current money system has a monetary collapse built-in: the destruction of the money unit, destruction of money as a relationship management tool – evidenced in hyperinflation, complete loss in the value of the currency, collapse of money-intermediated exchange.
8. **The optimum quantity of money is managed via barbaric instruments.** (1) central banks kill the economy across the board to reign in the money supply – akin to a medieval doctor bleeding a patient; (2) in bad times central banks cannot efficiently combat hoarding, i.e. cannot force the commercial banks to go out and lend.
9. **The money system is bank-centric, but fractional reserve banking is inherently unstable.** Banks are the institutional carriers of the money system, but banks are ever-susceptible to rational or irrational fears, “irrational exuberance”, shocks elsewhere in the economic/financial/political systems.
10. **The money units bear no standard of value** – the dollar/pound/yen/etc. do not represent any standard of value – commodity, labor, basket of consumer goods, energy – nothing. An existing money unit is just a number. It doesn’t mean anything, except that it is one more claim on the total real output of wealth of the country issuing it. This makes it (1) easier to manipulate and (2) harder to interpret it in everyday life (no one goes around knowing in their head what the total output of the US economy is, and what the total money supply is, hence what a “dollar” really means).

¹⁹ Michael McLeay, Amar Radia, Ryland Thomas, Bank of England, Quarterly Bulletin, 2014 Q1

11. **The system has no anchor** for its store of value function. Gold used to perform that function with a high degree of efficacy and predictability. With the closing of the gold window by President Nixon in 1971 the link between the (so-called) paper money and gold was severed for good. The world has gone “fiat”, and the store of value function of money now depends on the decisions of central bankers and government officials.
12. **Government is heavily involved in the money system**, restricting democratic freedoms within society, causing depreciation of the monetary unit, enabling wars, currency wars, and trade wars.
13. **Unstable velocity of circulation**. Since profit is the fundamental driver behind new money creation by the banks, there is a pronounced tendency for high velocity (overheating) during boom times, and hoarding (freezing) in bad times. An apt term for such pro-cyclicality would be “manic-depressiveness” of the money/banking system – it makes the good times too good, and the bad too bad.
14. **Interest induces short-term economic behavior**. The NPV calculation for an interest-bearing currency encourages short-term thinking on behalf of economic actors, negatively affecting sustainability for the planet as a whole.
15. **The payment system is exposed to credit risk, maturity transformation risk and other risks**. Some systemically important banks must exist if society is to be able to simply transfer large amounts of money fast around the economy.
16. **The FDIC myth** applies only in case a relatively small bank goes under, in case of cascading bank failure the tiny percentages of all deposits that banks pay into the fund, plus the Fund’s borrowing capacity, are insufficient to cover the losses of all “insured” depositors. Again, the central bank must socialize the losses in a “heads I win, tails you lose” scenario for the banking system vs. society at large.
17. **Maturity transformation against a fractional reserve creates instability**. Borrowing short and investing long, in the commercial banking system or in the shadow banking system is inherently risky, bank runs are always possible, and no one can predict how severe the contagion effect will be.
18. **Money is nationalistic** – money is still mostly country-specific, leading to “monetary nationalism”, currency and trade wars. One of the main reasons for creating the euro was political – the desire to stop centuries-old history of European wars and bloodshed.

“Money is merely a human construct...that was designed in and for another age”

Bernard Lietaer, Jacqui Dunne, “Rethinking Money”

THE CURRENT SYSTEM: SUMMARY

Technological progress during the Primitive Age – the first tools made of wood, stones, bones – allowed higher productivity, specialization, hence division of labor that gave rise to the first exchange processes, aka the “economy” (from Greek – rules of the household). Barter might have been some initial solution only in very simple, limited economies; the costs of barter skyrocket as economies grow in complexity. Around that time the first IOU contracts must have come into existence – most likely as socially implied duties if not explicit oral contracts - but the associated counterparty credit risk there must have been huge – these IOUs were difficult to enforce outside of a close trust network, illiquid, there was no way to find out how many of them the issuer had outstanding. Hence the necessity of some intermediary token of exchange, some liquid good that had value by itself and eliminated the credit risk inherent in the *quid-pro-quo* exchange process – and that’s how money was born – as a tool to manage counterparty credit risk in the exchange process. Millennia ago, the credit signal inherent in every exchange has been suppressed by a credit-surrogate money good exogenous to the exchange. Very early on, the exchange process became indirect.

The self-interest of those entrusted with the safekeeping and management of the money good brought about the invention of *credit* as a medium of exchange, allowing the fixed money supply of gold to expand as needed to meet emerging growth opportunities. Bank credit enabled the great advances of the economy during the Industrial Age – the railroads, the factories, the skyscrapers, but bank credit also came with a fractional-reserve asset base, and as a debt system. Today, just as it has been for millennia, direct clearing of the exchange process is impossible – nowadays economic actors must bring their IOUs to a bank, where these IOUs are evaluated for soundness, then a bank IOU is issued, against interest, as medium of exchange for settlement of debts incurred during the exchange process. Thus, banks intermediate every exchange process out there in the economy, and interest is built into every bank-intermediated transaction. But make no mistake – banks intermediate the exchange process for their own benefit, not for the benefit of the exchange process – just as any profit-maximizing enterprise is expected to.

This fractional-reserve, debt-based, interest-charged, maturity-mismatched, system of money and credit, however, has been empirically proven to be bubble-prone and unstable, and requires an obliging government and a Central Bank – to lend a helping hand in times of crisis. And lend they do – well into the trillions - as acting otherwise may mean a collapse in the very blood system of the economy.

Trillions upon trillions in bailout costs, crushing debt levels across the economy, an economy so laden with debt so as to be unable to withstand even minimal interest rate increases, government debt monetization, unfunded liabilities, depreciating fiat currencies, banking balance sheets exceeding the GDP, lavish banking salaries – these are all symptoms of a system of money/banking that has grown too large within the economy, whose pursuit of self-interest is threatening the very economy it was supposed to lubricate. A similar phenomenon in living systems goes under the name of

CANCER

Luckily, the whole edifice of money and banking rests on one fundamental, crucial, hidden, overlooked assumption that has been taken for granted for millennia – namely, that exchange processes *must* be intermediated via something exogenous that has value independent of the economic exchange process in order to manage the counterparty risk in an exchange – and hence the existence of the banking system as the institutional, systemic manager of the system of money and credit based on exogenous money supply. The purpose of this book is to show how *Information Technology and networks can empower economic actors to issue, structure, evaluate, transfer and redeem the IOUs arising endogenously from the exchanges of goods and services – and manage counterparty credit risk - on a peer-to-peer basis, thus eliminating the very reason d’être for the existence of any exogenous, credit-surrogate money goods, as well as a banking system* (at least the base money and credit creation functions of a banking system), disintermediating from the economic exchange process not only the whole gamut of conventional fiat currencies, but also precious metals, Bitcoin, Ethereum, Litecoin, and any other thing, notion, idea, concoction aimed at intermediation of the exchange process:

INFORMATION ABOUT THE EXCHANGE PROCESS IS THE BEST DISINFECTANT FOR THE PROCESS ITSELF

ENDGAME

“The next crisis will be bigger than the Fed”

Jim Rickards, author/investor

Governments across the globe are overleveraged. Staggering debt/GDP ratios are the new “normal”. Debt level trajectories are clearly on an unsustainable path.

Unfunded liabilities are a ticking time bomb, a harbinger of social unrest and/or inflation to come.

Central banks’ balance sheets are overextended, and cannot be easily reduced given the amount of debt in the economy and the size of the asset-markets bubbles.

Banks have very large derivatives’ books; sit on large positions of overpriced securities; mark-to-assumptions models and stress tests leave room for doubt.

Inequality has reached histrionic levels.

Growth is sluggish across the globe.

China and *Russia* are posing a number of challenges towards a “multipolar world”

The dollar is at a risk of diminished international currency reserve status.

Interconnectedness across the globe transmits economic shocks across countries and continents.

War is rearing its ugly head in too many locations, globally.

Bubbles – in bonds, equities, real estate, currencies – have formed.

The *paper precious metals markets* are likely manipulated, making a correction down the road more likely and more severe.

Financial analysts, gold bugs, commentators, writers, psychics in touch with the Pleiadians, the Bitcoin cult – there is too much (possibly self-fulfilling) talk about a coming collapse, about the system of money and banking.

These are the risks and the symptoms. The root cause - the disease - are the flaws in the ad hoc design of the money system currently in use globally.

The risks are too many, too great; at the same time the safety systems – governments’ and central banks’ balance sheets - are nearly destroyed. We are facing the risk that the next crisis/es may not be crises *within* the system, but crises *of* the monetary system itself – massive money printing will be the only possible solution, possibly resulting in rapid inflation/hyperinflation, destruction of the store of value function of money, refusal of the economic actors to participate in exchange for the legal tender - a systemic crash.

“The money corrupting power of the state is manifested all about us... The nations of the world, in a conspiracy of ignorance, are pouring poison into their own economy and bringing about a universal breakdown of exchange through impaired media, forcing a return to barter, impoverishment and chaos”

E.C. Riegel “The new approach to freedom”

What’s needed in such an environment is, parallel with attempts to stabilize the existing system, to direct efforts, via pilot projects, at the establishment of new, better thought through, more humane, possibly fully-reserved, debt-free, supranational money systems – away from the current debt-based, centralized, nationalistic, fractional, fiat money system. The Internet provides the environment for it. The IT industry, via the Internet, can supply high quality, global, bank-independent and government-free money. The first crypto”currencies” – the Bitcoin, the Litecoin, etc. - have been the initial, albeit rudimentary from a monetary perspective, steps in this direction.

How...can we establish a monetary system that is stable, free from irresponsible tinkering, and incapable of being used as a source of power to threaten economic and political freedom?"

Milton Friedman, "In Search of a Monetary Constitution"

"The monetary problem stands out today as the greatest intellectual challenge to the liberal faith. For generations we have been developing financial practices, financial institutions, and financial structures which are incompatible with the orderly functioning of a system based on economic freedom and political liberty"

Henry C. Simons "Economic Policy for a Free Society"

"The political money system is seen to be the channel of perversion for both the political and economic spheres"

E.C. Riegel, "The New Approach to Freedom"

"Without stable money, the private profit system will some day go. This means that the bankers, as long as they insist on operating their (fractional reserve) 10% system, will be playing with fire. The best available safeguard against the overthrow of capitalism is the 100% system, combined with money management, to give us a stable dollar"

Irving Fisher

"The issuing power should be taken from the banks and restored to the people to whom it properly belongs"

Thomas Jefferson

"Of all the many ways of organizing banking, the worst is the one we have today... Change is, I believe, inevitable. The question is only whether we can think our way through to a better outcome before the next generation is damaged by a future and bigger crisis. This crisis has already left a legacy of debt to the next generation. We must not leave them the legacy of a fragile banking system too."

Mervyn King (Bank of England)

"There should be no monopoly of credit, no central authority with exclusive power to issue money, and no forced circulation of any currency....To truly empower a community, a currency must be issued on the basis of goods and services changing hands, i.e. it should be "spent into circulation" by local business entities and individuals who are able to redeem it later by providing goods and services that are in everyday demand by local consumers"

Thomas Greco, "The end of money and the future of the civilization"

"The main thing we miss today is universal money, a standard of value, the link between the past and the future and the cement linking remote parts of the human race to one another"

Robert Mundell (Nobel Memorial Prize in Economics)

"How can power be dispersed, as it should be to preserve freedom, in control over money?"

Milton Friedman, C. A.E. Goodhart, "Money, Inflation and the Constitutional Position of the Central Bank"

“There is a growing body of opinion that Democracy, in this country at any rate, has not been given a square deal. Its political power has been useless without real economic power..... It is finding itself under vague international compulsions to pursue policies which inflict irreparable damage to its internal economy, continuously to restrict production and employment, to get deeper and deeper into debt, and unable to use its strength or skill for its own life. After over a century’s unparalleled advance in the arts of producing wealth, living is becoming for an ever-increasing proportion more difficult and insecure. Everyone knows that there is something wrong, and that the solution of the problem is not yet within the horizon of party politics.

The alarming increase of unemployment and the continued deep depression of our staple industries is the continuous theme of all parties, but on the money policy as the obvious, and indeed the definitely predicted cause, there is a conspiracy of silence. Parliament endorses and encourages the banker in his belief that the nation’s money is his sole concern to create and destroy as he decides...

The public knows perfectly well that hardly any step in knowledge or advance in thought, however commonplace to-day, has ever been made without those deeming themselves authorities in the matter being hostile and opposed to it when first made. To regard money as made for man rather than man as made for money would, to the money expert to-day, be as great a heresy as it was at one time to believe and teach that the earth went round the sun and not the sun round the earth. But if Galileo and Copernicus had lived to-day, and had upset the theories of the authorities regarding the nature of money rather than of the universe, they would have had far more difficulty of getting their new views impartially discussed than they had from the Medieval Schoolmen and the Courts of the Inquisition.

Freedom of thought and discussion applies, as yet, only to the affairs of the mind and conscience which affect directly no man’s pocket. It does not yet apply to money. That is the Ark of the Covenant, the Holy of Holies of the Slave Civilization. Those in authority know well the danger. It might have consequences to humanity graver and more fundamental than freedom of belief. It might lead to economic freedom, the tap root of all freedom, worth the name.”

Frederick Soddy, “Money vs. Man” (1933)

A sad & lyrical note to Satoshi Nakamoto

It will always start with you, brother. The Bitcoin paper, the Fall of 2008 – that’s when you opened up the floodgates of monetary innovation, and, more than anything, captured the hearts and minds of people all over the world. Ours, too. And we still believe that you are tall, dark and very handsome.

You inspired people to explore money like no one had ever done it before. Infatuated, chaotic, unruly, starry-eyed, crypto bros charged forward under Your Flag, and, in Your Name, started churning out coins left and right. An army of revolutionaries! A cult of loyal followers! Any disbelievers – publicly crucified and blocked on Twitter!!

That Cambrian explosion of monetary innovation, however, amazing as it was, was, unfortunately, taking place at what we believe was only a local maximum. It was all taking place within the classical realm, within the realm of “money”, and, just like in physics, in economics, underneath the classical illusion there lies a different realm, a strange realm, a realm with different laws and dynamics – the quantum realm. The realm holding the strongest of all energies.

Crypto-curious, we went to explore the nature of economic reality into its deepest, most granular structure. And you know what we found down there? CREDIT! Underneath it all, at the deepest level, at the most granular structure of economic exchange – lies credit – the simplest, most basic human economic commitment: the berries gatherer, promising the hunter, to be there for him, when the berries season arrives in the summer, in exchange for that bison meat now in the winter time. And vice-versa. Peer-to-peer exchanges, all credit-based, not intermediated through money. A network of credit relationships, all peer-to-peer. Actions done for the good of the fellow Man. A socio-economic Eden. Moneyless. Innocent. Virgin.

*I want you to do something for me, brother: on a clear, starry night, go up there to Griffith Park on Mount Hollywood, alone, and just sit and observe, in silence, LA at night... The millions of tiny flickering lights - and think of all the economic exchanges taking place at that moment – Mary the hairdresser, hailing a cab, releasing a tiny credit signal for that economic interaction - a tiny flicker of light, a Max-Planck-like quantum of economic action; Jimmy, the cab driver, getting a pack of smokes – and releasing that quantum credit signal again...repeated across millions and millions of economic interactions...**The CREDIT NETWORK.** And once you become aware of its breathtaking scope, of the immense creative human energy behind it, the pristine purity and beauty of its abstraction, and the awesome, almost God-like power of its algorithms – the traffic controllers - constantly searching, sorting, optimizing, helping you make perfect sense of the millions of currencies, directing the currents of human action, channeling greed, fear and trust within the most amazing arena ever... that’s when you’ll realize, brother, just as I have: that this is where we fight, we fight here, on this hill. The Credit Network is there, it lives and breathes, only right now it is not allowed to manifest itself, hidden behind the veil of banking. But it’s there – waiting, longing to be revealed, like something out of Schrodinger’s wave equation – an urge, a potentiality, a desire for manifestation, a somewhat likely promise for things to come. Right now, the ugly veil of the classical illusion of money is cast over it, that greasy film of banking sucking the economic life force out of the productive economy for its own benefit, suffocating human creative energy, holding it down, chained, soiled.*

Only now, for the first time in millennia, we have the capacity to go, in our economic and credit interactions, peer-to-peer again if we want to. Millions upon millions of transactions – sure, no problem, bring it on. Millions upon millions of credit issuers – sure, the Amazon cloud is a click away. Money - that wonderful baby stroller for human economic action which did such amazing things for humanity over Man’s first several thousand years of socio-economic development – well, we’ve outgrown it, thank you very much. Mr. Powell, Ms. Lagarde – thank you very much, get your \$20 Timex parting gifts and retire; crypto bros – go back to Mommy’s basement, get a job, get a life, get married, do something useful for a change – your services are no longer required. We all have smartphones now, thank you very much, we can all manage our own economic and monetary affairs on our own. The time of the “Sovereign Individual” has arrived.

I hate to be the one to bring you the sad news, Satoshi, brother. But you are history. You’ll always stay in our hearts, like a first love. But now it’s time to move on. Beyond Bitcoin. Beyond crypto. Time to take that baby stroller called money away from the economy.

Time to build The Credit Network.

MONEY AND CREDIT FOR THE INFORMATION AGE

“I hope it will not be too long before complete freedom to deal in any money one likes will be regarded as the essential mark of a free country”

Friedrich Hayek

THE CREDIT NETWORK

“Look at the businesses around yourself, professor – the copy center, the cafeteria, the food truck, the University itself – they all have balance sheets innocent of monetary debasement...Hey, they never issued any money to begin with! Yet they could – as privately issued credit claims against their future output of goods and services – yes, good old company scrip... On your smartphone, of course.

And you get an ecology of issuers, permaculture design, systemic resilience, creative destruction, many small fires but not a single large one, choice in currency, competition in currency, the Invisible Hand and all that.

It all starts with a simple bookkeeping entry:

<i>Privately issued cash</i>	<i>.....XXX</i>
<i>Unearned revenues</i>	<i>.....XXX</i>

Easy-peasy.”

an excerpt from a letter to a monetary economics professor

QUANTUM MONEY MECHANICS

Quantum Money Mechanics is the money mechanics of the very small - of the local company store, of the gas station down the road, the coffee shop next door, etc. A web-based, potentially global money layer – ideally, a public utility; a multicurrency credit ledger in which we can safely issue our own standardized company-credit currencies, peer-to-peer, no longer needing central and commercial banks to intermediate credit creation; a digitally engineered ecosystem of a multitude of tiny, competing, privately issued, company-credit currencies.

It is the money mechanics of a social contract coded into the money layer, hedging a variety of downside risks for its users – hunger, poverty, unemployment, ill health, etc. - while assuring unlimited upside potential for entrepreneurs, ensuring equality in opportunity but not in outcome for its users.

It is a system which empowers entrepreneurs and communities with their own credit-creation capabilities, and gives them the benefit of seigniorage - once the exclusive privilege of kings, emperors and princes.

It is a peer-to-peer, decentralized system for private credit creation, where users in the real economy swap baskets of assets peer-to-peer, while the system measures the creation, transfer and settlement of the credit relationships between the users, turning these relationships into digital, transferrable, bearer, money tokens.

It's the collective memory of the community, digitized and decentralized, up in the cloud, accessible to us all via our mobile devices.

It's a system designed to release the credit of the local company store to be used as money in the economy.

Basic Philosophy of the Quantum Money System

Interconnectedness on the Internet allows IOUs issued by economic actors to be evaluated and enforced on a peer-to-peer, decentralized basis, via the power of collective intelligence and ambient accountability - as opposed to the current bank-centric model in a bank lending process - rendering the banking system largely redundant, at least in its debt-based, fractional-reserve credit-creation aspects. Moreover, the correct mapping of certain real-world processes on the Internet – health care, education, social security - allows efficient collectivization of individual needs via selected money printing, as opposed to the current cumbersome, inefficient, expensive, centralized, Industrial Age, Bismarck-ian model of government-sponsored, tax-funded social safety net.

Name of the Currency Unit

Bartercoin (bc). Interestingly, users invariably confuse the peer-to-peer exchange process (and its flipside – endogenous decentralized private credit creation) with “barter”. Hence the use of barter terminology and optics.

Alternatively, the currency unit could be referred to as a “private credit dollar” – a name which better reflects the true nature of the currency, yet such a name felt alienating/too academic to most users during early beta-tests.

Standard of value

1 bc = value of an hour of unqualified human labor of average intensity. It **measures human effort** or productivity over time.

Various standards of value are possible for a money unit: consumption standards (a basket of goods/services), a commodity standard (a single commodity or a basket of commodities), an energy standard (a unit of energy), a unit of some type of labor. The standard of value should measure a valuable resource, so as to encourage its wise use; it should be (intuitively) easy to understand and to interpret prices quoted in that unit; and it should be abstract enough so as to remain unchanging through time as a value measuring rod – independent from human (policy) decisions, technological improvements, new ore deposits discoveries, and any other developments *within* the economic arena. It should be *meta*.

In this line of thinking, the current fiat metrics are meaningless – they are just a bunch of volatile cross rates, largely dependent on the ~~whims~~ decisions of a bunch of apparatchiks in some lofty, sumptuous palace. The exalted “Ph.D. standard” is one very unreliable, unimpressive – and constantly failing at 2% p.a. – “standard”.

A basket of goods/services suffers from volatility related to technological improvements. It is a good measure of inflation, yes, but it lacks the *meta*, the independence from the hustle and bustle of the economic arena to serve as a neutral measuring rod for value on the economic arena.

Commodity standards suffer from the same flaw. Gold was a good – excellent – money-chaperone with its great chemical properties and historically stable, predictable growth rate of about 2% p.a. - perfect for the Agricultural Age economies. But it is still way too embroiled with the economic arena to be a neutral measuring rod for value on the arena: new gold deposits discoveries, new mining technologies, potential new demand from industry.... they all influence the “intrinsic” value of “precious” metals... imagine one of those gigantic asteroids full of metals and rare elements crashes on the Earth and covers the whole planet with 10 feet of fine gold dust. How “precious” and “intrinsically valuable” will be gold then? Gold used to be a great money-chaperone from bygone Ages, yes, but it still lacks sufficient *meta*.

And so we arrive at *energy* as a potential standard of value. Energy – human and machine-generated. The Kilowatt-Hour and the Labor-Hour. So absolutely fundamental to value creation. The Kilowatt-Hour, at first glance, might seem as the more respectable, objective and “scientific” one – but it is a measuring rod which still fluctuates with technological improvements. Ultimately, underneath all value – is the Labor Hour. The human ingenuity, inventiveness, imagination, effort – the most fundamental economic driver of all. The Labor Hour provides the direction, intelligence, creativity – the Kilowatt Hour provides the brute force and the raw power. They both move the economy forward, with the Labor Hour firmly in the driver’s seat. The ultimate measure of economic progress is how many Kilowatt Hours we pack into a single Labor Hour – via steam engine and search engine technologies: that field of corn, a mere 300 years ago requiring hundreds of people to work on, soon-to-be taken care of by a single remote operator controlling a few powerful autonomous tractors via IT.

But the *basic* Labor Hour – the hour of unqualified human effort of average intensity - is still out there – and will continue to exist for the foreseeable future. Sweeping the city streets, reforestation, basic maintenance of just about anything not very high-tech, the housekeeping chores, etc. etc. And, interestingly, it is *meta* enough - it exists as a notion in our minds. We all know what it means – one hour of cleaning the fallen leaves, one hour of housekeeping chores, one hour of cutting the grass.

The labor hour serves as a practical, discrete quantum of economic action on the network – an economic analogue of Planck’s constant in physics. The labor hour gives quantization, or “chunkiness”, to economic value. Just like in physics, where action has a dimension of *energy x time*, on the credit network, economic action has dimension of *productive energy x time*. Labor hours function like photons – discrete packets carrying productive economic energy. The intensity – the productivity - can vary (like the frequency in $E = hv$)²⁰ but the base quantum is the hour of unqualified effort of average intensity. The labor hour metric does not imply that all human labor is of the same value – absolutely not. It only gives **the base rate**. For higher pay – either put in more brains, or more brawn (higher-frequency, more intense human productive energy).

To summarize: a unit of unqualified labor of average intensity is a good choice as a value measuring rod because:

- (1) money has been, from Day One, a construct within division of labor economies designed to store, value and exchange labor; human labor is invested, in one way or another, in virtually every good and service we consume;
- (2) in a deeper sense, the labor hour measures *the* most important asset of them all – the time we are given on this Earth;

- (3) prices quoted in such a unit are very easy to interpret in any part of the world;

- (4) it gives a natural floor to wages, and with the Employer of Last Resort functionality (explained later on pg.47), it eliminates much of the need of wage controls and regulation;

- (5) it provides equalization of incomes worldwide at the low-income level (the value of a man’s output sweeping the streets of Nairobi with a broom is the same as the value of a man sweeping the streets of Manhattan);

- (6) it drives home a very important point – that the only way to increase real wealth is to make sure that,
 - (6.1) through technological advancement, those brooms get smarter and replace unqualified human labor, and,
 - (6.2) through education, the human behind the broom is elevated into a more productive capacity and hence a higher income bracket.

²⁰ The Planck-Einstein relation, linking energy and frequency of a photon

Money Taxonomy

Private (Commercial) Money (*private credit instruments, privately issued cash, private IOUs*). Companies issue private monies on their own initiative, as claims against their future productive output, as this output is evidenced by their quarterly revenues through the system. Commercial money is credit – promise of the issuer to redeem its IOU in the goods and services they provide. Commercial credit carries default risk – the issuer may not be able to redeem it for a variety of reasons. Private money can be rejected as a means of payment – i.e. it does not have “legal tender” status, choice in currency is allowed. Only the issuer of private money is obliged to accept its own money and redeem it at par.

Public Money (*publicly/collectively issued credit instrument, public IOU – or rather WOU “We Owe You”*). In addition to the privately issued credit instrument (aka “private IOU”), the set of credit instruments defined on the network includes a public credit instrument, issued on behalf of the network as a whole, where the network members have agreed that certain individual needs, in certain cases, are better socialized than left unmet – and this could be hunger, unemployment, health care, etc. When a collectivization of an individual need is agreed upon and required, this is when the public IOU, or rather WOU, credit instrument is issued to finance the socialization of that individual need. The WOU instrument maps credit relationships (commitments) existing from society as a whole to individuals in need. This instrument is specifically designed to allow efficient socialization of individual needs via the selected printing of this instrument by the network’s algorithms - as opposed to the Bismarck-era social safety net executed via taxation and government social programs. The WOU instrument attempts to solve societal challenges such as hunger, unemployment, social security and health care with only a minimum participation from the state. The WOU instrument does not carry default risk and is universally accepted, i.e. it has “legal tender” (money proper) status.

Systemic deflationary forces

1. Technological progress in the real economy;
2. There is no credit creation for unproductive purposes, in contrast to the present commercial banking model;
3. The way credit is issued on the credit network by companies – as claims against expected revenues (explained on pg.40-44) - creates a strong incentive for companies to lower prices, hence sell more and issue more money on that basis, i.e. businesses get rich by producing the money themselves - hence the need to constantly undercut prices and sell, sell, sell.

Overall, the system, at its core, is inherently deflationary.

Systemic inflationary forces

Adding socially oriented algorithms to the system, however – Employer of Last Resort and Provider of Last Resort – (selective printing of new money for social purposes, explained in part “Living in wonderland” on pg.47) while incredibly more efficient and effective as compared to the Industrial Age, Bismarck-ian social safety net currently in use, can be, nevertheless, inflationary, if done in amounts exceeding the productivity gains of the economy and the efficiency gains of the vastly more efficient, software-based, social safety net:

1. Money printing for pensions via the Provider of Last Resort Algorithm: with a functioning Digital Identity Layer, *literally a few lines of code can replace the whole Social Security apparatus* – taxation, administration, means-testing, eligibility - the whole lot of government inefficiency, waste, fraud and abuse.
2. Similarly, money printing for health care and elimination of hunger via the Provider of Last Resort Algorithms: again, code can replace the Food Stamps and Health Care programs – both in terms of taxation and administration of the currently existing programs, while providing a robust safety net for economic actors. Again – staggering, absolutely staggering(!) - efficiency gains, and elimination of government bureaucracies, fraud, waste and abuse.
3. Similarly, money printing for full economic inclusion via the Employer of Last Resort Algorithm (explained on pg.47): relatively simple code can replace the totality of the Unemployment Insurance program, while providing a Universal Basic Employment – work, that is, not handouts - for all economic actors.

Thus, the more socially-oriented the system is designed to be (the more public WOUs printed), the higher the inflationary pressures will be.

THE COCA COLA PRIVATE CREDIT DOLLAR VS. THE FED FIAT DOLLAR: CAN'T BEAT THE REAL THING

Currently, an entrepreneur in need of working capital financing cannot issue her IOUs directly to vendors, employees, etc. – an entrepreneur must go through the banking system, where her IOUs are (1) evaluated for soundness, then (2) the entrepreneur provides a guarantee to the bank in the form of a mortgage maybe, (3) the entrepreneur's IOU is provided to the bank as a loan contract, which becomes an asset of the bank, and then (4) the bank issues its IOUs to the entrepreneur – as a bank deposit convertible into Federal Reserve notes. These bank IOUs can then be presented by the entrepreneur to vendors, staff, etc. for payment of goods and services – either as a wire transfer to the vendor's bank (inside money, i.e. without explicit conversion into Federal Reserve notes), or as cash – after a conversion of the deposit into Federal Reserve notes.

Within the credit network, however, the evaluation of the entrepreneur's IOU is done on a peer-to-peer basis, and the banking intermediation is eliminated. Entrepreneurs issue their own IOUs, as claims against the entrepreneur's future output, and they constitute most of the money stock in the quantum economy.

As explained earlier, the issuance of company credit instruments is based on the 19th century company scrip experience. This is essentially peer-to-peer working capital financing, without the intermediation of the banking industry. Here it is not for your banker to decide if your business is any good to deliver the goods/services – it is the person accepting (or rejecting) your money making that call. It is the power of your business (or your personal) brand. And it may be worldwide (Coca Cola), or it may industry-wide (Kleiner Perkins Caulfield Byers in the US venture capital community), or it may be in your neighborhood only (Papa Joey from Papa Joey's Pizza, whose word has been his bond ever since he moved to San Francisco from Sicily 47 years ago). The premise here is simple: a currency can only be backed by the productive output of its issuer – hot pizzas if issuer is Papa Joey's Pizza, haircuts if issuer is Carlo's Hairstyling. It *looks* as if the mighty US dollar is backed “by the full credit of the US government” – it is not. The Federal Reserve dollar is only a content aggregator, of sorts - it's those pizzas and haircuts that back the dollar, collectively. An issuer can issue claims only on its own output of goods and services, whatever they might be – and if her word is her bond, she must redeem the claims she has issued – if and when they are presented to her for redemption by the bearer of the claims - at par.

A crucial bane in the history of banking in the 19th century, and for the Hayekian currency discovery process in general, has been the cost of the discovery process – actors in the economy had to invest time and effort to find out if the currency of the issuer was any good. With a variety of issuers, this becomes too great of a burden, and makes the whole process impractical. That's why free banking²¹ in the US during the 19th century was such a hassle – for a large country such as the US, and given the lack of reliable communication channels back then, there was no way to find out if a bank note from an unknown bank was any good. There were fly-by-night operators, the so called “wildcat banks” who would come on the scene, issue a lot of notes and then disappear without a trace, or there were fake notes, or simply notes from banks too far away to know them well. There were businesses maintaining lists of banks with samples of their notes, providing guidance as to which issuers are reputable and which are not. But these quality control systems were too slow, too inefficient, too cumbersome; hence the need for standardization of reserve requirements, and note standards, and hence the Central Bank as regulator/protector of the standards, a central storehouse for reserves and a marketplace for liquid reserves, and a lender of last resort. In contrast to the US, in smaller markets – Scotland, Canada – with correspondingly lower note redemption costs and currency discovery costs, free banking worked surprisingly well²², in line with Hayek's academic argument. Obviously, without reliable information for decision-making and proper feedback mechanisms, “competition” disintegrates into “free for all”, chance and chaos, and the damage caused by the “free for all” can outweigh the advantages of the competitive, free entrepreneurial environment. With advanced IT, however, the currency discovery costs can be brought down to the cost of computer processing time, and with the right metrics and feedback loops, the spirit of freedom and competition can be safely released to do its magic. The next pages demonstrate how the Hayekian currency discovery process can be implemented in practice within an IT environment to build a peer-to-peer, decentralized, collectively intelligent monetary space (“credit network”):

²¹Organization of the banking industry without a Central Bank

²² For a rigorous treatment of free banking, refer to the works of George Selgin, Lawrence White, and Kevin Dowd.

Good for the money: store of value defenses within an ecology of private credit currencies

Let's assume Papa Joey's Pizza can issue its own Papa Joey's Pizza private credit dollars, which dollars can be used on the network as money. An obvious temptation for Papa Joey would be to over-issue his Papa Joey's Pizza private dollars – to issue more promises for future pizzas and sandwiches than he can possibly deliver. He gets the reward now by spending the private dollars into the economy (the so called “seigniorage”), yet he has to put in the redemption effort later, so – why not print some more private dollars now and worry about it later. In this case, his private credit dollars will become somewhat less reliable – there are more promises made (private dollars outstanding) than there will be pizzas and sandwiches. If he over-issues, there is a strong doubt as to whether he will be able to redeem all the private dollars at face value – there will simply be not enough sandwiches to go around, and either some of his currency holders will go empty-handed, or every currency holder will get half a pizza or something. So, how can we guarantee that Papa Joey doesn't over-issue – doesn't engage in fractional-reserve type of private credit creation, pizzas being his reserve asset? Simple. Let's agree what is a reasonable measure of his ability to deliver the goods – how about his last month's revenues from operations? Or maybe quarterly revenues? Semi-annual? Let's say he's good for three months' worth of pizzas and sandwiches - which means that if he issues 3 months' worth of operating revenues as Papa Joey's Pizza private credit dollars, he's good, 100% good. Anything issued over and above that – and his whole note issue goes down in its reserve (i.e. pizzas & sandwiches) coverage - aka goes down in its “*backing*”.

That's where IT comes in. The system continuously monitors Papa Joey's revenues vs. his outstanding currency, and publishes a simple, easy to understand metric - % *backing*. At 100% (or more) Papa Joey's dollars are as good as gold – he can be safely assumed to be able to deliver his pizzas when presented with his currency. At less than 100% backing - well, it is not so sure if all those who hold a Papa Joey's dollar will get a full pizza...

Thus, each private credit dollar bears the mark of respectability – % backing. Backing of 100% means that the issuer has exactly 3 months' worth of revenues as outstanding private dollars; backing below 100% means the issuer either has been too adept with his privately owned, commercial money printing press, or his revenues went down since he last issued private dollars. A private credit dollar with higher than 100% backing means the issuer has a very tight monetary policy, and can issue more of his money (and claim goods and services from the economy) – and will still be able to redeem everything at par.

Choice in currency: professor Hayek on Tinder

Free choice in currency has been demonstrated to reverse Gresham's Law (the so called “Gresham's Law” is the notion that bad money drives out good from circulation, as people hoard the good money and spend the bad – in the past coinage would often get debased in various ways so as to diminish the content of the precious metal used as money). Free to choose the best currency for them, and well-armed with adequate information for correct decision-making, rational economic actors naturally refuse bad money (and bad money remains hoarded with their issuers, and hence completely useless as media of exchange) and accept the good money. The practical operation of this process is well documented in the book “Good Money” by George Selgin about the experience of Great Britain in the 18th century with private coinage. Back then, however, the medium of exchange *had* to have a *material* carrier, economic actors *had* to *physically come together* for a decision-making meeting, in which to *vote by hand* in favor of the best issuer's coins (the Anglesey Company in that particular example). Fast forward two centuries, and we have at our disposal easy-to-generate data structures (as opposed to having to mine/process/melt/mold ores), iPhones, Facebook, Wikipedia, Zoom - tools that could have made the Anglesey Company's job so much easier in terms of what to use as medium of exchange, how to circulate it, how to have it evaluated, rated, ranked, accepted, redeemed... IT, and the Quantum Money System in particular, does not change the essence of sound money – it only makes everything about it ***so much easier***.

In this Hayekian line of thinking, a private credit dollar is a valid means of payment everywhere within the credit network - but the issuer is the only one *obliged* to accept it for payment - at any time, at face value. Choice in currency is allowed, and is easily executed via wallet filters, allowing wallets to “block” certain issuers, or alternatively, to “like” and “endorse” other issuers – and the system's payment algorithms honor that choice.

It's very simple, really. Kinda like Twitter. Or YouTube. Or even Tinder. Only for wallets and private currencies.

Ties that bind: infusing credit networks with homophily and peer-to-peer controls via Dunbar-number sets

The big catch of the proposed IT-based monetary architecture is that via the issuer's social graph, the issuer's private dollars are re-localized into the wallets of those closest to him – friends, family, customers, suppliers, etc., in a sort of “Monetary Facebook”, turning the large (potentially global) economic community into many small, local ones (similar to the small, closely-knit, trust-based, peer-to-peer gift-exchange, pre-historic tribes, if you will) – a Robin Dunbar-inspired **monetary morphogenesis** – so that irresponsible behavior of the person behind the private printing press hurts – immediately, directly, the first and the most - the closest people to him, the very people who trusted him with *his* money. Peer pressure has been demonstrated, again and again, to be one of the greatest motivators for human action, much greater than the orders of a boss or any authority figure: everyone who has accepted a businessperson's currency – these will most likely be the closest business partners, the employees, friends, family, neighbors – are designed within the quantum money system to become the guardian angels of the integrity of the monetary system. Using interconnectedness and IT, the credit network screams bloody murder each time a businessperson abuses her privilege with her privately owned printing press, by reducing the % backing of her currency. In the fiat monetary system, this would be the equivalent to have the dollar bills in our pockets shrinking with each successive round of QE by the Fed...*wouldn't that be a sight!* And not only the quantum money system shrinks the value of that businessperson's money, but chances are this rather unpleasant process will take place while the businessperson's money is in possession of those closest to her – business partners, employees, friends, family, neighbors – people best positioned to either help her raise revenues to re-establish full backing on the system, or, alternatively, inflict on her a “death by a thousand cuts” – provide negative feedback in a multitude of ways because that businessperson's overprinting made *them* poorer, thus exerting peer pressure on the issuer to tighten her monetary policy.

What we've just described is the concept of *emergence* – higher-level spontaneous order (sound money), arising out of individual actions based on local information only; the dynamic of the Invisible Hand working to weave individual rationality into a collectively superior outcome.

There is another topologically important point here - namely, that any centrally-planned network architecture – whoever the people on top may be - has the collapse of the whole system built into the architecture. So that when the alarm bell finally sounds for centralized systems – it sounds for the system as a whole, and boy is it ugly!

One of the reasons socialism failed, was that no one ever went bankrupt. In practice, there was no such thing as bankruptcy. And inefficiencies and malformations added up, and up, and up – until there was no bread in the stores and no electricity in homes. No one sounded an alarm when capital was misallocated, wasted, abused. “The government” was always there to patch things up. Workers stealing like crazy, working little if at all – no problem, there were more subsidies from the government. A factory built in the wrong place, selling the wrong products, at the wrong price – no problem, no problem at all...until eventually so many faulty economic designs added up that nothing could save socialism from itself. Too bad capitalism's current monetary design is way too socialistic, way too top-heavy, way too centralized. It went down on the watch of financiers like Alan Greenspan, John Mack, Ben Bernanke and Jamie Dimon – it will go down on *anybody's* watch. It's the recipe – not the cooks.

The quantum money system, in contrast, is designed to recognize losers, abusers and freeloaders early, while they are still small and not systemically threatening – and then proceeds to kill them quickly, protecting the overall health of the commons. The quantum money system does give monetary freedom, yes – lots of it - but it is freedom coupled with tough justice via a very strong negative feedback mechanism ingrained at the very micro level of the network's architecture.

And then, at the macro level, the Consumer Price Index is calculated in real time, and a negative feedback loop with the Demurrage²³ Bot protects the price stability of the economy at the macro level.

As to central banks' fiat money manipulations and gold - as tools for managing the optimum quantity of money, the velocity of money, the value of money – the time may be coming for such tools to take their rightful place in the museums of monetary history, along with the distinguished-looking pictures of central money planners such as our esteemed ~~Politburo~~ Central Bank presidents and FOMC members.

²³ A charge on the currency, pioneered by Silvio Gesell in the Austrian Worgl monetary experiment during 1932-1933.

Storms in teacups: quantum currency wars (example – Pizza Wars vs. World Wars)

It was a typical Friday afternoon...Walking around in his restaurant's kitchen, Papa Joey opened up one of the many cheese boxes stacked in the fridge and frowned. The cheese was not going to last much longer. On Tuesday he got a great offer from the cheese company, but acted maybe a little too impulsively – he overbought, it turned out, business during the week was slow, it was already Friday, and he knew he had only a day to sell the cheese...Taking out a pen and a napkin, Papa Joey ran a few numbers. He then punched a few buttons into his mobile device – printing some extra of his dollars - and the Papa Joey Pizza dollars, formerly fully backed, were now quoted on the system at 87%.

“Ready for action, boys” he yelled at his staff. “We are going to get busy tonight”

At the same time, Don Joerr – a venture capitalist from the Valley - was scanning the San Francisco area on his mobile device planning the usual Friday evening out for his beer drinking buddies. Suddenly, his eyes lit up “There!” he thought, looking at the discount on Papa Joey's dollars. He spread the word immediately, and soon enough two minivans with guys looking for a great pizza and some great time on Friday evening pulled over in front of Papa Joey's Pizza.

“You see, Papa Joey is not a very sophisticated fella, money-wise” Don was explaining to his beer drinking buddies at the table. “I almost feel bad taking advantage of the old man. I mean, such great pizzas at such a low price...” The table cheered “Cheers! Cheers!”, obviously drowning any feelings of remorse with large quantities of beer. Strangely, Papa Joey was telling a different story to his chef: “These VC guys! They think they are so smart, you know. They probably think I'm stupid or something. But they forget we Italians invented banking! Ha! I've priced the cheese at cost, but I make so much on the beer! These VC guys – so funny you know” Papa Joey was all smiles, too.

Everyone had great time. Papa Joey was happy, having sold all the cheese at cost but having made so much on the beer, Don&Company enjoyed great pizzas at a good discount, and everyone was happy and smiling.

One man, however, wasn't smiling – the owner of the Domino's Pizza franchise across the street. He saw the cheese company truck last week pulling at Papa Joey's, and all the cheese boxes Papa Joey unloaded into his restaurant. He thought then that the old man had lost it – yes, the cheese company was offering a great discount at the time, but there was no way you could sell that much pizza! Now, looking at his half-empty restaurant, and at all the fun going on at Papa Joey's, he knew all too well what was happening....Clenching his teeth, he made a few quick strokes on his personal device, and there – his own dollars were down in backing to 82%. “You won't be laughing tomorrow, old man” thought the Domino's Pizza owner.

Sure enough, next evening, Domino's was full, while Papa Joey was licking his wounds in a half-empty restaurant. Not one to be easily bulldozed, he replied in kind – another round of devaluation. Down to 75%!

Soon, the two restaurants were in a genuine currency war. They were working like crazy, yes – and losing their shirts. Customers were flocking in, redeeming cheap inflated private dollars for their nominal (face) value at the restaurants, but the restaurants themselves had to buy supplies for the real (deflated) value. The two businessmen were bleeding each other into extinction.....After a while, the situation had become unbearable. The two businessmen met at the Local Trade Organization, trying to sort things out – no luck. As negotiations failed, in their anger, they placed boxes of tomatoes in front of their restaurants and started throwing tomatoes at each other. Soon, the whole street was overflowing with red tomato juice....

The End

Now – change Papa Joey Pizza for the US, the Domino's Pizza Franchise for China; the Papa Joey Pizza private dollar for the US dollar, the Domino's Pizza private dollar for the yuan; change the Local Trade Organization for the World Trade Organization; change tomatoes for nukes; and before you change the red tomato juice overflowing the city streets with you know what – you have all the reasons you need for transferring currency conflicts into the quantum realm, into the hands of people who have tomatoes but not nukes...

Loans for productive purposes: Schrodinger's non-payment loan-repayment algorithm

The Quantum Bank is the sole bank of issue for the Quantum Money System. It issues debt-based money. It's a public bank, but "bank" is a misnomer. It's more of a public agency, with a primary goal of assessing viability and credit risk of projects and ventures creating new wealth – new assets, more goods and services for the economy. It **extends long term loans for productive purposes to credit-worthy businesses against good collateral**, and collects the proceeds of the loan on behalf of society, acting as a trustee on the loan. The Quantum Bank does not provide customer accounts of any kind, does not accept deposits and does not provide any wealth management services, nor any payment services. It does not maintain "reserves". It cannot experience a liquidity crisis – it has no liabilities whatsoever. It is always ready, willing and able to issue new loans to finance business. Its operation is completely independent from the financial system.

Having approved a loan, the Quantum Bank provides the approved businesses with money accumulated on its books from past successful loans, and/or with newly generated public money (in case the accumulated private dollars from past loan repayments are insufficient – thus the Quantum Bank has unlimited liquidity). There is a debt repayment schedule for the borrower, of course, just as it is currently with commercial bank loans – but there is a **big difference at the repayment stage** between the currently existing commercial banking model and the Quantum Bank's model: currently, as long-term commercial bank loans come due, they are repaid by businesses with money extracted from the economy. In contrast, in the quantum economy, as long-term debts come due, they simply become automatically generated active commercial private credit dollars of the borrower, **on the Quantum Bank's books** – claims owned by society (via the Quantum Bank) against the debtor, *for the debtor's goods and services*. Thus, at each loan payment date, new private dollars spring into existence on the Quantum Bank's books as claims of society against the debtor's output. The newly activated private dollars may have % backing below, at, or higher than 100%, depending on the revenues of the debtor at that moment. The Quantum Bank could then at loan repayment dates make one of two things:

- a) keep the maturing commercial private dollars on its books, where they will be available for public works and/or for extension of new loans for productive purposes – if the maturing coins are 100%-backed;
- b) repossess the collateral of the debtor, and sell it on behalf of society - if the maturing dollars have insufficient backing (meaning the borrower has failed to increase its revenues with the loan proceeds).

What is important, therefore, is that the debtor use the loan proceeds to develop sufficient capacity to generate new goods and services, and to grow sufficient revenues so as to be able to maintain 100% backing for all his private currency – that issued by him/her previously as working capital, as well as that springing into existence, maturing from the long-term loan repayment schedule on the Quantum Bank's books.

*Here is the crucial point, and **the key advantage which no money system based on exogenous money can provide**: since private credit dollars are issued by businesses as claims against their revenues, the more the sales of an issuer grow, the more good, 100%-backed private credit dollars a company can issue. Thus, if a loan for productive purposes by the Quantum Bank meets its revenue targets and does grow the borrower's business, then the borrower will be able to repay the loan simply by printing the money – by pressing the ENTER button on his private digital money printing press - and not by extracting the money from the economy as is presently the case with commercial bank loans. Moreover, the system is designed to automatically generate the maturing loan repayment amounts of the borrower's private credit dollars - at repayment dates, **on the Quantum Bank's books** - thus relieving entrepreneurs of everything but the need to grow their sales (so as to provide full backing for the loan repayment sums of the borrower's private dollars maturing automatically on the Quantum Bank's books).*

Imagine you go to a bank, get a loan for productive purposes, and then you ask the bank: "Now how much do I have to pay back each month?" And the bank says: "**NOTHING! You repay ABSOLUTELY NOTHING!** No interest, no principal. NOTHING! But do go out there and sell, sell, sell!". Such is the weird nature of Quantum Bank's loans. The loans for productive purposes do exist, yes, but.... nah, not *really* - they do not have to be repaid (only the borrowers' revenues must be increased in order to give backing to the borrower's private money springing into existence on the Quantum Bank's books at repayment dates).

Schrodinger loans.

THE ACHILLES HEEL OF CREDIT NETWORKS – COUNTERFEIT OR ERRONEOUS SALES DATA

Credit networks based on endogenous decentralized private credit creation do have a very high bar for their deployment – they need squeaky-clean, pristine, genuine, uncorrupted, issuers’ sales data:

Garbage-in Garbage-out

The endogenous private credit model is essentially an expected-revenue-monetization model. Expected revenues are calculated by the Credit Extension Algorithm via some statistical time series predictive model, on the basis of past revenues of the issuer as these revenues are recorded on the system. Obviously, if the recorded revenues are fake or incorrect to begin with, the expected revenues (i.e. the expected redemption capacity of the issuer) as predicted by the Credit Extension Algorithm will also be fake/incorrect. The money issued on the basis of that fake redemption capacity will also be fake.

A credit network can do wonderful things for its members, but it feeds on clean sales data. CLEAN.SALES.DATA! Feed it soiled, corrupted sales data – and it starts spewing out nonsense.

Auditors bite the coins now

Back in the Middle Ages, the goldsmiths - the money changers - would set up booths at the local markets where they would inspect coins. They would visually inspect the coins, weigh the coins, bite the coins.²⁴

Fake money, formerly made of fake metal/paper, are now produced on the credit network via fake revenues. On the credit network, the auditors take on the exact same function of currency quality control as the medieval goldsmiths, only they carry it out for a different type of money, and in a different kind of way.

The ABCD of credit network defense: Audits. Bots. Courts. Decapitations.

A credit network operator can attempt to keep fake money out of the system by micromanaging the network with the help of bots and some bookkeeping staff. This approach can work while the network is still small – small both in terms of number of issuing members and in terms of the proportion of the members’ business transactions the network processes.

But the big leagues are a whole new ballgame. They need strict rules and professional umpires. Beyond a certain network size, and above a certain network load (percentage of its members’ business transactions handled), structured, legally enforceable quality control over currency issuance becomes a must - the stakes become simply too high. What we have here is very much a “You can’t pour new wine in old wineskins” type of a situation. New social processes and behaviors require new regulatory frameworks.

A Law on Private Credit Currencies would serve, at the very least, to:

- Require every issuing member of a credit network to have an auditor
- Mandate monthly revenue audits of issuing members of credit networks
- Regulate the auditing process
- Penalize fraudulent or negligent behavior by issuing companies when recording sales data on the network
- Penalize fraudulent or negligent behavior by auditors

Only the combination of well-designed fraud-detection bots, persistent, regulated, quality audits, and the threat of legal prosecution of negligent or fraudulent revenue recognition practices can provide the level of data cleanliness required for a large credit network to work properly.

The Chinese, when they pioneered their *jiaozi* paper notes, had the following heart-warming, user-friendly hazard warning inscribed on the notes:

“THE FORGER WILL BE BEHEADED”

The Chinese knew.

²⁴ An interesting survey of this wide-spread cliché is in Manas, Arnaud “Why do pirates bite gold coins they are given”

EXCHANGE PROCESSES REVISITED: A KODAK MOMENT FOR BANKING

By now, the advantages of the peer-to-peer, endogenous-credit-based exchange process, enabled by and executed within a fully digital credit network environment, over the exogenous-money-intermediated exchange processes, are becoming clear:

1. Businesses issue their own working capital, no need to borrow it;
2. Loans for productive purposes to businesses do not have to be repaid – only revenues must be increased;
3. Extension of debt-based productive credit is independent of financial, monetary, liquidity, etc. shocks;
4. The payment system is immune from financial, monetary, liquidity, etc. shocks;
5. Indebtedness in society is decreased across the board;
6. Positive and negative externalities can be priced into the money system;
7. Fractionally-reserved credit claims, maturity transformations, pro-cyclicality, new money issuance for unproductive speculation and consumption - are eliminated from the monetary system, and with them the instability and fragility they induce;
8. The large societal costs of operating and bailing out a system of banking are replaced by the cost to run a distributed IT platform;

Moreover, these advantages do not include the opportunity to incorporate socially-oriented features into the money system – features specifically designed to address pressing social ills (to be discussed in the next chapter).

These are some of the reasons (on the bright side of things) for us to make the claim that the days of banking – the centralized, intermediated production of exchange media out of credit – are numbered. Given the extremely broad, deep, and pervasive lock-in of the current system of money, it is hard to predict how long this process may take – short of a major shock to the system – many decades, probably. But just as barter and gift exchanges replaced self-sufficiency, just as precious metals replaced barter and gift exchange, and banking replaced precious metals, so will banking be replaced by smarter, more efficient, vastly more powerful IT-based systems of exchange.

Banking has been such a great invention back in its days! Banking, and its main product – structured bank-credit money – did miracles for humanity. *Miracles!* Fractionally-reserved bank credit released human ingenuity, vision, drive, ambition, willingness to work hard - from the arbitrary availability of some weird physical substance (be it shiny metals, big stones with holes in it, salt, exotic parrot feathers, dried fish, whatever). The money engine of the Industrial Age – fractionally-reserved bank credit – has been no less of an invention than the steam engine itself. Designed for growth, and growth only, it assured humanity's relentless - even ruthless, avaricious - progress forward – towards more goods and services, bigger bridges, bigger highways, bigger factories, bigger skyscrapers.

And so here we are, in the early 21st century - and there is enough *stuff* out there already in the developed world – enough empty buildings, enough idle factories, enough empty malls, enough parking lots choking with auto inventories. And some of the main challenges of the 21st century – resource depletion, climate change, technological unemployment, over-indebtedness, hyper-competitiveness, slow growth, inequality – can all be traced, to a large extent, to the ad hoc design of the money system and the way it has been used, and abused. And no amount of Universal Basic Income, of QE, of deficit spending, and no tweaks and gimmicks will solve the systemic problems with our money. Only now the search engine, and the Information Age that it ushered in, enables, and requires, a *different kind* of money engine, a money engine better suited to the dynamics of the Information Age society.

Banking will go

Banking will go – like the horse carriages. Like typewriters. Like film photography. No matter how well, or how lousy, banks are run, no matter how good, or not good, the captains of the banking industry are – banking will go. No matter how much the Blockchain is utilized to streamline banking back-office operations; no matter how many fancy front-end mobile apps banks release – through the Internet and the Blockchain, the very nature of money will change.

“Money is merely a human construct...that was designed in and for another age”
Lietaer/Dunne “Rethinking Money”

LIVING IN WONDERLAND: PUBLICLY ISSUED NET-OF-DEBT CREDIT ADDRESSING SOCIAL ISSUES

“The tramp is not a self-invented, self-developed, self-made brute; he is an evolution, and society is responsible for his brutalization, and the monetary laws of civilization have had the greater part in that evolution”

“The government supervisors capable of measuring the needs for currency of the various parts of the United States and the extent of the volume best suited to such needs, as well as the methods of getting the currency to them, are angels that have not yet been sent to Earth” **James A.B Dilworth** “Free banking, a natural right”

Public credit creation by social algorithms

Social algorithms issue public credit – the (“We Owe You”) instrument - *net of debt*. To repeat the explanation given earlier in the book in part “Money Taxonomy” for the WOU: a public credit instrument, issued on behalf of the network as a whole, where the network as a whole has agreed that certain individual needs, in certain cases, are better socialized than left unmet – and this could be hunger, unemployment, health care, etc. When a collectivization of an individual need is agreed upon and required, this is when the WOU is issued to finance the socialization of that individual need. The WOU instrument maps credit relationships (commitments) existing from society as a whole to individuals in need. This instrument is specifically designed to allow efficient socialization of individual needs via the selected printing of this instrument by the network’s algorithms - as opposed to the Bismarck-era social safety net executed via taxation and government social programs. The WOU instrument attempts to solve societal challenges such as hunger, unemployment, social security and health care with only a minimum participation from the state. Currently, social programs are financed via government taxation and government borrowing. The disadvantages of this venue are obvious – large inefficient government bureaucracies, unsustainable government debt, ineffective coverage by the programs.

The Credit Network, however, could easily issue new WOU coins for social programs, achieving the goals of these programs while disintermediating the government from active management of these programs, transferring entitlement programs from fiscal to monetary policy. Basic livelihood - goods and services we feel everyone should be entitled to – basic education, basic healthcare, the bare necessities of life, old age security – can be provided for the poorest members of society, by society at large, via selected money printing by the social algorithms of the WOU instrument:

Employer of Last Resort Algorithm

This algorithm allows unlimited demand for human labor at 1bc/hour. If a certain activity is designated as “Employer of Last Resort-eligible”, then those practicing it can be issued new money 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 possible examples are community work and reforestation:

Employer of Last Resort: Community work.

Say we bestow “Employer of Last Resort” functionality to community work – sweeping the streets, painting the public buildings, repairing the public benches, landscaping those public gardens. The community can elect its local “Employer of Last Resort”, who will have the duty to oversee the employment opportunities at 1bc/hour within his/her community. The inspiration for this program is drawn from the military “If it moves – salute it!! If it doesn’t – move it!! If you can’t – *paint it!!!*”. Anyone with military experience will testify how work *never(!)* ends in the military – there is always something to clean, sweep, repair, repaint - an obvious example how human labor can always be applied to improve the environment, assuming absence of budgetary constraints.

With the current broad penetration of video-enabled smartphones, it would be possible to have an ELR center with the government, 24/7, where anyone can call and stream evidence of useful public work done in her community – and get paid on the spot by confirmation of the ELR staff with newly issued money. Theoretically, it would be possible to pull your car by the road, call the ELR center, repair the road fences, paint the traffic signs – say for an hour or so – and earn 1bc.

The same reasoning can be applied for reforestation.

The Employer of Last Resort functionality, if properly implemented, would mean an end to unemployment. Every member of the Information Age economy is entitled to 6 to 8 hours of productive effort at 1 bc/hour. For higher pay - either put in more brawn, or more brains.

The Employer of Last Resort algorithm, along with the store of value defenses, gives value to the bartercoin.

Provider of Last Resort Algorithms

Elimination of hunger (or rather, in the developed world, the fear of hunger)

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, and if not, will then generate the WOU coins (have everyone pay for this poor person's bread and water) and complete the transaction. This algorithm, along with the Employer of Last Resort algorithm, should eliminate any beggars from the city streets.

Other possible socializations of individual needs via the WOU public credit instrument

Priests and yoga instructors, doctors and educators could get paid via the issuance of new money at the point of sale for their own services – by invoking, Aladdin-like, the social contract algorithms (being subject to certain limitations and safety checks of course). This will mean even the poorest members of society are entitled to a sermon/yoga practice, to a basic health care package and basic education. Using a platform based on a well-developed Digital Identity Layer, it would be possible to confer the “Midas touch” (i.e. the capability to invoke “Aladdin” – the appropriate social algorithm – to issue new money on the spot) to any profession as per society's choice – judges, public coaches, artists, etc, if this is what society wishes. The point here is if the provider of a given good/service is bestowed with the “Aladdin touch” – society will be encouraged to use that good/service, as even the poorest members of society will consume it, courtesy of the more affluent members of society. For example: if coiffeurs can get paid via issuance of new money at the point of sale on the basis of need, chances are members of this society will go around with really nice hairdos, as even the poorest ones will be able to afford great hairstyling, courtesy of (the diluted via WOU money printing) society at large. Changing the composition – the source - of the money supply, has significant motivational effect on the members of society and motivates and allows the channeling of society's resources into commonly agreed upon activities. Gold digging in the past, or bitcoin, with its proliferating server farms, in the present, are such examples.

For social algorithms to work, all value accounts must reside within the credit network. The proper and fair operation of the Provider of Last Resort social algorithms is impossible if users can hold significant amounts of exchange media outside of the digital credit network.

“The test of our progress is not whether we add more to the abundance of those who have much; it is whether we provide enough for those who have little”

F.D. Roosevelt

“How many have the talent to become a Steven Spielberg, a Jane Austen, or an Albert Einstein? We know there was at least one of each, and maybe one is all we're allotted. I cannot help but believe, though, that there are many talented people whose aspirations and potential have been thwarted by economics and their lack of tools....The Information highway will open undreamed-of artistic and scientific opportunities to a new generation of geniuses.”

Bill Gates, “The Road Ahead”

The Demurrage Algorithm – a defense against excessively generous credit network designs

“Only money that goes out of date like a newspaper, rots like potatoes, rusts like iron, evaporates like ether, is capable of standing the test as an instrument for the exchange of potatoes, newspapers, iron and ether. For such money is not preferred to goods either by the purchaser or the seller. We then part with our goods for money only because we need the money as a means of exchange, not because we expect an advantage from possession of the money. So we must make money worse as a commodity if we wish to make it better as a medium of exchange.”

Silvio Gesell, “The Natural Economic Order”

The bartercoin may, under certain circumstances, decrease over time – it shrinks in inflationary environments - a concept pioneered by Silvio Gesell a century ago. The general argument goes like this: if real wealth cannot be stored through time without incurring extra costs – real wealth may rot, rust, it needs storage, security, there may be all kinds of shrinkage – then money, representing real wealth, should have similar features.

On the credit network, excessive deployment of socially-oriented algorithms can bring about inflation on the system via WOU money printing in excess of the productivity gains of the productive economy. For example:

- very generous qualification thresholds – very early retirement age, or allowing rich people to qualify for socialization assistance of food, medicine, pensions;
- very generous socialize-able sets of goods and services – rich monthly pension payments, fine dining included as emergency food assistance in elimination of hunger, frivolous cosmetic procedures included in basic health care assistance, etc.

In such inflationary cases, the Demurrage Bot can be deployed through a negative feedback loop with the CPI in order to destroy some of the monetary mass already in circulation.

Benefits of demurrage

The Demurrage Bot penalizes the most those with accumulated large idle money balances (the “idle rich”). In contrast, under the current monetary system, central banks must kill the economy across the board by raising the interest rate in order to reign in the demand for credit – akin to a medieval doctor bleeding a patient. The demurrage bot can allow tailor-made solutions for the optimum quantity and velocity of money.

The fact that currently money does not decrease through time makes financiers absolutely unwilling to lend it unless they receive interest, and interest bears some rather serious consequences, as was previously demonstrated in this book. Whereas with real wealth, an owner of that wealth might be happy to just receive the equivalent real wealth in the future, being relieved of storage costs required for carrying that real wealth forward in time.

Demurrage changes time preferences. The higher your liquid money at any present moment, the bigger your exposure to the Demurrage Bot. In the quantum realm, what you need is not liquid resources, but productive resources – the Demurrage Bot has no effect on your factory, patent, diploma. And the longer term you invest – the less worry you will have when you yet again convert into cash at the end of your investment horizon. In contrast, current Net Present Value calculations discount heavily the future, making the case for sustainability rather ... unsustainable.

In earlier real-life experiments, demurrage on money has been demonstrated to increase the velocity of money in circulation²⁵. An attempt to hoard money – the root cause of deflation, one of the root causes of post-boom depressions – will make your money literally burn in your pockets in the quantum realm. You must make your money move around – or you’ll pay the price.

The existence of demurrage within the monetary system, however, does not exclude interest – far from it. In the quantum realm, interest still exists but is not ubiquitous. Riskier wealth transfers will of course need interest as an incentive for their realization. It is liquidity preference per se, the proverbial love of money (the root of all evil), that is attacked by the Demurrage Bot.

²⁵ The Austrian “Miracle of Worgl” experiment, the German “Wara” and “Chiemgauer”, the Japanese “Peanuts” currency.

The multi-currency payment system, the multi-currency wallet and the multi-currency transaction

In the quantum economy, a multitude of private credit-based currencies are integrated under a common pattern in a single peer-to-peer-exchange-and-credit network and circulate simultaneously as media of exchange.

Choice in currency is realized by allowing users to *filter* incoming currencies in their multi-currency wallets.

Private credit *can be rejected* for payment, and can fluctuate in terms of purchasing power/value.

Public credit is universally acceptable and *cannot be rejected* as a valid means of payment. Public credit is always 100% backed, its market value is always equal to face value.

The system sorts, filters and matches currencies to ensure the execution of transactions between actors who do not have direct coincidence in their monetary preferences/filters.

The Quantum Money System: Summary

The Quantum Money System is a **multi-currency credit ledger** with a **multi-currency payment system** for **multi-currency transactions** - nothing that commercial banks plus SWIFT, Visa, MasterCard, etc. haven't already done for mono-culture bank-credit money even if in a more Balkanized and content-poor way (due to their evolutionary baggage from the Industrial Age).

It is a system “**closer to the metal**” (to borrow a metaphor from the “C” programming languages) – it is closer to the underlying economic exchange process, eliminating the whole layer of exogenous, artificially introduced currencies (fiat, cryptos, commodities, etc.) in-between the exchange of goods and services in the real economy.

Being universally accessible via mobile devices, with an invariant, supranational value metric (labor hour), and with uniform processes for private credit creation, transfer and settlement, the Quantum Money System is a credit ledger spanning potentially many countries across different continents, hence it is a more **unified** - and unifying - economic exchange environment.

It is a ledger with social algorithms smarter and more efficient than the government social service agencies of today – it has sufficient information content to allow public credit to be issued precisely whenever, wherever, by whoever and to whomever, in amounts and under circumstances as per a **social contract coded** into the ledger.

It is a ledger smarter than the existing commercial bank ledgers – it knows not only the revenues of the businesses on the ledger, but also the trustworthiness of each business according to the community of users, which enables it to allow **businesses to self-issue their own private credit monies** in amounts which are safely redeemable, without any third-party intermediation - monies which are fully-backed not fractionally-reserved, debt-free not debt-based, interest-free not interest-charged, and without destabilizing maturity transformations as part of the credit-creation process.

The **overall control over the amount of money in the economy** is carried out by the Demurrage Bot, via a negative feedback loop with the Consumer Price Index, preventing inflation.

The combination of ensured minimum labor input for every productive member of society via the Employer of Last Resort feature of at least 6 to 8 hours a day, combined with the deflationary forces of technology and the incentive for companies to lower prices (hence sell more and issue more money on that basis, i.e. businesses get rich by producing the money themselves as opposed to extracting it via higher prices) will likely lead to **rising real wages** across the full economic spectrum of economic agents. (A quick message to Senators Elizabeth Warren and Bernie Sanders: leave those robots alone, Senators, and stop the unfathomable stupidity of “We’ll tax them bad robots”; Mr. Musk, Mr. Bezos – go ahead and use every robot you can so as to pack more and more goods and services, in the most efficient way possible, into that Labor Hour of the fellow Man – for that’s **the only way to improve the lot of fellow Man.**)

THE QUANTUM MONEY SYSTEM IS DESIGNED TO:

- (1) DISINTERMEDIATE THE CENTRAL/COMMERCIAL BANKING SYSTEM,
COMMODITIES AND CRYPTOS FROM THE BASIC EXCHANGE PROCESS OF
GOODS AND SERVICES**
- (2) SIGNIFICANTLY REDUCE THE GOVERNMENT'S PARTICIPATION IN THE
EXECUTION OF THE SOCIAL SAFETY NET**

EXPECTED BENEFITS OF THE QUANTUM MONEY SYSTEM

1. *Separation of money from the state*, enhancing the power of the individual *vis-à-vis* the state, making wars, devaluations, deficits, inflation, less likely.
2. *Elimination of inflation, and stability of the currency unit without the use of a commodity anchor*.
3. *Elimination of hunger*. No one needs to starve. A loaf of bread and a bottle of water a day can always be provided by society-at-large via the Provider of Last Resort Algorithm.
4. *Elimination of unemployment*. Everyone is entitled to provide productive output to society via the Employer of Last Resort algorithms, allowing unlimited demand for labor at 1bc/hour.
5. *Elimination of poverty*. Through the Employer of Last Resort and Provider of Last Resort algorithms, through better access to education, healthcare and entrepreneurial financing.
6. *Reduction of inequality*. On the down side, extreme forms of poverty will be eliminated; on the up side, holders of liquid wealth will bear the largest burden of the social algorithms (via demurrage).
7. *Rising real wages across the board*.
8. *Reduction in frequency and severity of boom-bust cycles (bubbles)*.
9. *Increased funding for education, health care, and other public projects while simultaneously keeping government out of the money system and much of the social programs*.
10. *Solution for the unfunded liabilities problem*. These will stop being a government's concern any more.
11. *Solution for the mounting debts problem*. Debt levels in society will be reduced across the board.
12. *Alleviation of climate change*. Negative and positive externalities can be priced into the money system;
13. *Small government and massive privatization*. Since everyone will have the right to *earn(!)* a basic income, right to education and basic health care, massive privatizations will be possible. Social security taxes, unemployment benefits taxes and health-related taxes will end. Taxation will be greatly simplified, focused on consumption.
14. *Ease of access to capital for entrepreneurs*.
15. *Return of the community*. Support of local businesses on a peer-to-peer basis, availability of money for local public works, work for everyone in small community projects and community upkeep.
16. *Topological robustness*. Permaculture as opposed to monoculture design. No one is "too big to fail". No one is "systemically important". Creative destruction is allowed in the monetary realm.
17. *Payment system isolated from any financial system risks*.
18. *Factor price equalization*. In the quantum currency union, the minimum wage across participating countries will be the same.
19. *Multinational currency union formed by default; end to trade wars*. The monetary problems currently faced by the European Union are largely avoided in the quantum currency union.

WHY THE QUANTUM MONEY SYSTEM

Technological evolution must go hand in hand with personal and societal evolution

Humanity is still learning to use the power given to it through technology. The horrors of World War II became possible on such a large scale precisely because there was the technology to enable it – the tank, the airplane, the submarine, the machine gun. Couple that technology with the fear-driven minds of leaders at the time – and the result is suffering on unimaginable scale. Currently, nuclear arsenals are supposedly kept under control through the Mutually Assured Destruction (MAD) doctrine. How applicable will that doctrine be 50 years from now when even small groups of people will have the technology for weapons of mass destruction? ...Wonder why your grand-grand-grand parents did not participate in the Dutch tulip mania? Lack of connectivity. They didn't have cell phones and e-mail at the time, so they didn't *know* about the "great investment" in tulip bulbs and couldn't easily "wire" the money. Wonder how the whole world got into the subprime mortgage debacle – couple greed and competitiveness with a phone line and a payment system and – voila!

Obviously, it's not the phone line – it's the *greed* at the end of the phone line that did the trick. And now the bombs are getting bigger, the guns are 3D-printed at home, the communication lines stream in High Definition. The power of a person's mind – previously constrained by his own two hands and legs, and his voice – is being multiplied, via the steam engine and the search engine, *ad infinitum*.

“... they may lead us ... to the Buddha or to the Bomb, and it is up to each of us to decide which path to take” **Fritjof Capra**, “The Turning Point”

Technology inexorably exacerbates the distance on that continuum – between the Buddha and the Bomb, allowing us to do ever greater good through technology, or inflict ever greater damage; and more and more puts that choice squarely with each one of us.

Maybe we need a new philosophy for the technologically advanced Information Age. A new set of personal, interpersonal and societal norms and values. Something different from the mechanistic, distributive, me-vs-you silo thinking of the Industrial Age. Something within the lines of Open vs. Closed, Transparent vs. Secret, Shared vs. Individually-owned, Peer-to-Peer vs. Intermediated, Distributed vs. Centralized, Dynamic vs. Static, Adaptive vs. Rigid, Fluid vs. Structured, Self/community-regulated vs. Government-controlled, Enough vs. More, Abundant vs. Scarce.

One thing is for sure, though - we can't have a society that's technologically advanced while being bitterly divided over nationality, race, religion, wealth; which is histrionically competitive, with disregard for values and environment; with large parts of the population marginalized, unemployed, disenfranchised – such a society will end badly, one way or another.

IN THE LONG RUN, FOCUSING ON TECHNOLOGY WITHOUT FOCUSING ON THE SELF MAY BE THE GREATEST TECHNOLOGY-RELATED RISK FOR SOCIETY

The Gods did not nail Prometheus to the rocks just for nothing, you know.

The Quantum Money System is, thus, first and foremost, a *social* technology - social technology designed to alleviate the distributive pressures within a technologically advanced, democratic, free market society. It brings *call-optionality* to the social contract: limited, hedged downside risk – freedom from hunger, poverty, unemployment, poor health, and lack of education - while providing unlimited upside potential for those having the vision, the courage, the execution skill and the willingness to put in what it takes to succeed.

The great empires of the past – the Lydians', the Romans', the Greeks' - were built on plentiful slave labor and sound gold money. Technology is about to provide both in abundance – via robotics and software algorithms. If history is any guide, great prosperity should lie ahead – assuming (1) we can all share in it, and (2) we don't kill each other in the meantime over staggering debts, over diminishing resources, over nationalistic, religious or any other types of segregations.

THE BIGGER PROMISE OF IT: PUBLIC GOVERNANCE

Many scholars have examined the essential link between political freedom and economic freedom – Milton Freedman and his classic “Capitalism and Freedom”, Hayek and “The Road to Serfdom”, Henry C. Simons and “Economic Order for a Free Society”, etc. – it is a long list. And when put to the test, societies with centrally planned economies (and the political regimes that usually come with central planning) eventually wither, while societies with decentralized economies and decentralized political power grow and prosper. Lately, however, capitalism and democracy seem to be, strangely enough, at odds with each other.

Lawrence Lessig, in his book “Republic, lost” talks about “how money corrupts Congress – and a plan to stop it”:

- “The great threat today is instead in plain sight. It is an economy of influence now transparent to all, which has normalized a process that draws our democracy away from the will of the people.”
- “We have created an engine of influence that seeks not some particular strand of political or economic ideology, whether Marx or Hayek. We have created instead an engine of influence that seeks simply to make those most connected rich.”

Joseph Stiglitz, in his book “The Price of Inequality” uses the terms “a democracy in peril”, and “one dollar one vote” to describe the political battleground between the average citizen and moneyed interests.

Al Gore, in his book “The Future” says “Democracy and capitalism have been hacked. The results are palpably obvious in the suffocating control of policy decisions by the elites”.

How could a political system based on individual freedom (democracy) and an economic system based on individual freedom (capitalism) be at odds with each other? The short answer is: Money. Not “money” as in “bribes”, or some dark conspiracy theory cast on the American people by the devious “1%” - no. The currently observed threats to democracy are only logical consequences of the money system currently in use: ever-increasing inequality is virtually assured through the “preferential attachment” and other features of the interest-charged money system, the built-in growth requirement via interest means ever larger businesses must compete ever more ferociously – they have bills to pay, they have competitors - domestic and international, there are dwindling natural resources. Naturally, Congress comes under ever increasing pressure from ever-larger businesses, with election campaigns logically getting ever more expensive, and lobbying efforts becoming ever more well-heeled and intense. The “average American” gets stomped out. At its core, this is a *monetary issue*, this is the system of money casting its long shadow over other social systems and arrangements – at least money in its current form. It’s not *democracy per se*, and not *capitalism per se* (as many a misguided protester may think) that are to blame. It’s the nature of our *money*. But money is ever so subtle, so invisible, like the water in that proverbial fish tank, and we are so used to it that very few of us ever take a deep hard look into it.

Way more pernicious to democracy, however, is the ever-increasing severity and scope of recurrent financial crises, predicated via the current monetary and financial architectures operating in an increasingly interconnected world. Right now, after the 2007/2008 crisis and COVID forced the use of every piece of financial ammunition in the US, both the Federal Reserve chairperson and the Treasury Secretary are out of bullets – and the only bullets left are those in the gun chambers. Yet another crisis of the 2007/2008 variety, given the amount of existing government debt and the amount of dollars already on the Fed’s balance sheet will most likely mean that Americans in uniforms will have to stand against Americans in jeans – without a clear resolution in sight. Let us remind you there was a time when America was supposed to be the Land of the Free. The Founding Fathers may soon be turning in their graves.

The purpose of this book is to communicate the message that there may be another bullet – of the proverbial silver variety. But it is not a bullet designed to be fired by Presidents – it will misfire in the hands of government; and it is not a bullet designed to be fired by the Federal Reserve – if anything, it is designed to end the Fed. It is a bullet made in the Silicon Valley.

IT can help a democracy under fire from money in two ways - through alternative money systems and direct democracy:

Alternative money systems:

At least one web-based money system – the Quantum Money System introduced in this book – could, *in theory*, alleviate the currently existing distributive pressures in society, allowing for full employment, better access to education, health care and social security; it could greatly reduce inequality by penalizing most heavily the “idle rich” – those not using accumulated resources for productive purposes; it could eliminate the risks for the payment system and the new money creation system - risks currently emanating from “too big to fail” banking institutions having mismanaged a variety of financial system and operating risks – thus providing stable monetary and hence economic environment; and it could also provide both entrepreneurs and the public sector with abundant funding. Using large, integrated IT platforms, new money systems of virtually every variety, strand, shape, form, and size, designed for every taste and preference – can be put forward; in the Information Age, banking is not – not by far! – the only possible way to organize the medium of exchange, store of value, unit of account functions within society; far better-performing money systems can be tailor-made to specifically address social issues, using information as the backbone of the money system. In the Information Age,

Banking is a legacy system

Direct democracy:

Through IT, every citizen can have *legislative initiative*, in a Wiki format. New laws can be put forward and designed through the power of collective intelligence – easily - with only modest expert oversight.

Strong, secure biometric identification and encryption technologies can enable *anonymous voting on anything* from our likes of the latest Dolce & Gabbana shoes to the proposed new laws or the job done by any publicly elected official – at virtually no cost. Elections and referenda can be held at any time, on any issue.

IT can also provide *transparency over the executive branch* of the state – if they (the government) can spy on us, we can collectively “spy” on them – “like” any of their actions, “comment”, “share”, and vote any one of them out of office virtually on a moment’s notice.

Gradually, over the last two centuries, the composition and functioning of Congress have become hostage to moneyed interests. Allegiance to political parties occasionally seems to overcome allegiance to the country - despite the prescient warnings of George Washington on the dangers of political parties²⁶. In a technologically advanced society where everyone can vote easily on virtually anything at zero cost, intermediation of the political process via elected officials is a limitation on the voting rights of the citizens. In the Information Age,

Congress is a legacy system

Another name for the removal of one form of public governance with another is “*revolution*”. This one may come, however, through firing bits, not bullets.

It is possible to (1) code the social contract into a smart, distributed money supply system, largely (1.1) disintermediating the banking system from the money supply, and (1.2) disintermediating the IRS, and the government in general from active management of most social programs.

It is possible to (1) create and pass laws, (2) control government, and (3) hold referenda on virtually anything at virtually anytime and anyplace – largely disintermediating Congress from the democratic process - using IT.

These things are not like gravity, you know – they were made by Man, they can be changed by Man.

“How quickly can institutions be adapted to the Internet?...long established institutions are notoriously resistant to change. The speed with which business models have been disintermediated and new models have emerged offers reason for hope”
Al Gore, “The Future”

²⁶ Farewell Address, 1796

ONE WORLD OR NONE

Shortly after atomic bombs were dropped on Hiroshima and Nagasaki, the book “One World or None: A Report to the Public on the Full Meaning of the Atomic Bomb” was published by Whittlesey House/McGraw-Hill. A collection of essays by Manhattan Project participants and others, it made the case that with the arrival of atomic energy, humanity faces a stark choice: international cooperation (one world) or annihilation (none).

The role that money could play for international cooperation and unification cannot be overstated.

Paul Volker, former US Fed chair:

“The global economy needs a global currency²⁷”

Friedrich Hayek:

“A wisely and impartially controlled system of managed currency for the whole world might, indeed, be superior to it (the gold standard) in all its aspects. But this is not a practical proposition for a long while yet²⁸”

Robert Mundell, in his Nobel Prize acceptance speech in Dec 1999, said:

“The main thing we miss today is universal money, a standard of value, the link between the past and the future and the cement linking remote parts of the human race to one another.”

It is still early, way too early to propose outright a societal change of such staggering magnitude as a monetary regime change. But it is not too early for this issue to take its rightful place on the policy-makers’ agenda as part of a thoroughly analyzed, carefully planned and prudently executed, long-term public policy.

The next major financial crisis will achieve this effect.

The Internet – that amazing global platform - is waiting.

Expecting its native, peer-to-peer, digital, distributed, meaningful, regulated, global monetary solution.

²⁷ This quote, while widely cited, has never been referenced, and could not be traced by the author (or by any of the search engines and LLMs used) to any specific Paul Volker speech or writing.

²⁸ Hayek, F. “A Commodity Reserve Currency” *The Economic Journal* vol.53 No 210/211 June-Sept.1943

SUMMARY

There are three fundamental civil liberties - rights of participation in society - necessitated by the conjecture that collective intelligence, properly organized, in the long run produces better outcomes for society than individual intelligence:

- Democracy - the power of collective intelligence brought to the governance of the political process.
- Free Market (capitalism) - the power of collective intelligence brought to the governance of the economy.
- Distributed Money Supply - the power of collective intelligence brought to the governance of money.

Too much restriction (centralization) in any one of these liberties can destroy the other two.

Information technology can be used as a tool to either enhance, or to limit, these liberties.

Money, in particular, is not the neutral measuring rod often assumed in economics. A monetary system can have a variety of architectures, each architecture with its specific effects on the economy and society.

The fiat money system currently in use has the following structural flaws, which are becoming more pronounced with the passage of time and with the advancement of the networked society:

- The money system is top-heavy, centralized.
- Money is issued mostly as debt, against interest, on the basis of repayment ability only, for-profit.
- Both the payment system and the issuance of new money are vulnerable to mismanagement of credit risk and maturity transformations by structurally unstable, fractionally-reserved, debt-based banking system.
- The stability of the store of value function of money is not assured.

This results in instability of the economic system, as described by Hyman Minsky, hence the necessity for top-down intervention that came to be known as Keynesianism. The scope of Keynesianism is limited, though, as its long run consequences are unsustainable level of government debt and depreciating fiat currency.

Other negative consequences of the fiat money system are negative externalities (most notably climate change), currency and trade wars, inequality, unemployment, growth imperative, resource depletion.

It is possible to devise an infinite number of money systems (ledgers) based on information technology - as private or public goods to be used by communities of various sizes – from as few as two people to, very long term maybe, all of mankind. This book explains the mechanics for the creation of one such ledger.

The Quantum Money System is a fully digital, decentralized, credit-based, bank-less, fully-reserved, maturity-matched, inflation-proof, largely debt- and interest-free money system that seeks to eliminate hunger, poverty, unemployment, to encourage greater access to education, health care, and economic opportunity, to largely eliminate instability within the economy, to reduce the inequality gap (or at least to limit it on the downside), to promote democracy. Yes, this is a long, overly ambitious – utopian maybe? - wish list. (Funny, though, the software works, even if still on a small scale, even if still mostly in the lab; nothing utopian about that).

This particular system is only at its earliest, more or less prototyping, stages, and the case for its applicability at the systemic level is as yet neither obvious nor advisable; its full unfolding would require very large amounts of time, sustained effort, resources, leadership, and will entail wrenching, excruciating societal changes. Small, disciplined steps, taken one at a time by the private sector, very long planning/testing horizons, with failure as the inevitable bitter guide going forward, coupled with awareness and prudent regulation from policy makers, could provide the fertile petri dish to eventually prove - or disprove - the full potential of the next generation of money ledgers enabled by IT.

AFTERWORD

*You've read the magic words. You've breathed the air. The change is irreversible. You've been **infected** – infected with the virus of distributed money supply. You are about to experience the following disturbing side effects:*

- You'll be driving home from work, and looking at all the dirt vehicles bring onto the streets, and all the leaves falling from trees – and knowing how easily they could be monetized via an Employer of Last Resort algorithm – and you will be seeing money...And you will realize that once again America can be the country it used to be generations ago for our forefathers as they were arriving into the land of milk and honey – a land where the streets are paved with gold and money grows on trees, only this time the beacon of hope is not in the hand of the Statute of Liberty, but in the Googles, the Apples, and the Facebooks of the world;*
- As you drive on, you will see a group of protesters, protesting against something - inequality, unemployment, capitalism...something – and you will think “What if all these people could get work right there and then, from as little as one hour to a whole lifetime? Any amount of work they needed? As a guaranteed right of every member of the Information Age society?”*
- And you will pass by a bum going through the garbage bins, and will think “What if we lived in a society where no one needed to go through the garbage bins – for food or basic necessities?”*
- And then you will be listening on the car radio, about the government's staggering debts, the unfunded liabilities, the deficits, the depreciating currency - and you will think “What if instead you could listen to a message that the Quantum Bank is flush with cash, cash for public projects? And the government was so very small...And it had nothing to do with the money we use or with people's pensions - fully funded at any time as long as businesses generated goods and services?”*
- And then you will be driving by a decrepit public school, and you will be thinking “What if there were no public schools? What if all schools were private? If the government was only the standard setter for the education industry – an industry as exciting and fun as Disney? But every student – even those from the poorest families – had the money to choose the right teacher/school for him?”*
- And you will be listening on the radio of yet another failed government health care program – the latest in a long string of failed government health care programs – and you will be thinking “What if all the government had to do for health was to make sure the hospitals are clean and the drugs are safe – and everything else was private? Yet each one of us, even the poorest – had the money for basic health care?”*

The list goes on and on and on...You got the idea.

*Is this project doable? It's too early to tell. But if you dare dream – dream that a project like this **is** doable – then next time you drive your car in the middle of nowhere and see one of those Google Internet balloons hovering up in the air, you will know something way bigger than just free e-mail and Youtube videos – you'll know no one around goes hungry, and no one goes unemployed.*

We leave you here, with a shared dream. And the strangest of questions – if this dream is technologically possible, how come it's just a dream?

A cautionary note on the practical applicability of the Quantum Money System

The key elements of a multi-currency ledger with social algorithms:

- wallets, transaction functions, choice in currency, competition in currency
- various store of value defenses
- the issuance, transfer and redemption of private credit currencies,
- working capital financing,
- Employer of Last Resort (reduction of unemployment),
- Provider of Last Resort (funding pensions),

have already been coded for a commercial-level launch as a complementary community currency; a business model mapped out; a modest β -test - facing stiff resistance from banking interests, tons of red tape and regulatory hostility - is underway.

*The applicability of the concept of a multi-currency monetary space beyond the commercial-operator level – as a systemic **complementary** mechanism for credit creation (existing parallel to commercial bank credit creation), or, even more boldly, as a systemic **replacement** of the system of banking (central and commercial) - is a task whose purely intellectual, academic, analytical, and modeling aspects are a multi-year, possibly multi-decade, challenge; a meaningful nation-wide β -test here poses possibly insurmountable challenges of execution under normal circumstances.*

*Any investigative steps beyond a commercial-operation level are, obviously, in the realm of public policy, and, if taken at all, should be taken in a very measured way, with the proper prudence, caution, patience, and healthy skepticism, as part of a **long-term** policy.*

Starry-eyed monetary reformers beware: building a large-scale economic network based on decentralized, endogenous private credit creation, will, in all likelihood, require Congressional approval, and will face gut-wrenching - legal and otherwise - challenges from the incumbents. Short of a major shock to the current monetary system, or without a blessing from policy makers, this fight is bound to remain for the hearts and minds of the people only.

QUANTUM MONEY

a web-based system of money and credit

Down the rabbit hole: a metaphor for entry into the unknown, the disorienting or the mentally deranging, from its use in Alice's Adventures in Wonderland.

Wikipedia

This book shows why, in the Information Age, fractional reserve banking is a legacy system, how commercial banking can be disintermediated from the economy using IT, and how algorithms can carry out the monetary functions of the gold standard.

Written by two monetary history buffs with little in the way of formal economics credentials - partners in an IT start-up developing a system of money and credit for the Internet.

Here is the critical acclaim by the few bankers who reviewed the book:

"A collection of dangerous fallacies."

"Terrible. A terrible book."

"What, should I look for a new job now?? Ha-ha-ha-ha..."

"Uh... well... look - I'm busy right now..."

Still, much like that irreverent boy in the Hans Christian Andersen's fairy tale, the book claims the emperor has no clothes. Read at your own risk. The book can be downloaded for free from www.bartex.org

Alice laughed: "there is no use trying" she said; "one can't believe impossible things." "I daresay you haven't had much practice," said the Queen. "When I was younger, I always did it for half an hour a day. Why, sometimes I've believed as many as six impossible things before breakfast".