The Breedlove Anthology

A collection of Bitcoin writings from Robert Breedlove.

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Goals and Scope

WORDS is a journal of Bitcoin commentary, established February 13, 2019. Its purpose is to document and advance commentary and research in disciplines of particular interest related to Bitcoin. The journal is broad in scope, publishing content from original research, essays, blog posts, and tweetstorms from a wide variety of fields, especially governance, technology, philosophy, politics, and economics, but also legal theory, history, criticism, and social or cultural analysis. Its broader mission is to capture the conversations and think pieces in the Bitcoin space for current and future researchers. *WORDS hopes to* continue and expand the tradition established by publications such as the *Journal of Libertarian Studies* and *Libertarian Papers*.

History

There exists a gap in Bitcoin publishing. For authors with commentary and scholarly papers on topic, the choice of publication outlets is relatively limited. The number of journals that serve as outlets for Bitcoin research is in any event too small, as the number of Bitcoin thinkers continues to grow with every market cycle.

This generation of Bitcoin thinkers have limited places to submit thought pieces for publication. Content is scattered across the web, and in some cases behind paywalls which prevent the free flow of information. With the advent of the Twitter and blogging, authors also now have the option of self-publishing: they post the content to their own site or some private site, link it in a blog post, or post a working paper. But this is obviously not the best way to document and publish. What is needed is a journal that takes full advantage of the possibilities of the digital age as a go to resource for think pieces in the Bitcoin space.

Enter *WORDS*. Published independently, *WORDS* is a journal that welcomes submissions on a range of topics of interest related to Bitcoin. In addition to conventional research articles, we welcome review essays blog posts, tweets as well as papers in other formats, such as distinguished lectures. Finally, wherever possible, content on this site is licensed under a Creative Commons Attribution 4.0 License. Authors retain ownership without restriction of all rights under copyright in their articles. *WORDS* is open access, and we encourage readers to "read, download, copy, distribute, print, search, or link to the full texts of these articles…or use them for any other lawful purpose." We want our ideas read, spread, and copied.

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Foreword

This is a collection of writings by Robert Breedlove as of July 23, 2020. Robert has contributed an invaluable collection of writings to Bitcoin. His writings are often referenced by Bitcoiners and are helping to shape narrative around this revolutionary social phenomenon.

Future versions and changelog will be listed below.

Money, Bitcoin and Time: 1 of 3

By Robert Breedlove

Posted January 20, 2019

This is part 1 of a 3 part series

Money, Bitcoin and Time: 1 of 3

Money, Bitcoin and Time: 2 of 3

Money, Bitcoin and Time: 3 of 3

A synthesis of perspectives from many prolific thinkers, this 3-part essay will cover the following topics in sequence:

Money – its properties, story and evolutionary history

Bitcoin – its nature and significance in the story of money (see PART 2)

Time – perspectives on its value and how the story of money might play out (see PART 3)

This essay is guided, inspired and adapted from the literary works of many. Each section header will include a number [n] referencing relevant synthesized works at the end of each part. For those seeking further elucidation on any of the topics discussed herein, I highly encourage you to read these original works.

This essay is also available in .pdf form at: https://www.parallaxdigital.io/blog

Please feel free to send any questions or feedback to info@parallaxdigital.io

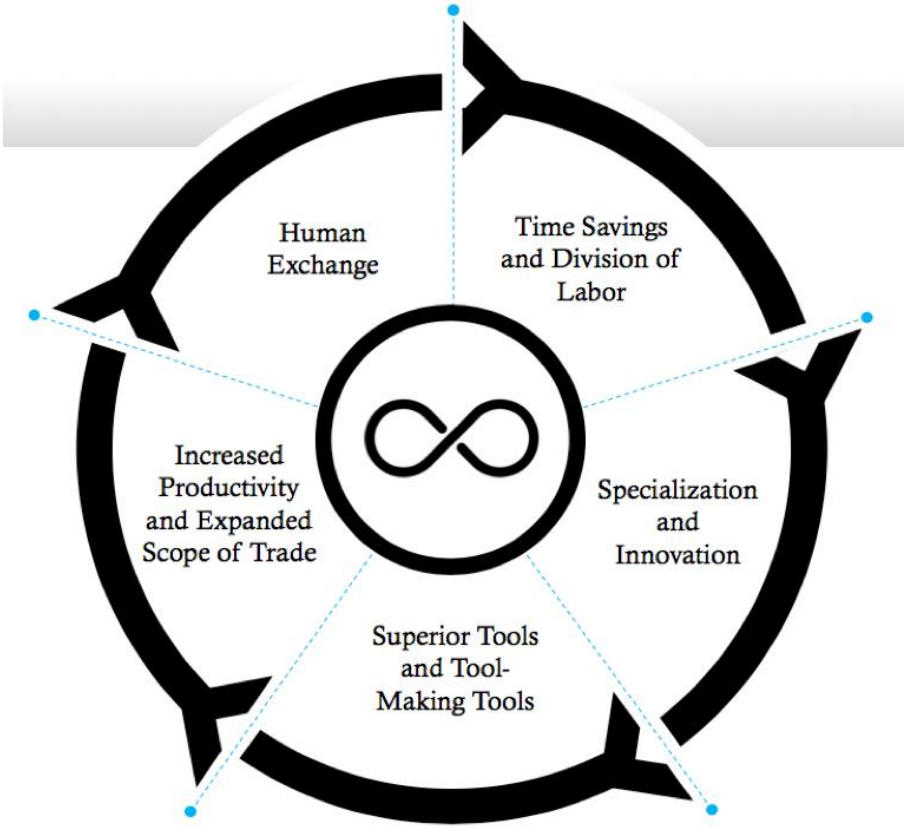
The Simple Truth about Money: Money is the most successful story ever told by humans. It is a reflexive narrative: meaning it has value only because everyone believes it, and everyone believes it because it has value. Money is a story that continues to be written...

Human Exchange [2,6]

Human beings are the networked species. Initially, these were small bands of hunters and gatherers numbering no more than 150 persons strong (Dunbar's number). When humans began to exchange with one another, they intuitively discovered the division of labor which allows people to focus on their relative advantages and concentrate on their chosen craft. The division of labor enables the specialization of productive efforts for mutual gain. If John makes axes faster than Steve, and Steve makes bows faster than

John, then they both are better off by specializing and trading. Interestingly, this holds true even if John is faster than Steve at making axes and bows (up to a point) and, amazingly, this effect compounds.

Tools, or technologies, are mechanisms that increase productivity by amplifying the returns on human time directed at production. You can chop more wood per man hour using an axe than you can with your bare hands. As people made and exchanged more tools, time savings increased and specialization deepened. Specialization sparked innovation, because it encouraged the investment of time in tool-making tools, such as whetstones used for making sharper axes. This enabled people to create superior tools, which increased productivity even further. That saved more time, which people used to specialize even further and expand their scope of trade by exchanging with an even greater number and variety of people, which increased the division of labor even further, and so on. This recursive dynamic persists to this day as a virtuous cycle with no known natural limit — modern markets in goods, services and ideas allow human beings to exchange and specialize honestly for the betterment of all. In this way, the act of exchange is the incipient force driving all human progress and prosperity . Prosperity is simply time saved, which is proportional to the division of labor:



Human exchange is the incipient force driving all human progress and _prosperity_ . Prosperity is simply time saved, which is proportional to the division of labor. This recursive dynamic persists to this day as a virtuous cycle with no known natural limit — modern markets in goods, services and ideas allow human beings to exchange and specialize honestly for the betterment of all.

Human exchange is to cultural evolution what sex is to biological evolution. By exchanging and specializing, innovations come into existence and spread. At some point, human intelligence became collective and cumulative in a way that happened to no other animal. Language, and later writing, allowed us to pass our collective learnings to each successive generation. Written language allowed us to manifest and share our belief systems. As the only animal that can tell and believe stories, we learned to organize ourselves using abstractions such as money, mathematics, nations and corporations. Our unique ability to tell and believe stories — as free market capitalists, human rights activists, national citizens or whatever story we accord with — enables us to cooperate flexibly in large numbers and across genetic boundaries. This scale of collaboration, never

attained by any other animal before or since, is the reason mankind came to dominate the Earth. We are the networked species, fully interconnected by our acts of exchange. A spontaneous emergent property of these complex human interactions is money, which solved problems inherent to trade and accelerated the rate of human exchange and the division of labor. Money, as the vital lubricant for human exchange, was among the first stories we used to collectively organize ourselves.

Story of Money [1]

Let's begin with first principles and follow logic from there. The simplest form of human exchange is the direct trading of actual goods, say guns for boats, in a process known as direct exchange or barter. Direct exchange is only practical when few people are trading few goods. In larger groups of people, there are more opportunities for individuals to specialize in production and trade with more people, which increases the aggregate wealth for everyone. This simple fact, that exchange enables us to produce more goods per hour of human effort is the foundation of economics itself:

Economics is the social science of increasing production per unit of contribution.

Larger groups of people exchanging goods mean larger markets, but also creates a problem of non-coincidence of wants — what you are seeking to acquire by trade is produced by someone who doesn't want what you have to offer. This problem has three distinct dimensions:

Non-coincidence in Scales — imagine trying to trade pencils for a house, you cannot acquire fractions of a house and the owner of the house may not need such a large amount of pencils

Non-coincidence of Locations — imagine trying to trade a coal mine in one place for a factory in another location, unless by coincidence you are seeking a factory in that exact location and the counterparty you are dealing with is seeking a coal mine in that precise place, the deal will not be completed since factories and coal mines are not movable

Non-coincidence in Time Frames — imagine trying to accumulate enough oranges to trade for a truck, since the oranges are perishable they would likely rot before the deal could be completed

The only way to resolve this three-dimensional problem is with indirect exchange, where you seek to find another person with a good desired by the counterparty and exchange your good for theirs only to, in turn, exchange it for the counterparty's good to complete the deal. The intermediary good used to complete the deal with the counterparty is called a medium of exchange - the first function of money. Over time, people tend to gradually converge on a single medium of exchange (or, at most, a few media of exchange) as it simplifies trade. A good that becomes widely accepted as a medium of exchange is commonly called money.

Money offers its users pure optionality, as it can be readily exchanged for any good available in the marketplace. In other words, money is the most liquid asset within a trade network. In this sense, money is said to have the highest salability, meaning the ease with which it can be sold on the market at any time with the least loss in price. Salability of a good is relatively determinable by how well it addresses the three dimensions of the non-coincidence of wants problem:

Salability across Scales – a good that is easily subdivided into smaller units or grouped together in larger units, which allows the user to trade it in whatever quantity desired

Salability across Space – a good that is easily transported or transmitted over distances

Salability across Time – a good that can reliably hold its value into the future by being resistant to rot, corrosion, counterfeit, unpredictable increases in supply and other debasements of value

It is the third element, salability across time, that determines a good's utility as a store of value – the second function of money. Since the production of each new unit of a monetary good makes every other unit relatively less scarce, it dilutes the value of the existing units in a process known as inflation . Protecting value from confiscation via inflation is a critical feature of money, and money is critical to the existence of flourishing trade networks.

Hard Money [1]

Hard money is more trustworthy as a store of value precisely because it resists intentional debasements of its value by others and therefore maintains salability across time. The hardness of a monetary good, also known as its soundness, is determined by the stock of its existing supply and the flow of its new supply. The ratio which quantifies the hardness of money is called the stock-to-flow ratio:

'Stock' is the existing supply of monetary units

'Flow' is the newly created supply over a specified time period, usually one year

Dividing the stock of a monetary good by its flow equals its stock-to-flow ratio

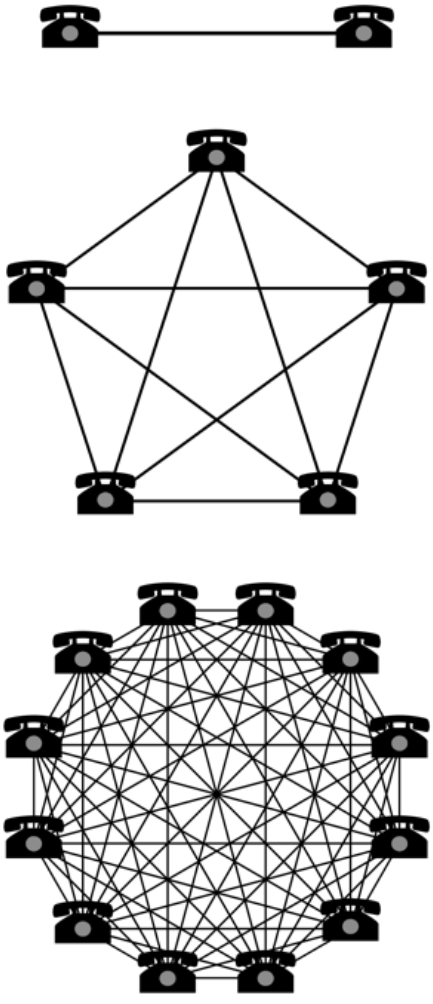
The higher the stock-to-flow ratio, the greater the hardness (or soundness) of money

The higher the stock-to-flow ratio, the more resistant the money is to having its value compromised by inflation. There are no correct choices as to forms of money, however there are consequences to what form a market naturally selects. If people choose to store their wealth in a monetary good which exhibits less hardness, then the producers of this monetary good are incentivized to produce more monetary units, which expropriates the wealth of existing unit holders and destroys the monetary good's salability across time. This is the fatal flaw of soft money: anything used as a store of value that can have its supply increased will have its supply increased, as producers seek to steal the value stored within the soft monetary units and store it in a harder form of money. As many historical examples in this essay will demonstrate, any monetary good which can have its supply cheaply and easily increased will rapidly destroy the wealth of those using it as a store of value.

For a good to assume a dominant monetary role within an economy, it must exhibit superior hardness with a higher stock-to-flow ratio than competing monetary goods. Otherwise, excessive unit production will destroy the wealth of savers and the incentives to use it as a store of value. Particular goods achieve monetary roles based on the interplay of people's decisions. It is from the chaos of complex human interactions that monetary orders emerge. Therefore, it is important to consider the social aspects of the spontaneous emergence of monetary orders.

Money is a Social Network [1,4]

Money, as a value system which connects people across space and time, is the original and largest social network. The value of a network is a reflection of the total number of possible connections it allows. Similar to the telephone and modern social media platforms, a monetary network becomes exponentially more valuable as more people join it because the number of possible connections it allows is proportional to the square of the number of its total network participants, a relationship defined by Metcalfe's Law:



Network values are based on the number of possible connections they allow. Such values grow exponentially with the addition of each new constituent—a property commonly known as network effects.

In a monetary network, more possible connections mean more salability and a broader scope of trade. Participants in a monetary network are connected by their use of a common form of money to express and store value. Network effects, defined as the incremental benefit attained by adding a new member to a network for all existing members in that same network, encourage people to adopt a single form of money. Intuitively, a monetary good that holds value across time (hard money) is always preferable to one that loses value (soft money). This causes people to naturally gravitate to the hardest form of money available to them. Further, since human exchange is a singular communal phenomenon suffering from a three-dimensional non-coincidence of wants problem, any monetary good that can solve all three dimensions of this problem will win the entire (or vast majority) of the market. For these reasons, a free market for money exhibits a winner take all (or, at least, a winner take most) dynamic . Network effects accelerate people's natural coalescence around a single monetary technology since larger monetary networks support higher salability of the monetary good involved. However, the selection of a monetary good is limited by the technological realities of the markets selecting. This can impede the winner take all dynamic, since particular monetary goods each satisfy the desirable traits of money to greater or lesser extents.

Monetary Traits [1,4]

As we will see, markets have naturally and spontaneously selected for the monetary good which best satisfies a variety of desirable traits that determine how useful a particular monetary good is as a form of money:

Hardness—resistance to unpredictable supply increases and debasements of value

Fungibility – units are interchangeable and indistinguishable from one another

Portability – ease of transporting or transmitting monetary units across distances

Durability – resistance of monetary units to rot, corrosion or deterioration of value

Divisibility – ease of subdividing or grouping monetary units

Security – resistance to counterfeiting or forgery

Sovereignty – the source of its value, trust factors and permissions necessary to transact with it (natural social consensus or artificial government decree)

Government Issued – authorized as legal tender by a government

As discussed, hardness is the singular trait that takes primacy over all others in determining a good's suitability for playing a monetary role. Money, as an expression of value, has remained conceptually constant but has evolved to inhabit many different goods over time. Like language, which was first spoken, then written and now typed, the meaning expressed by money remains the same while its modality continually evolves. As the monetary technologies we use to express value change, so too do our preferences.

Prospects of Prosperity [1]

In economics, a critical aspect of human decision making is called time preference, which refers to the ratio at which an individual values the present relative to the future. Time preference is positive for all humans, as the future is uncertain, and the end could always be near. Therefore, all else being equal, we naturally prefer to receive value sooner rather than later. People who prefer to defer current consumption and instead invest for the future are said to have a lower time preference. The lowering of time preference is closely related to the hardness of money and is also exactly what enables human civilization to advance and become more prosperous. In regard to time preference, hard money is important in three critical aspects:

By providing a reliable way to protect value across time, hard money incentivizes people to think longer term and thus lowers their time preferences

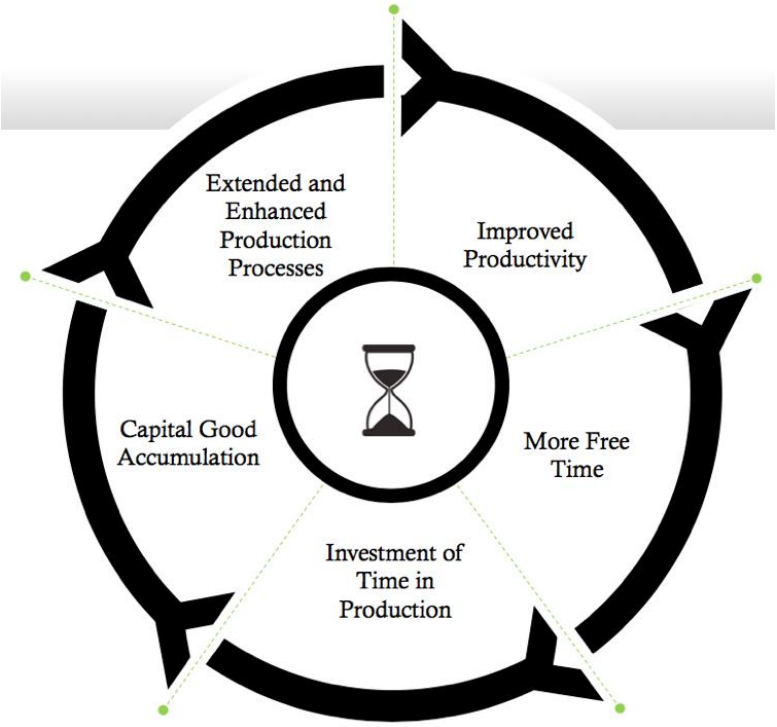
As a stable unit of measurement, hard money enables markets to grow ever-larger by reducing the costs and risks of free trade, which increases the incentives for long-term cooperation and lowers time preferences

Self-sovereign money (like gold and Bitcoin) that cannot be manipulated by any single party reduces governmental intervention which encourages the growth of free markets, which increases their long-term stability and lowers time preferences

A lower time preference is an important part of what separates humans from other animals. By considering what is better for the future, we can curb our animalistic impulses and choose to act rationally and cooperate for the betterment of everyone involved. As humans lower their time preference, they develop a scope for carrying out tasks over longer time horizons. Instead of spending all our time

producing goods for immediate consumption, we can choose to spend time creating superior goods that take longer to complete but benefit us more in the long run. Only by lowering time preference can humans produce goods that are not meant to be consumed themselves but are instead used in the production of other goods. Goods used exclusively for the production of other goods are called capital goods .

Only humans with a lower time preference can decide to forgo a few hours of fishing and opt to build a superior fishing pole, which cannot be eaten itself, but in the future will enable better results per hour of human effort spent fishing. This is the essence of investment: humans defer immediate gratification and invest their time producing capital goods which will, in turn, make the production process itself more sophisticated, extend it over a longer time horizon and yield superior results per hour of human effort. In this way, investment increases capital good stocks which increases productivity. Amazingly, this effect also transforms into a positive feedback loop . Also known as a virtuous cycle or the flywheel effect, a positive feedback loop is a process that is recursively energized (its outputs also serve as its inputs) and therefore creates compounding effects. Positive feedback loops play an important role in biology, chemistry, psychology, sociology, economics and cybernetics. In respect to investment, as more capital goods are accumulated, levels of productivity are increased even more and the time horizon of production is extended even further:



As people exhibit lower time preferences and spend their time wisely, they increase their capacity for investment and create more free time for themselves.

To understand this preference clearly, let's consider two hypothetical fishermen, Harold and Louis, who start out with nothing other than their bare hands. Harold has a higher time preference than Louis and chooses to spend his time catching fish with using just his bare hands. Using this approach, Harold spends about 8 hours per day to catch enough fish to feed himself for one day. Louis, on the other hand, spends just 6 hours per day catching fish, makes do with the smaller amount of fish and chooses to spend the other 2 hours building a fishing pole. Two weeks later, Louis has succeeded in building a fishing pole, which he can now use to catch twice as many fish per hour as Harold. Louis's investment in the fishing pole could allow him to only fish for 4 hours each day, eat the same amount of fish as Harold and spend his other 4 hours in leisure. However, since Louis has a lower time preference, he instead chooses to fish for 4 hours per day and spend the other 4 hours building a fishing boat.

One month later, Louis has succeeded in building a fishing boat, which he can now use to go further out to sea and catch fish that Harold has never even seen. Not only has Louis increased his productivity (fish

caught per man hour) but he has also increased the quality of his production (a greater variety of fish from the deep sea). By using his fishing pole and boat, Louis now needs only 1 hour per day to catch a day's worth of food and spends his other 7 hours engaged in further capital accumulation — building better fishing poles, boats, nets, lures, etc. — which, in turn, further increases his productivity and quality of life.

Should Louis and his descendants continue to exhibit a lower time preference, the results will compound over time and across generations. As they accumulate more capital, their work efforts will be ever-further amplified by productivity gains and enable them to engage in ever-larger projects that take ever-longer to complete. These gains are amplified even further when Louis and his descendants begin trading with others that specialize in crafts in which they themselves do not — such as housing, wine making or farming. Successive layers of learning, productivity gains and flourishing trade networks are the foundational sediment upon which all human advancement in terms of knowledge, technology and culture is built. Human advancement is noticeable in the tools we make and the way we relate with one another.

From this perspective, it becomes clear that the most important economic decisions any individual faces are related to the trade-offs they face with their future self. Eat less fish today, build a fishing boat tomorrow. Eat clean today, be healthy tomorrow. Exercise today, be fit tomorrow. Read books today, be knowledgeable tomorrow. Invest money today, be wealthy tomorrow. We can all take solace that this compounding force of nature is always available to each and every one of us. No matter how bad the circumstances are for a man with a low time preference, he will likely find a way to keep compounding his present efforts and prioritizing his future self until he achieves his objectives. Contrarily, no matter how much fortune and wealth favors the man with a high time preference, he will likely find a way to continue squandering his wealth and shortchanging his future self. These individual relationships with our future selves is the microcosm of the societal macrocosm. As society develops a lower time preference, its prospects of prosperity improve in tandem.

Foundation of Economic Growth [1,4]

There are many factors beyond the scope of this essay which influence time preference. Most relevant to our discussion is the expected future value of money. As we have seen, hard money is superior at holding its value across time. Since its purchasing power tends to remain constant or grow over time, hard money incentivizes people to delay consumption and invest for the future, thereby lowering their time preference. On the other hand, soft money is subject to having its supply increased unexpectedly. Increasing the money supply is the same as lowering the interest rate, which is effectively the price of borrowing money and the incentive to save. By reducing the interest rate, the incentive to save and invest is diminished whereas the incentive to borrow is increased. So, soft money disincentivizes a favorable orientation towards the future. In other words, soft money systems raise society's time preference. For this reason, soft money, once it is sufficiently debased, tends to precede societal collapse (more on this later).

An ideal hard money would be one whose supply is absolutely scarce, meaning no one could produce more of it. The only noncriminal way to acquire money in such a society would be to produce something of value and exchange it for money. As everyone seeks to acquire more money, everyone would become ever-

more productive which would encourage capital accumulation, productivity gains and a lowering of time preference. Since the money supply is fixed, economic growth would cause the prices of real goods and services to drop over time, as a fixed quantity of monetary units chases an increasing quantity of goods. Since people could expect to be able to purchase more with the same amount of money in the future, such a world would discourage immediate consumption and encourage saving and investment for the future. Paradoxically, a world that consistently defers consumption will actually end up consuming more in the long run as its increased savings would increase investment and productivity, thus making its citizens wealthier in the future. This dynamic would spark a positive feedback loop—with present needs met and an ever-greater focus on the future, people naturally begin concentrating other aspects of life such as social, cultural and spiritual endeavors. This is the essence of free market capitalism: people choosing to lower their time preference, defer immediate gratification and invest in the future.

The foundation of all economic growth is delayed gratification, which leads to savings, which leads to investment, which extends the duration of the production cycle and increases productivity in a self-sustaining, virtuous cycle with no known natural limit.

Debt is the opposite of saving. As saving creates the possibility for capital accumulation and its associated benefits, debt is what can reverse it by reducing capital stocks, productivity and living standards across generations. As we will show later, when the gold standard was forcibly ended by governments, money not only became much softer, but it also fell under the command of politicians who are incentivized to operate with high time preferences as they strive for reelection every few years. This explains why politicians continue to mandate the use of soft government money, despite the long-term harm it causes to an economy, ensuring that it remains the dominant form of money in the world (we will cover soft government money's unnatural ascent to world domination later).

When a form of money becomes globally dominant, it finally serves the third function of money—unit of account . History shows us that this function is the final evolutionary stage in the natural ascendancy of monetary goods that achieve a dominant role—which are first a store of value, then a medium of exchange and finally a unit of account. As economist William Stanley Jevons explained:

"Historically speaking, gold seems to have served, firstly, as a commodity valuable for ornamental purposes; secondly, as stored wealth; thirdly, as a medium of exchange; and, lastly, as a measure of value."

Today, the US Dollar is dominant and serves as the global unit of account as prices are most commonly expressed in its terms. This consistency of expression simplifies trade and enables a (somewhat) stable pricing structure for the global economy.

The Economic Nervous System [1]

Market prices are an essential communicative force in economics. As economic production moves from a primitive scale, it becomes harder for individuals to make production, consumption and trade decisions without having a fixed frame of reference (unit of account) which to compare the value of different objects to one another.

In his paper 'The Use of Knowledge in Society' Friedrich Hayek elucidated the economic problem as not merely a matter of allocating human effort. More accurately, the economic problem is one of allocating

human effort according to knowledge that is distributed in the minds of people that are each primarily concerned with their respective area in the broader economy. This distributed knowledge includes the:

Conditions of production

Availability of the factors of production

Preferences of individuals

Knowledge, due to its dynamic and fluid nature, cannot be fully known by a single entity as it is constantly in flux and widely distributed within many minds. In a free market economic system prices capture this distributed knowledge, convert it into impartial information and disseminate it widely. Price signals are the coordinating force of free market systems. Each individual decision maker can faithfully rely on the prices of goods relevant to their production process, as the prices themselves are a distillation of all known market realities into a single, actionable variable. Each individual's buy and sell decisions, in turn, further shape prices which carry this altered information back out into the market. Price signals are to market participants what light is to the eye.

To understand this point, consider the 2010 earthquake which badly damaged an area in Chile responsible for a great deal of the world's copper production. This earthquake severely damaged copper mines and export infrastructure, which immediately reduced the flow of new supply to the world copper market and resulted in a 6.2% increase in its price. Anyone in the world whose business interfaces with the copper market will be affected by this, but they do not need any specific knowledge about the earthquake in Chile or market conditions to decide how to respond. All the relevant information they need to make effective decisions is contained within the price of copper itself. Immediately, all firms that demand copper are incentivized to demand less, delay purchases or find substitutes. On the other side of the market, all firms that produce copper are incentivized to produce more of it. With a natural shift in price, everyone in the world involved in the copper industry is incentivized to act in a way that alleviates the negative consequences of the earthquake. This is the power of a free market with accurate price signals.

The wisdom of the crowd is always superior to the wisdom of the board room. There is simply no way to recreate the adaptivity and collective intelligence of markets by installing a centralized planning authority. How would they decide who should increase production and by how much? How would they decide who should reduce consumption and by how much? How would they coordinate and enforce their decisions in real time on a global scale? In this sense, prices are the economic nervous system that disseminate knowledge across the world and help coordinate complex production processes by:

Incentivizing supply and demand changes to match economic reality and restore market equilibriums quickly

Efficiently matching buyers and sellers in the marketplace

Compensating producers for their work efforts

Without accurate price signals, humans could not benefit from the division of labor and specialization beyond a small scale. Trade allows producers of goods to mutually increase their living standards by specializing in goods in which they have a relative or comparative advantage—goods they can produce

relatively faster, cheaper or better. Accurate prices expressed in a common, stable medium of exchange help people identify their comparative advantage and specialize in it. Specialization, guided by reliable price signals, enables producers to improve their efficiency of production and accumulate capital specific to their craft. This is why the most productive allocation of human efforts is only determinable by an accurate pricing system within a free market. Also (as we will see later), this is exactly why capitalism prevailed over socialism, because socialism lacked an economic nervous system. But before diving into the economic aspects which underpinned this historic ideological struggle and seeing how it is still relevant today, we first need to understand the evolutionary forces that have shaped money throughout history.

Monetary Evolution [1]

Throughout history, money has taken many forms—seashells, salt, cattle, beads, stones, precious metals and government paper have all functioned as money at one or more points in history. Monetary roles are naturally determined by the technological realities of the societies shaping the salability of goods. Even today, forms of money still spontaneously emerge with things like prepaid mobile phone minutes in Africa or cigarettes in prisons being used as localized currencies. Different monetary technologies are in constant competition, like animals competing within an ecosystem. Although instead of competing for food and mates like animals, monetary goods compete for the belief and trust of people. Believability and trustworthiness form the basis of social consensus—the source of a particular monetary good's sovereignty from which it derives its market value along with the trust factors and permissions necessary to transact with it.

As these competitions continue to unfold in a free market, goods attain and lose monetary roles according to the traits which determine how believable or trustworthy they are and are expected to remain over time. As we will show, free market competition is ruthlessly effective at promulgating hard money as it only allows those who choose the hardest form available to maintain wealth over time. This market-driven natural selection causes new forms of money to come into existence and older forms to fade into extinction. Like biologically-driven natural selection, in which nature continuously favors the organisms which are best suited for success in their respective ecologies, this market-driven natural selection is a process in which people naturally and rationally favor the most believable and trustworthy monetary technologies available in their respective trade networks. Unlike ecological competition which can favor many dominant organisms, the marketplace for money is driven by network effects and favors a winner take all (or, at least, a winner take most) dynamic as the non-coincidence of wants problem is universal and if a single hard money is capable of solving all three of its dimensions than it will become dominant (as discussed earlier in the social network aspects of money).

An example of this market-driven natural selection of money comes from the ancient Rai Stones system of Yap Island, located in what is today Micronesia. Rai Stones were large disks of various sizes with a hole in the middle that weighed up to eight thousand pounds each. These stones were mined in neighboring Palau or Guam and were not native to Yap. Acquiring these stones involved a labor-intensive process of quarrying and shipping. Procuring the largest Rai Stones required workforces numbering in the hundreds. Once the stones arrived in Yap, they were placed in a prominent location where everyone could see them. Owners of the stones could then use them as payment by announcing to the townsfolk the transfer of ownership to a new recipient. Everybody in the town would then record the transaction in

their individual ledger, noting the new owner of the stone. There was no way to steal the stone because its ownership was recorded by everyone. In this way, the Rai Stones solved the three dimensions of the non-coincidence of wants problem for the Yapese by providing:

Salability across scales as the stones were various in size and payments could be made in fractions of a stone

Salability across space as the stones were accepted for payment everywhere on the island and did not have to be moved physically, just recorded by the townsfolks' individual ledgers (remarkably similar to Bitcoin's distributed ledger model, as we will see later)

Salability across time due to the durability of stones and the difficulty of procuring new stones which meant that the existing supply of stones was always large relative to any new supply that could be created within a given time period (a high stock-to-flow ratio)

This monetary system worked well until 1871, when an Irish-American captain named David O'Keefe was found shipwrecked on the shores of Yap by the local islanders. Soon, O'Keefe identified a profit opportunity in buying coconuts from the Yapese and selling them to coconut oil producers. However, he could not transact with the locals because he was not a Rai Stone owner and the locals had no use for his foreign forms of money. Undeterred, O'Keefe sailed to Hong Kong and acquired some tools, a large boat and explosives to procure Rai Stones from neighboring Palau. Although he met resistance from them initially, he was eventually able to use his Rai Stones to purchase coconuts from the Yapese. Other opportunists followed O'Keefe's lead and soon the flow of Rai Stones increased dramatically. This sparked conflict on the island and disrupted economic activity. By using modern technologies to acquire Rai Stones more cheaply, foreigners were able to compromise the hardness of this ancient monetary good. The market naturally selected against Rai Stones because, as their stock-to-flow ratio declined, they became less reliable as a store of value and thus lost their salability across time, which ultimately led to the extinction of this ancient monetary system.

A similar story played out in western Africa which for centuries used aggry beads as money. These small glass beads were used in a region where glassmaking was an expensive craft, which gave them a high stock-to-flow ratio and made them salable across time. Since aggry beads were small and light they could easily be combined into necklaces or bracelets and transported easily, thus giving them salability across scales and space. In the 16th century, European explorers discovered the high value ascribed to these beads by the west Africans and began importing them in mass quantities; as European glassmaking technology made them extremely cheap to produce. Slowly but surely, the Europeans used these cheaply produced beads to acquire most of the precious resources of Africa. The net effect of this incursion into Africa was the transference its vast natural resource wealth to Europeans and the conversion of aggry beads from hard money to soft money. Again, the market naturally selected against a monetary good once its stock-to-flow ratio began to decline, as its store of value functionality and, therefore, its salability across time were compromised as a result. Although the details vary, this underlying dynamic of a declining stock-to-flow ratio presaging a good's loss of its monetary role has been the same for every form of money throughout history. Today, we are seeing a similar pattern cause the collapse of the Venezuelan bolivar, (where some Venezuelans are using Bitcoin to protect their wealth as the currency collapses).

As societies continued to evolve, they began to move away from artifact money like stones and glass beads and towards monetary metals. It was initially difficult to produce most metals which kept their supply flows low, thus giving them good salability across time. Gold in particular, with its extreme rarity in the Earth's crust and its virtual indestructibility, made it an extremely hard monetary technology. Gold mining was difficult, limiting supply increases relative to its existing supply, which itself could not be destroyed. Gold gave humans a way to store value across generations and develop a longer-term perspective on their actions (a lower time preference), which led to the proliferation of ancient civilizations:

The earliest coins are found mainly in the parts of modern Turkey that formed the ancient kingdom of Lydia. They are made from a naturally occurring mixture of gold and silver called electrum.

Monetary Metals [1]

The last dictator of the Roman Republic, Julius Caesar, issued a gold coin called the aureus coin which contained a standard 8 grams of gold. The aureus was traded widely across Europe and the Mediterranean, alongside a silver coin called the denarius, which was used for its superior salability across scales. Used together, these coins provided a hard money system that increased the scope of trade and specialization in the Old World. The republic became more economically stable and integrated for 75 years until the infamous emperor Nero came into power.

Nero was the first to engage in the act of coin clipping in which he would periodically collect the coins of his citizenry, melt them down and mint them into newer versions with the same face value but less precious metal content, keeping the residual content to enrich himself. Similar to modern day inflation, this was a way of surreptitiously taxing the population by debasing its currency. Nero and successive emperors would continue the practice of coin clipping for several hundred years to finance government expenditures:

Isaac Newton is attributed with adding the small stripes along the edges of coins as a security measure against coin clipping. These stripes are still present on most coins today.

Citizens gradually wised up to this deceit and began hoarding the coins with higher precious metal content and spending the debased coins, as they were legally required to be accepted at face value in settlement of debts, one of the earliest instances of legal tender laws being implemented. This had the effect of driving up the price of coins with higher precious metal content and driving down the price of those with less—a dynamic that came to be known as Gresham's Law: bad money (soft money) drives good money (hard money) out of circulation. This is an important law to recall when we look at how modern-day hoarding of Bitcoin impacts its price.

Eventually, a new coin called the solidus was introduced which contained only 4.5 grams of gold, almost half the content of the original aureus coin. Pursuant to this decline in monetary value, a cycle familiar to many modern economies running on government money began to take hold—coin clipping reduced the money's real value, increased the money supply, gave the emperor the means to continue imprudent spending and eventually ended with rampant inflation and economic crisis. Analogous to central bank practices today, Swiss banker Ferdinand Lips summarized this era well:

"Although the emperors of Rome frantically tried to 'manage' their economies, they only succeeded in making matters worse. Price and wage controls and legal tender laws were passed, but it was like trying to hold back the tides. Rioting, corruption, lawlessness and a mindless mania for speculation and gambling engulfed the empire like a plague."

Amid the chaos of the crumbling Roman Republic, Constantine the Great took power. Intent on restoring the once great empire, Constantine began adopting responsible economic policies. He first committed to maintaining the solidus at 4.5 grams of gold, ended the practice of coin clipping and began minting massive quantities of these standardized gold coins. Constantine then moved east and established Constantinople in modern day Istanbul. This became the birthplace of the Eastern Roman Empire, which adopted the solidus as its monetary system.

Rome continued its soft money-induced cultural deterioration until it finally collapsed in 476 AD. Meanwhile, Constantinople flourished. The solidus, which eventually became known as the bezant, provided a hard money system with which Constantinople would remain prosperous and free for centuries to come. As with Rome before it, the fall of Constantinople happened only when its rulers began the debasing its currency around 1050 AD. As with Rome before it, the move away from hard money led to the fiscal and cultural decline of the Eastern Roman Empire. After suffering many successive crises, Constantinople was ultimately overtaken by the Ottomans in 1453. However, the bezant inspired another form of hard money that still circulates to this day, the Islamic dinar. People all over the world have used this coin for over seventeen centuries — which began as the solidus before changing its name to the bezant and finally becoming the Islamic dinar — for transactions, thus highlighting the superior salability of a hard money such as gold across time.

Following the collapse of the Roman Empire, Europe fell into the dark ages. It was the rise of the city-state (a new story mankind would begin organizing itself around) and its use of hard money systems that would pull Europe out of the Dark Ages and into the Renaissance. Beginning in Florence in 1252, the city minted the florin which was the first major European coinage issued since Julius Caesar's aureus. By the end of the 14th century more than 150 European cities and states had minted coins to the same specifications as the florin. By giving its citizenry the ability to accumulate wealth in a reliable store of value which could be traded freely across scales, space and time, this hard money system unlocked scientific, intellectual and cultural capital within the Italian city-states and eventually spread to the rest of Europe. Of course, the situation was far from perfect, as there were still many periods marked by various rulers choosing to debase their currencies to finance war or lavish expenditure.

Global Gold Standard [1,4]

When they were being used as physical means of settlement, gold and silver coins served complementary roles. Silver, having a stock-to-flow ratio second only to that of gold, had the advantage of being a more salable metal across scales, since its lower value per weight than gold made it ideal as a medium of exchange for smaller transactions. In this way, gold and silver were complementary as gold could be used for large settlements and silver could be used for smaller payments. However, by the 19th century, with the development of modern custodial banking and advanced telecommunications, people were increasingly able to transact seamlessly across scales using bank notes or checks backed by gold:

The US Dollar was once redeemable for gold on demand.

With all of the critical salability characteristics gathered under a gold standard monetary system facilitated by paper bank notes, the superior salability across scales of physical silver lost relevance, setting it up to become demonetized (due to the winner take all dynamic discussed earlier). Ironically, the same banking industry that enabled a global gold standard would in later years see to its elimination (more on this later).

A brief aside on silver: This demonetization dynamic also explains why the silver bubble popped many times throughout history when facing off with gold and will pop again if it ever reflates. Since silver is not the hardest form of monetary good available, should any significant investment flow into silver, its producers will be incentivized to increase the flow of silver, and store any value expropriated from its increased production in the hardest form of money available to them (which, before Bitcoin, was only gold). This, of course, will bring the price of silver crashing back down, taking the wealth from the investment inflows with it. As a more recent historical example of this dynamic in action: In the 1970s, the affluent Hunt brothers attempted to remonetize silver by buying vast quantities of it in the market. This drove up the price initially, and the Hunt brothers believed they could continue driving up its price until they cornered the market. Their intent was to induce others to chase its appreciation and recreate a monetary demand for silver. As they kept buying and the price kept rising, silver holders and producers kept selling into the market. No matter how much the Hunt brothers purchased, the selling and flow of silver continued to outpace their buying, which decreased its stock-to-flow ratio and eventually led to a dramatic crash in the price of silver. The Hunt brothers lost over $1B (due to rampant inflation of government money since then, their losses equal $6.5B in 2019 dollars) in the ordeal, which is likely the highest price ever paid for learning the importance of hard money and its defining metric, the stock-to-flow ratio.

Driven by expanding telecommunication and trade networks, and with custodial banks enhancing its salability across scales by issuing gold-backed bank notes and checks, the gold standard spread quickly. More nations began switching to paper based monetary systems fully backed by and redeemable in gold.

Network effects took hold as more nations moved onto the gold standard, giving gold deeper liquidity, more marketability and creating larger incentives for other nations to join.

Those nations which remained on a silver standard the longest before converting, like China and India, witnessed tremendous devaluations of their currencies in the intervening period. The demonetization of silver for China and India was an effect similar to the west Africans holding aggry beads when Europeans arrived. Foreigners who adopted the gold standard were able to gain control over vast quantities of the capital and resources in China and India. This drives home a key point: every time hard money encounters a softer form of money in a trade network, the softer money is ultimately outcompeted into extinction.

This dynamic has significant consequences for the holders of soft money and is an important lesson for anyone who believes their refusal of Bitcoin means they are protected from its economic impact. History shows us repeatedly that it is not possible to protect yourself from the consequences of others holding money that is harder than yours.

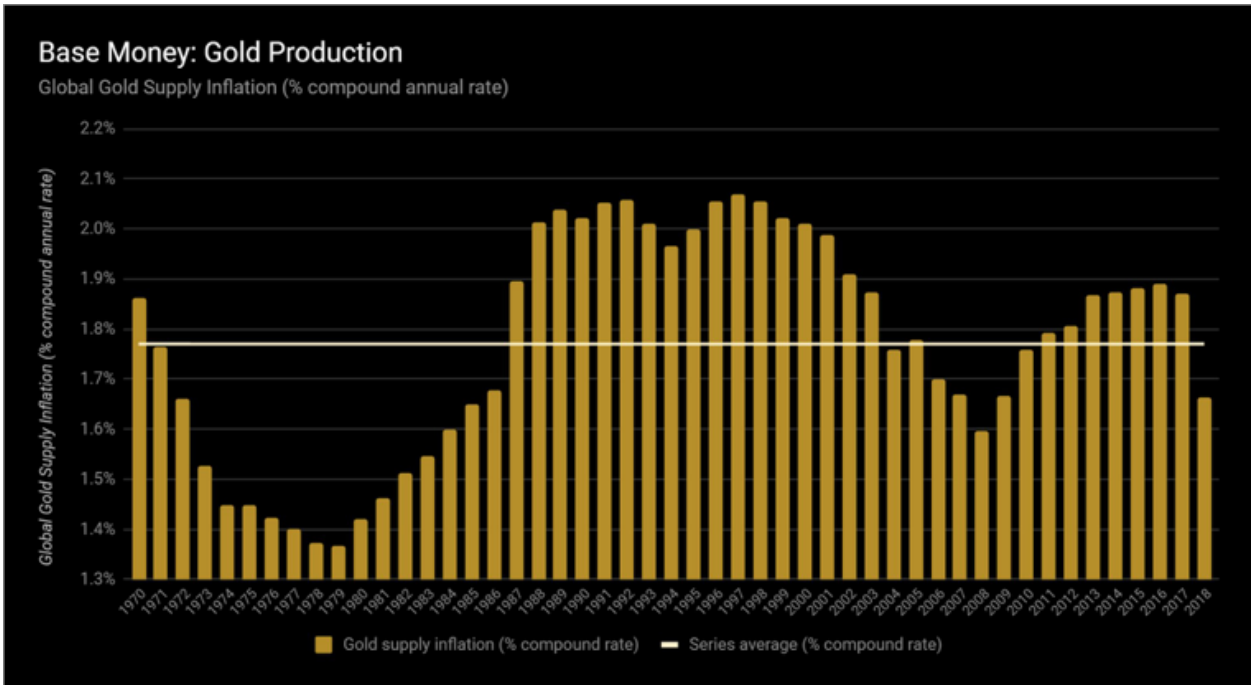
Finally, for the first time in history, the majority of the world economy began operating on a gold-based, hard money standard that was naturally selected for by the free-market.

Hardness of Gold [1,3]

By this point in history, virtually everyone had come to fully trust gold's superior stock-to-flow ratio and therefore believed they could use it to reliably store value across time. After thousands of years of mining this chemically stable element, virtually all the gold ever procured by humans is still a part of its extant supply. The stock of all the gold in the world fits into an Olympic-sized swimming pool today and is valued at almost $8T USD. Gold is rare in the Earth's crust and extraction is costly in terms of time and energy, which keeps its flow predictably low. It is impossible to synthesize gold by chemical means (as alchemy never panned out) and the only way to increase its supply is through mining.

The costliness of gold mining is the skin in the game necessary to increase its flow—the risk necessary to procure the reward. Skin in the game is a concept based on symmetry, a balance of incentives and disincentives: in addition to upside exposure, people should also be penalized if something for which they are responsible for goes wrong or hurts others. Skin in the game is the central pillar for properly functioning systems and is at the heart of hard money. For gold, its mining costs and risks form the disincentives which are balanced against the incentives of its market price. Unless consequential decisions are made by people who are exposed to the results of their decisions, the system is vulnerable to total collapse (an important consideration when we discuss soft government money later).

Every market-driven evolutionary step for money has naturally selected the form with the highest stock-to-flow ratio available to its population but stopped when the form lost this key property. With the highest stock-to-flow ratio of all the monetary metals, gold is the hardest physical form of money that has ever existed, which explains its success as hard money throughout history. Even with advances in mining techniques, gold still has a relatively low and predictable flow, as evidenced by its annual supply growth since 1970:



The rarity of gold in the Earth's crust ensures that its new supply flows are relatively low and predictable. Since gold is virtually indestructible, nearly every ounce that has ever been mined throughout history is still part of current supply stocks. The combination of these factors gives gold the highest stock-to-flow ratio of any monetary metal and is precisely the reason gold became a global hard money standard.

Gold mining, of course, only makes economic sense if the cost of producing an additional ounce of gold is less than gold's market price per ounce. Relatedly, when the price of gold increases, its mining becomes more profitable and draws new miners into the market and makes new methods of gold mining economically feasible. This, in turn, increases the flow of gold until supply and demand forces again reach equilibrium. So, although gold is the hardest form of physical money, it doesn't have perfect hardness as changes in demand for it elicit both a supply and price response, meaning:

An increase in the demand for gold increases its price,

An increase in the price of gold incentivizes gold miners to increase its flow,

An increase in the flow of gold increases its supply

An increase in the supply of gold puts downward pressure on its price

In this way, changes in demand for gold are expressed partially in its price and partially in its supply flow. This price elasticity of supply is true for all physical commodities. For all practical purposes, as we will see later, the Earth always has more natural resources to yield assuming the right amount of time and effort are directed towards their production (this will support an important point later when we look at the impact of changes in demand on Bitcoin's price).

Final Settlement [1]

Gold also has the advantage of being an instrument of final settlement . Whereas the use of government money requires trust in the monetary policy and creditworthiness of the issuing authority or payment intermediaries, known as counterparty risk, the act of physically possessing gold comprises all of the trust factors and permissions necessary to use it as money. This makes gold a self-sovereign form of money. This is best understood as an identity of the universal accounting equation: Assets = Liabilities + Owner's Equity

When you own gold free and clear, it is your asset and no one else's liability, meaning that your personal balance sheet includes a 100% gold asset matched by 0% liabilities and 100% owner's equity (since no one else has a claim on your gold asset). This makes gold a bearer instrument, meaning that any individual in physical possession of the asset is presumed to be its rightful owner. This timeless and trustless nature of gold is the reason why it still serves as the base money and final settlement system of central banks worldwide.

In the 19th century, the term cash referred to central bank gold reserves, which was the dominant self-sovereign monetary good at the time. Cash settlement referred the transfer of physical gold between central banks to execute final settlement. Central banks can only settle with finality in physical gold, and still do so periodically in the modern era, since it is the only form of money that requires no trust in any counterparty, is politically neutral and gives its holders full sovereignty over their money. This is why gold maintains its monetary role even today as only the delivery of a bearer instrument can truly be the final extinguisher of debt. In this original sense of the word cash, gold is the only form of dominant cash money that has ever existed (although Bitcoin is well-suited to serve a similar role in the digital age, more on this later). Unfortunately, the combination of gold's self-sovereignty and physicality would lead to the demise of the gold standard.

Centralization of Gold [1,4]

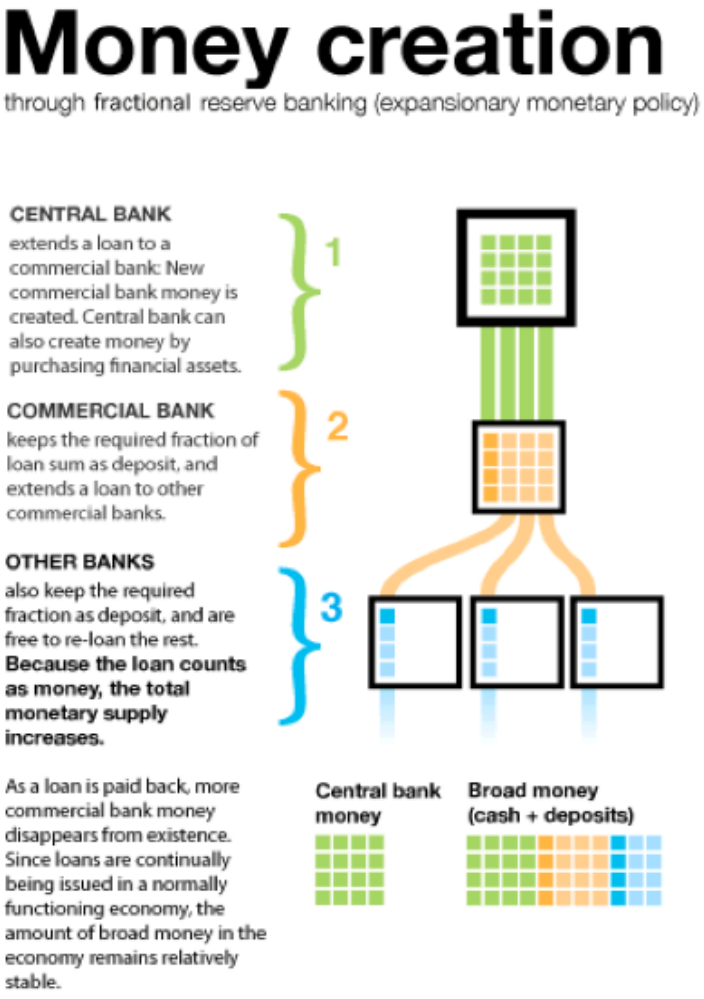
By the end of the 19th century, all the industrialized nations of the world were officially on the gold standard. By virtue of operating on a hard money basis, most of the world witnessed unprecedented levels of capital accumulation, free global trade, restrained government and improving living standards. Some of the most important achievements and inventions in human history were made during this era, which came to be known as la belle époque across Europe and the Gilded Age within the United States. This golden era enabled by the gold standard remains one of the greatest periods in human history:

"La Belle Époque was a period characterized by optimism, regional peace, economic prosperity, an apex of colonial empires, and technological, scientific, and cultural innovations. In the climate of the period, the arts flourished. Many masterpieces of literature, music, theater, and visual art gained recognition."

As multiple societies had now converged on gold as their universal store of value, they experienced significant decreases in trade costs and an attendant increase in free trade and capital accumulation. La Belle Époque was an era of unprecedented global prosperity. However, the hard money gold standard which catalyzed it suffered from a major flaw: settlement in physical gold cumbersome, expensive and insecure. This flaw is associated with the physical properties of gold, as it is dense, not deeply divisible and

not easily transactable. Gold is expensive to store, protect and transport. It is also heavy per unit of volume which makes it difficult to use for day to day transactions. As discussed earlier, banks built their business model around solving these problems by providing secure custody for people's gold hoards. Soon after, banks began issuing paper bank notes that were fully redeemable in gold. Carrying and transacting with paper bank notes backed by gold was much easier than using actual gold. Offering superior utility and convenience, the use of bank notes flourished. This, along with government programs to confiscate gold from citizens (such as Executive Order 6102 in the United States), encouraged the centralization of gold supplies within bank vaults all over the world.

Incapable of resisting the temptation of wealth expropriation by tampering with the money supply, banks soon began issuing more notes than their gold reserves could justify, thus initiating the practice of fractional reserve banking . This banking model facilitated the creation of money without any skin in the game. Governments took notice and began to gradually take over the banking sector by forming central banks, as this model enabled them to engage in seigniorage, a method of profiting directly from the money creation process:



In fractional reserve banking artificial money and credit is created. For instance, assuming a reserve ratio of 10% and an initial deposit of $100 will soon turn into $190. By lending a 90% fraction of the newly created $90, there will soon be $271 in the economy. Then $343.90. The money supply is recursively increasing, since banks are literally lending money they don't have. In this way, banks magically transform $100 into over $1,000.

The ability to control this process was too tempting for governments to resist. Total control of over the money supply gave those in charge a mechanism to continually extract wealth from its citizenry. The virtually unlimited financial wealth the printing press provided gave those in power the means to silence dissent, finance propaganda and wage perpetual warfare. It is a fundamental economic reality that wealth cannot be generated by tampering with the money supply, it can only be manipulated and redistributed. Civilization itself relies on the integrity of the money supply to provide a solid economic foundation for free trade and

capital accumulation. With a firm grip on the prevailing monetary order established, the next logical step for central banks was to begin moving away from the gold standard altogether.

Abolishing the Gold Standard [1]

By 1914, most of the major economies had begun printing money is excess of their gold reserves at the onset of World War I. Unsurprisingly, this had many negative consequences, some of which were immediate while others came on more slowly. Eliminating the gold standard immediately destabilized the unit of account by which all economic activity was assessed. Government currency exchange rates would now float against one another and become a source of economic imbalance and confusion. This distorted price signals, which would now be denominated in various government currencies with rapidly fluctuating exchange rates. This made the task of economic planning as difficult as trying to build a house with an elastic measuring tape.

For a world that was becoming increasingly globalized and technologically sophisticated, freely floating currency exchange rates represented a significant step backwards and gave rise to what is commonly called a 'a system of partial barter'. For people to buy goods from other people who lived on the other side of any number of imaginary lines called national borders, they would now be required to use more than one medium of exchange (their own currency and the foreign currency) to complete the transaction. To an extent, this reignited the non-coincidence of wants problem which money was meant to solve in the first place. Today, over $5T ($5,000,000,000,000) of foreign currencies are exchanged daily, forming an annual market valued at over 12 times global GDP. This industry is purely parasitic — it enriches bankers and sucks real value out of society in the form of global trade frictions, market distortions and transaction fees. For this reason, it is excluded from GDP calculations and exist solely because of the inefficiencies caused by centrally controlled capital markets and the absence of a global, politically neutral hard money system. The resultant frictions to global trade fanned the flames of warfare.

Governments Take Control [1,3]

As 20th century wars raged, so did the printing presses. Governments and their central banks continued to grow more powerful with each new bank note printed as their citizens became poorer. The death stroke came when most governments, due to a unilateral decision of President Nixon in United States, finally severed the peg to gold entirely in the 1971. Which brings us to the modern form of dominant money: government fiat money . Fiat is a Latin word meaning decree, order or authorization. This is why government money is commonly referred to as fiat money, since its value exists solely because of government decree:

Today, the US Dollar is not redeemable for anything and its value is derived solely from government decree. Paradoxically, people were coerced into adopting soft government fiat money only because of their shared belief in gold as a hard monetary good.

This is an imperative point: it was possession of gold (self-sovereign, hard money) that gave governments the power to decree the value of their fiat money (soft money) in the first place. National governments were only able to achieve "sovereignty" because they drew this power from their possession of gold. Paradoxically, people were coerced into discarding the gold standard and adopting soft government fiat money only because of their belief in gold as a hard monetary good. This is proof that it is possible to create an artificial asset and endow it with monetary properties, whether by decree or by market-driven natural selection. Governments did so by stealing gold from citizens, which gave them the power to create fiat money and decree its value by force. As we will later see, Satoshi Nakamoto did so by creating Bitcoin and releasing it into the marketplace as a self-sovereign money free to compete for the trust and belief of the people based on its own merits.

Central banks also began engaging in propaganda campaigns declaring the end of gold's monetary role. However, their actions rang louder than their words as they continued to accumulate and hold gold, a practice they continue to this day. Gold remains the exclusive instrument of final settlement between central banks. Strategically, holding large gold reserves also makes sense for central banks since they can opt to sell reserves into the market should gold start to appreciate too quickly and threaten the value of fiat money. With their monopoly position protected and reinforced by legal tender laws, propagandists and sufficient control of the gold market central banks were free to print money at will. This exorbitant privilege gives central banks extraordinary power and made them extremely dangerous entities. In the words of former US President Andrew Jackson spoken at the Constitutional Convention in 1787:

"I believe that banking institutions are more dangerous to our liberties than standing armies. If the American people ever allow private banks to control the issue of their currency, first by inflation, then by deflation, the banks and corporations that will grow up around them will deprive the people of all property until their children wake up homeless on the continent their fathers conquered. The issuing power should be taken from the banks and restored to the people, to whom it properly belongs."

Unlike to the flow restrictions associated with gold mining, there are practically no economic restraints preventing a government from printing more fiat money. Since there is virtually no cost associated with producing additional units (no skin in the game), government fiat money is the softest form of money in the history of the world. Predictably, money supplies grew quickly, especially in the heat of warfare. In the past, for societies operating with hard money systems, once the tide of war had shifted in favor of one belligerent over the other, treaties were quick to be negotiated as war is an extraordinarily expensive endeavor. The fiat money printing press, on the other hand, gave governments the ability to tap the aggregate wealth of entire populations to finance military operations by implicitly taxing them via inflation. This provided a more secretive, implicit method of funding warfare than explicit taxation or selling government wartime bonds. Wars began lasting much longer and became more violent. It is no coincidence that the century of total war coincided with the century of central banking:

Table 5.1 Conflicts steadily cost more in human lives

Period	Conflict-related deaths (millions)	World population, mid-century (millions)	Conflict-related deaths as share of world population (%)
Sixteenth century	1.6	493.3	0.32
Seventeenth century	6.1	579.1	1.05
Eighteenth century	7.0	757.4	0.92
Nineteenth century	19.4	1,172.9	1.65
Twentieth century	109.7	2,519.5	4.35

The ability to print unlimited quantities of money gives governments a means to finance military operations by implicitly taxing their citizens via inflation. This provides a more secretive method of funding warfare then explicit taxation or selling government wartime bonds. Resultantly, wars have grown in duration and violence.

As is to be expected, soft government money has an abysmal track record as a store of value. This becomes abundantly clear when we look at its inflationary effects on the price of gold. An ounce of gold in 1971 was worth $35 USD, and today is worth over $1,200 USD (a decrease of over 97% in the value of each dollar due entirely to inflation). Based on these figures, it is easy to see that gold continues to appreciate as its supply is increased less quickly than the supply of $USD (government fiat money). The constantly increasing supply of government money means its currency depreciates continuously, as wealth is stolen from the holders of the currency (or assets denominated in it) and transferred to those who print the currency or receive it earliest. This transfer of wealth is known as the Cantillon Effect: the primary beneficiaries from expansionary monetary policy are the first recipients of the new money, who are able to spend it before it has entered wider circulation and caused prices to rise. Generally, this is why inflation hurts the poorest and helps the bankers, who are closest to the spigot of liquidity (the government fiat money printing press) in the modern economy. A centrally planned market for money like this completely contradicts the principles of free market capitalism.

Free Market Capitalism versus Socialism [1]

In a socialist system, the government owns and controls all means of production. This ultimately makes the government the sole buyer and seller of all capital goods in its economy. Such centralization stifles market functions, like price signals, and makes decision making highly ineffective. Without accurate pricing of capital goods to signal their relative supply, demand and relevant market conditions, there is no rational way to determine the most productive allocation of capital. Further, there is no rational way to determine how much to produce of each capital good. Scarcity is the starting point of all economics and people's choices are meaningless without skin in the game in the form of price or trade-offs. A survey without a price would find that everyone wants to own a private island but when price is included, very few can afford to own a private island. The point here is not to trumpet free market capitalism over socialism, but rather to clearly explicate the difference between the two ways of allocating resources and making production decisions:

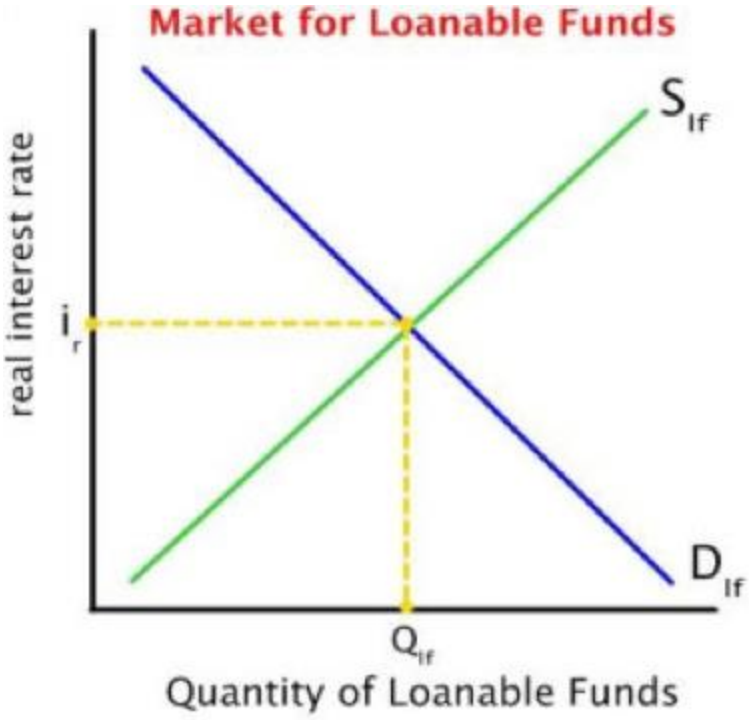
Free Market Capitalism places trust in Price Signals

Socialism places trust in Centralized Planning

A free market is one in which buyers and sellers are free to transact on terms determined solely by them, where entry and exit into the market are free and no third parties can restrict or subsidize any market participants. Most countries today have well-functioning, relatively free markets. However, every country in the world today engages in centralized planning of the market for money (aka the market for financial capital) itself.

No country in the world today has a free market for money, which is the most important market in any economy.

In a modern economy, the market for money consists of the markets loanable funds . These markets match savers with borrowers using the interest rate as their price signal. In a free market for loanable funds, the supply of loanable funds rises as the interest rate rises, as more people are willing to loan their savings out at a higher price. Conversely, the demand for loanable funds decreases as the interest rate rises, as less people are inclined to borrow funds at a higher price:



In a free market for money, the interest rate (the price of money) is determined by natural supply and demand dynamics. Central banks attempt to "manage" these market forces and in doing so create recessions and the boom-and-bust business cycle which is now considered "normal" in the modern era.

Notice that the interest rate in a free market for capital is always positive because of people's naturally positive time preference, meaning that no one would part with money unless they could receive more of it in the future. These natural market forces are artificially manipulated in every market for money in the world. All markets for money in the world today are centrally planned by central banks, who are responsible for "managing" the market for loanable funds using monetary policy tools. Since banks today also engage in fractional reserve banking, they lend out not only customers' savings, but also their demand deposits (monies available to customers on demand, like checking accounts). By loaning out demand deposits to a borrower while simultaneously keeping them available to the depositor, banks can effectively create new, artificial money (a part of the money creation process from earlier). Central banks have the power to manipulate the market for financial capital and can artificially increase the money supply by:

Reducing interest rates, which increases demand for borrowing and money creation by banks

Lowering the required reserve ratios, allowing banks to lend more money out than their capital reserves justify

Purchasing government debt or other financial assets with newly created money in the open market

Relaxing lending eligibility criteria, allowing banks to increase lending activities and money creation

In a free market for money, the exact amount of savings equals the exact amount of loanable funds available to borrowers for the production of capital goods. This is why the availability of capital goods, as we saw with Harold and Louis, is inexorably linked to a reduction in consumption. Again, scarcity is the starting point of all economics, and its most important implication is the notion that all decisions involve tradeoffs.

In the free market for money, the opportunity cost of saving is foregone consumption, and the opportunity cost of consumption is foregone saving — an indisputable economic reality.

No amount of centralized planning can alter this fundamental economic reality. This is why centrally planned markets always suffer from distortions (aka bubbles, surpluses or shortages) as political agendas run up against the underlying free market forces. Undeterred, central banks continually attempt to "manage" these market forces to achieve politically established policy goals. Most often, central banks are trying to spur economic growth and consumption, so they will increase the supply of loanable funds and lower the interest rate. With the price of loanable funds (the interest rate) artificially suppressed, producers take on more debt to start projects than there are savings to finance these projects. These artificially low interest rates don't provide any benefit to the economy, rather they simply disseminate distorted price signals that encourage producers to embark on projects which cannot realistically be financed from actual savings. This creates a market distortion (in other words, blows up another bubble) in which the value of consumption deferred is less than the value of the savings borrowed. This distortion can persist for some time but will inevitably unwind with disastrous consequences as economic reality cannot be fooled for long.

The excess supply of loanable funds, backed by no actual deferred consumption, initially encourages producers to borrow as they believe the funds will allow them to buy all the capital goods necessary for their project to succeed. As more producers borrow and bid for the same amount of capital goods, inflation sets in and prices begin to rise. At this point, the market manipulation is exposed since the projects become unprofitable after the rise in capital good prices (due to inflation) and suddenly begin to fail. Projects like these would not have been undertaken in the first place absent the distortions in the market for money created by central banks. An economy-wide simultaneous failure of overextended projects like this is called a recession . The boom and bust business cycle we have all grown accustomed to in the modern economy is an inevitable consequence of this centrally planned market manipulation. The United States and Europe saw a great illustration of this process when the dot-com bubble of the late 1990s was replaced by the housing bubble of the mid-2000s.

Free market capitalism cannot function without a free market for money.

As with all well-functioning markets, the price of money must emerge through the natural interactions of supply and demand. Healthy markets require functional nervous systems, as market participants must have accurate price signals to make decisions effectively. Basic economics shows us clearly that central bank meddling in the market for money is the root cause of all recessions and the business cycle. By imposing an artificial price, in this case the interest rate on loanable funds, central banks inhibit natural price signals which coordinate allocation decisions among savers and borrowers. Their market manipulation creates market distortions and recessions. Attempting to remedy a recession by injecting more artificial liquidity into the system will only exacerbate the distortions which caused the crisis in the first place and blow up new bubbles. Only central planning of a soft money supply and its pricing mechanism can cause widespread failures in an economy like this, as an economy based on hard money remains firmly rooted in economic reality and resists market distortions.

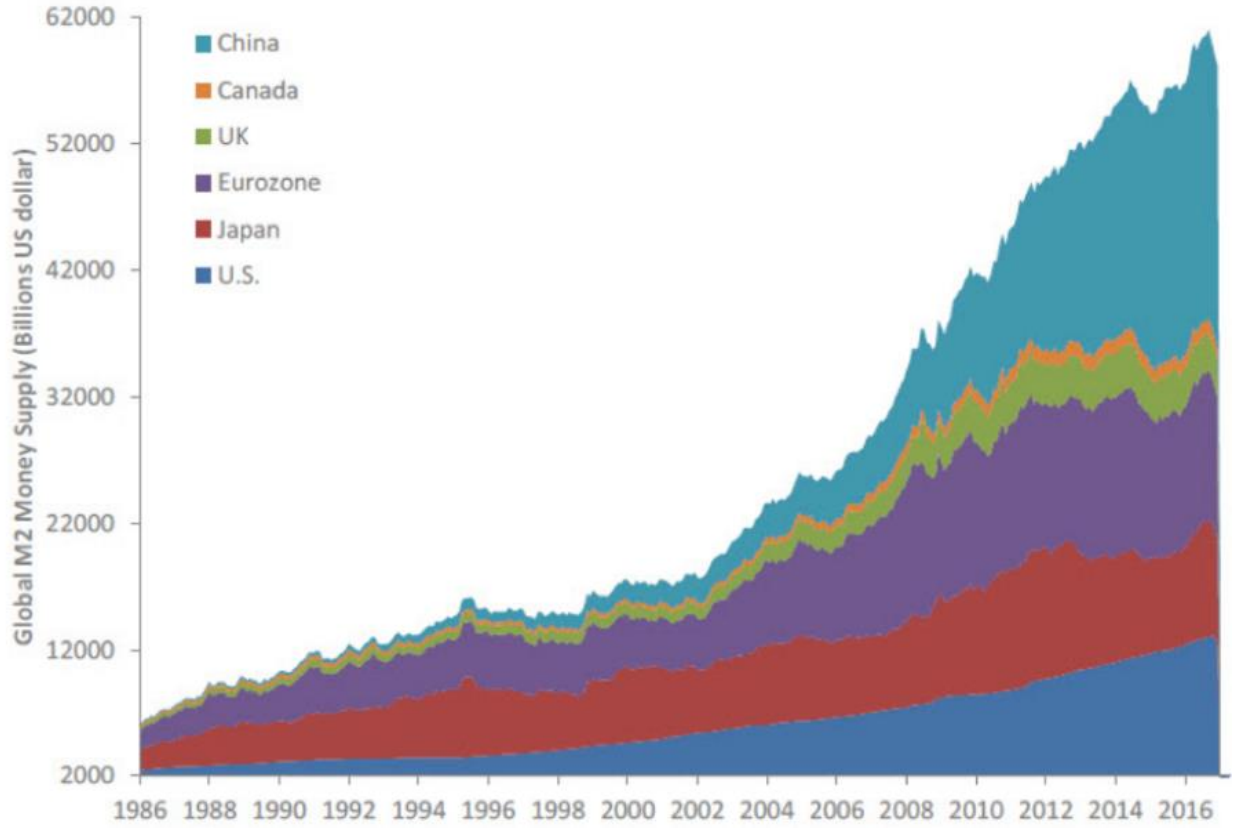
Alignment with natural market forces like supply, demand and the price signal is the principal reason free market capitalism prevailed over socialism.

Failure of Government Fiat Money [1,3,4]

Seeing that governments have been forced to use coercive measures, such as confiscating gold and implementing legal tender laws, to enforce adoption of fiat money is a clear indication that soft money is inferior and doomed to fail in a free market. This severe inadequacy of government fiat money came to the forefront of global consciousness in the wake of the Great Recession that began in 2008. Due to gigantic market distortions driven by artificially low interest rates and credit ratings agencies with no skin in the game, US subprime real estate became the largest bubble in modern history. When it bursts, its affects were globally systemic, and central banks all over the world (predictably) began increasing their money supplies in an attempt to reflate their broken economies.

Instead of calling it what really is, central banks now deceptively refer to the act of printing money as quantitative easing. As we have learned, increasing the money supply creates no real economic value, it only causes market distortions and furthers the misallocation of capital. Injecting liquidity into an economic system experiencing a recession only provides illusory, temporary relief. Printing money delays and exacerbates the inevitable correction, as economic reality cannot be deceived forever. Despite economic reality, central bank market manipulation is worse than ever.

Here we show the amount of government fiat money printed by the largest economies of the world since 1986:



Money supply growth by global central banks is accelerated after each recession. This artificial liquidity

only provides illusory relief and further distorts the market signals which caused the distortions in the first place.

It was in the depths of the Great Recession that an anonymous individual named Satoshi Nakamoto introduced the open-source software project called Bitcoin to an online group of cryptographers. Many attempts at creating a digital cash had been made over the previous twenty years but none had succeeded. Initially, few in the group took Bitcoin seriously. However, Nakamoto was eventually able to convince a few other cryptographers to join and the Bitcoin network was born.

After ten years of virtually perfect operation, the Bitcoin network has gone from $0 to $80B in value stored on its network and has cleared $1.38T in total transactions. It is clear that this monetary technology is now competing successfully in the marketplace and is being used by many for real world purposes.

Synthesized Works & Further Reading

[1] *The Bitcoin Standard: The Decentralized Alternative to Central Banking* by Saifedean Ammous (a masterful work on which much of this essay is based)

[2] *The Rational Optimist* by Matt Ridley

[3] *Skin in the Game* by Nassim Nicholas Taleb

[4] *The Bullish Case for Bitcoin* by Vijay Boyapati

[5] *The Age of Cryptocurrency* by Paul Vigna and Michael J. Casey

[6] *Sapiens* by Yuval Harari

[7] Bitcoin is a Decentralized Organism, *Part 1* and *Part 2* by Brandon Quittem

[8] *PoW is Efficient* by Dan Held

[9] *The Fifth Protocol* by Naval Ravikant

[10] *Unpacking Bitcoin's Social Contract* by Hasu

[11] *Antifragile* by Nassim Nicholas Taleb

[12] *Letter to Jamie Dimon* by Adam Ludwin

[13] *Placeholder VC Investment Thesis Summary* by Joel Monegro and Chris Burniske

[14] *Diffusion of Innovations* by Everett M. Rogers

[15] *Why America Can't Regulate Bitcoin* by Beautyon

[16] *Hyperbitcoinization* by Daniel Krawisz

Money, Bitcoin and Time: 2 of 3

By Robert Breedlove

Posted January 26, 2019

This is part 2 of a 3 part series

Money, Bitcoin and Time: 1 of 3

Money, Bitcoin and Time: 2 of 3

Money, Bitcoin and Time: 3 of 3

The Simple Truth about Bitcoin: Bitcoin is the hardest form of money ever invented. It has successfully brought the advantages of physical cash money into the digital realm. Bitcoin is changing the way people organize themselves. The next chapter in the story of money is being written in a new language...

Grasping Bitcoin [7]

Bitcoin seems easy to understand at first (it's just magic internet money, right?), however truly grasping its significance is a formidable task. Once you think you have Bitcoin figured out, you'll see it from another perspective and realize how little you actually knew. This pursuit of understanding Bitcoin is like a mountain climber that continually encounters false peaks, which fool him into thinking he has reached the summit, only to realize it is higher still.

It has been said that you can judge the quality and importance of an idea by the vehemence of its opposition. Bitcoin has been called many things – digital gold, tulip mania 2.0, financial revolution, the MySpace of cryptocurrencies, environmental disaster, rat poison squared, libertarian idealism, apex predator of monetary technologies, the biggest bubble in history, the model-T of cryptocurrencies, a superior species of money – but it turns out that, in context of the history and nature of money, Bitcoin appears to be a distinct evolutionary leap forward. Bitcoin is not an internet application like MySpace, it is an internet protocol. Bitcoin is not the model-T of cryptocurrencies, it is a more like a global freeway system. Bitcoin is not like any type of gold coin, Bitcoin is more like the element gold. Its integrity is protected by the inviolable laws of mathematics. Human nature is one of its core components. It is a new form of social institution. Bitcoin is a living system unto itself that adapts to environmental changes.

This may sound mind blowing at first. Most innovations of this magnitude sound this way in the beginning as we struggle to communicate using outdated terms and analogies that cannot possibly convey their importance. However, history shows us that ignoring innovation is a terrible strategy. In light of its

inherent complexity and novelty, we will view Bitcoin from many different perspectives in an attempt to create a mosaic of understanding in the minds of our readers. First and foremost, Bitcoin is digital cash money .

Digital Cash Money [1]

As the global economy becomes increasingly digitized and interconnected, new technological realities are taking shape which will cause the market to naturally select for the most effective species of money native to this new digital terrain. Bitcoin is the first truly digital solution to the problem of money. It is the world's first digital cash (in the original sense of the word cash discussed earlier) meaning that it is under the full control of its owner and can be used for final settlement in the same way as gold is today. Put another way, Bitcoin is digital cash money, a self-sovereign asset that contains within it all the trust factors and permissions necessary to transact with it. Bitcoin is not the liability of any counterparty, hence its nickname—digital gold.

Like gold, Bitcoin is a supranational form of money, meaning that no government needs to decree its value or permit its use, nor can it be eliminated unilaterally by regulation. The hardness of Bitcoin is superior to all forms of money, including gold, and its stock-to-flow ratio will eventually reach infinity. As a digital asset, Bitcoin has unprecedented levels of salability across scales, space and time. It is resistant to confiscation, censorship, inflation and counterfeit. Meritoriously, Bitcoin's value is attained entirely from the social consensus it earns by competing freely in the marketplace.

As one perspective of its monetary significance, Bitcoin can be understood as the successful fusion of the advantages associated with physical cash payments with the efficiencies and certainties enabled by digital technology. Cash payments have the advantage of being immediate, final and requiring no trust from either counterparty in each other nor any other intermediary. The drawback of cash payments was the need for parties to be present in the same space and time, which increases risks associated with physical custody, especially for larger transactions. As more business is conducted remotely, thanks to ever-advancing telecommunications technologies like the internet, physical cash transactions become increasingly impractical.

Since the inception of computers, the nature of all digital objects is that they were infinitely replicable. This meant that no digital object could be provably limited in quantity. For instance, when you "send" and email, you are actually sending a copy, as you still have the email in your sent folder. Before Bitcoin, there was no way to send a digital good that could not also be resent elsewhere at a later time. This presented an intractable issue for direct digital payments known as the double-spend problem . Without a trusted third-party intermediary to verify the payer was not double spending, digital payments were not possible. Using intermediated digital payments (like Venmo or PayPal) exposed parties to additional transaction costs, risk of censorship, fraud and transaction disputes.

The nature of digital objects also meant creating a digital cash was impossible, since its monetary units could be reproduced endlessly and would therefore suffer from unlimited inflation. Before Bitcoin, people had to rely on physical laws (rarity and chemistry, in the case of gold) or jurisdictional laws (government and central bank monopolies) to regulate money supplies. Innovatively, Bitcoin relies on mathematical laws to protect its monetary policy. Building on top of decades of innovative trial and error

by other programmers and combining a wide range of proven technologies, Nakamoto successfully made Bitcoins the first digital objects that were verifiably scarce. As the world's first instance of digital scarcity, Bitcoin was able to solve the double-spend problem and become the world's first functional digital cash.

"That in order to make a person covet a thing, it is only necessary to make the thing difficult to attain." - Mark Twain

In this way, Bitcoin would bring the desirous advantages of physical cash to the digital realm and combine them with an immutable monetary policy to inoculate its holders from all unexpected inflation. Drawing on lessons learned by other programmers during two decades of attempts at this innovative breakthrough, Nakamoto finally achieved digital cash money by combining four key technologies:

Proof-of-Work – mathematical puzzles which require energy expenditure to be solved, solutions are rewarded with newly issued Bitcoin and user transaction fees, functions as the skin in the game necessary to keep Bitcoin's distributed ledger truthful and maintain its monetary hardness

Distributed peer-to-peer network – a record of Bitcoin's entire transaction history is maintained by each network participant (known as a node) who mathematically verify each other's work, making the entire system resistant to censorship and manipulation

Hashing – a method of computer cryptography that transforms any stream of data into dataset of fixed size (known as a hash), this transformation is irreversible and is the foundation of trustless verification within the Bitcoin network

Digital Signatures – a method of authentication that relies on a set of mathematically related elements called the private key, the public key and signatures – the private key (which must be kept secret) allows its holder to control the Bitcoin associated with it, meaning that the private key is a bearer instrument (holding Bitcoin is holding its private key, which makes it a self-sovereign monetary good like gold)

In the same way a monetary assessment of gold would not delve too deep into its chemical properties, this essay will not delve too deep into the technological properties of Bitcoin. We will instead focus on its monetary properties and its relevance in the story of money. However, some basic technical knowledge of Bitcoin is warranted to fully appreciate the importance of the innovation that is digital cash money.

Technological Properties [1]

Bitcoin is open-source software, meaning its source code can be inspected by anyone. This makes Bitcoin a language, its source code and transaction history are universally transparent and can even be printed onto paper (interestingly, this makes it protected under the First Amendment in the United States, more on this later). As an open-source software project, Bitcoin is supported by a global network of volunteer programmers. These programmers are self-interested in the sense that they are almost always Bitcoin owners as they are aligned with its purpose philosophically, and therefore stand to gain financially from its expanding network. Their work over the years has greatly enhanced the functionality of the Bitcoin network. However, these programmers are unable to change the rules of Bitcoin (as we will see when we discuss Bitcoin's social contract).

To become a Bitcoin network member, known as a node, all that is necessary is to download and run the software on a computer. Once downloaded, the software will enable you to store Bitcoin and transact it with any other node in the world. Also, by becoming a node, the entire Bitcoin transaction history will be recorded on your machine and updated in perpetuity, just as it is on every other node in the world. This is the essence of Bitcoin's decentralized architecture . The Bitcoin network, similar to the internet, lives everywhere and nowhere .

Owning a Bitcoin means owning the private key that can authorize it to be used in a transaction. The private key is purely informational, meaning that it is just a string of alphanumeric characters. This makes it a self-sovereign form of money, giving its holder the presumption of rightful ownership, which makes Bitcoin an instrument of final settlement (like gold). Bitcoin is the world's first global, digital final settlement system.

Bitcoin is entirely reliant on verification, which allows its users to completely eliminate any need for trust. All Bitcoin transactions are recorded by every node on the network so that they all share one common ledger of balances and transactions (remarkably similar to the Rai Stone system used by the Yap Islanders). Transactions are grouped together approximately every ten minutes in what is known as a block . Each block is then added to the previous block of transactions, forming a chronological chain of inextricably linked blocks that stretches all the way back to the genesis block mined by Nakamoto himself exactly 10 years ago today. This is commonly called the Bitcoin blockchain . The blockchain is the common ledger of which each node maintains its own copy (commonly known as the distributed ledger). Each node verifies the accuracy of every other node's transaction inputs and truth is established by consensus. In this way, the Bitcoin network relies 100% on verification and 0% on trust. This gives Bitcoin the unique property of trustlessness, meaning it is able to operate successfully without the need to trust any counterparty or intermediary whatsoever.

Blockchain, Energy and Mining [1,3,8,11]

Economic incentives and disincentives are used to maintain truthful records in the blockchain, it what is an ingenious application of the skin in the game concept. Nodes compete to solve complex mathematical puzzles in a process called proof-of-work . Nodes are incentivized to perform this computing task because the first one to solve the proof-of-work is awarded a batch of newly issued Bitcoin and the transaction fees generated within the latest block of transactions — called the block reward . A block is sealed approximately every ten minutes, which triggers the opening of the next block and proof-of-work competition. Nodes expend processing power (in the form of electricity) to solve these complicated mathematical problems, although considerably less and much more efficiently than the systems that support gold and government money today:

	Annual Cost ($USD)	Energy Consumption (GJ)	$USD per GJ
Gold Mining	$ 105,000,000,000	475,000,000	$ 221
Gold Recycling	$ 40,000,000,000	25,000,000	$ 1,600
Government Fiat Money Production	$ 28,000,000,000	39,000,000	$ 718
Banking System	$ 1,870,000,000,000	2,340,000,000	$ 799
Governments	$ 27,600,000,000,000	5,861,000,000	$ 4,709
Bitcoin Mining	$ 4,500,000,000	183,000,000	$ 25

Bitcoin mining is exceptionally energy efficient relative to other monetary systems and their institutions.

Proof-of-work energy expenditure is the thermodynamic bridge from the physical to the digital world. It transmutes the fundamental commodity of the universe, energy, into digital gold. This energy expenditure is essential to the functioning of the Bitcoin network, as it disincentivizes node dishonesty. If a node attempted to include a fraudulent transaction in a block, other nodes would reject it and it would incur the cost of processing power without the prospect of earning the block reward. This process is commonly referred to as mining and the competing nodes are called miners (or mining nodes). Mining is a truly capitalistic voting mechanism where energy expended equals hashes, which are votes for the proof-of-work solution, generated. The name mining is an ode to the arduous process of mining of gold. As we have learned, the costs and risks related to the mining of this monetary metal is necessary for it to maintain its hardness (skin in the game). Similarly, mining using proof-of-work is the only known method of creating digital cash money.

Money, which is the representation of the work required to generate goods, can also be considered a form of stored energy. In the early 20th century, free market proponents like Henry Ford and Thomas Edison were interested in replacing gold or the US dollar with an energy money. Showing great prescience, they foresaw the day when the world may exhaust its non-renewable energy sources and be forced to switch to alternatives. Convicted in their free market beliefs, they shared this idea and assumed a great deal of reputational risk in the process, as their views ran contrary to the established economic order. The concept of energy money was popular due to its hard money characteristics, as energy is costly to produce. However, energy money was technologically well before its time, as energy could not be transmitted or stored easily using technologies of the day. In championing a novel idea with the greater good at heart, Ford and Edison were exhibiting soul in the game, or the exposure to downside risks on behalf of others. As Edison said in 1931:

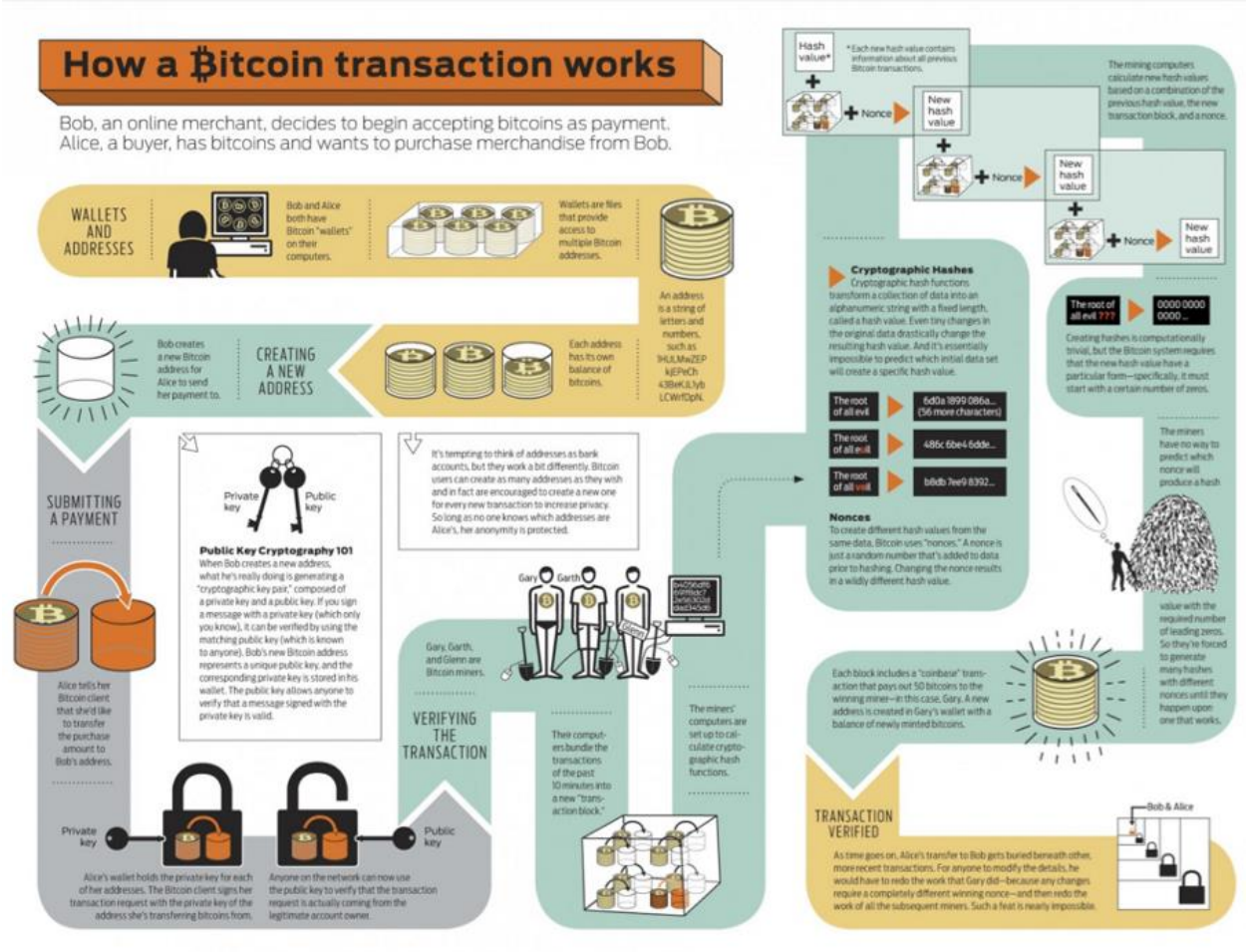
“I’d put my money on the sun and solar energy. What a source of power! I hope we don’t have to wait until oil and coal run out before we tackle that.”

By using proof-of-work, which was originally invented as a measure to mitigate email spam, Bitcoin became the world’s first functional energy money. With physical monetary goods, we were required to build walls to safeguard our money. With the Bitcoin network, we are required to expend energy to preserve the sanctity of its ledger, secure its network and enforce the immutability of its money supply. Proof-of-work is essential for Bitcoin to function as hard, digital cash money and enables it to serve as the buyer of last resort for electricity worldwide. The Bitcoin network provides a perpetual economic incentive for everyone in the world to invent more efficient methods of harnessing energy. This global incentive will increase the rate of innovation in energy technologies. As Bitcoin expert Nic Carter puts it:

"The Bitcoin network is a global energy net that liberates stranded assets and makes new ones viable. Imagine a 3D topographic map of the world with cheap energy hotspots being lower and expensive energy being higher. I imagine Bitcoin mining being akin to a glass of water poured over the surface, settling in the nooks and crannies, and smoothing it out."

As more nodes compete to solve the proof-of-work puzzle, the difficulty automatically increases so that new blocks are added on average once every ten minutes. This automatic algorithmic change is called the difficulty adjustment and is perhaps the most ingenious aspect of Bitcoin. It is the most reliable engineering solution for making and keeping money maximally hard and gives Bitcoin the unique ability to adapt its network security as it grows. As we have seen, when a form of money appreciates, people are immediately incentivized to increase its new supply flow, which reduces its stock-to-flow ratio and compromises its hardness. With Bitcoin, an increase in its price does not lead to the production of more Bitcoin beyond its transparent and predictable supply schedule. Instead, it simply leads to an increase in processing power committed by miners which in turn makes the network more secure and difficult to compromise. Like a vault that becomes harder to crack the more money that is stored within it, Bitcoin offers people an incredibly effective means of value storage.

Next, we depict the entire process of a Bitcoin transaction:



How a bitcoin transaction works

The Internet of Value [9]

"The internet of value" is a popular moniker to describe Bitcoin. In reality, the Bitcoin protocol can be considered an integral and newly evolved layer of the commercial internet. In computer science, a protocol is a ruleset that governs the transmission of data. The internet as we know it is an integration of four successive layers of open-source protocols, called the Internet Protocol Suite, that maintain constant communication with one another:

The Link Layer puts data packets on the wire

The Internet Layer routes data packets across networks

The Transport Layer persists communication across any given conversation

The Application Layer delivers software files and applications

In this context, Bitcoin can be considered the fifth layer of the internet protocol suite:

The Value Layer allocates scarce resources across networks

In the same way the internet is a set of open-source protocols for exchanging data, Bitcoin is an open-source protocol for exchanging value. It is trustless, as any machine can accept it from any other securely and at virtually zero cost. Bitcoin is also global and permissionless, meaning that any machine can speak its language and no central bank is required to authorize its use. This means that transactions on its network are essentially unstoppable as all trust factors and permissions necessary to transact with it are intrinsic to the act of holding a Bitcoin private key. Software protocol developments are being implemented that will make Bitcoin transactions even faster, cheaper, anonymous and capable of authentication. These can expand the utility of Bitcoin to enable the allocation of scarce network resources like computing power, verification of contracts or tracking identity and reputation.

Although Bitcoin is the fifth layer of the internet protocol suite, it is the base layer protocol for the value layer itself. This means that second and other higher order protocol layers may be built on top of it. A second layer protocol to Bitcoin, called the Lightning Network, is currently being implemented and is designed to sacrifice some degree of trustlessness to achieve higher transaction throughput, allowing Bitcoin to be used more effectively as a medium of exchange. The Lightning Network is an open-source protocol and functions by establishing trust channels among parties for faster, cheaper transactions that are then settled periodically to the Bitcoin blockchain. Higher order protocol development and integration is one of the many ways Bitcoin adapts to changes in its environment (more on this later).

In the same way that money is an emergent property of complex human interactions, Bitcoin is an emergent property of complex interactions occurring between people, machines and markets. Even if Nakamoto and Bitcoin never existed, it would still be necessary for us to invent the concept of cryptoassets to enable machines to exchange value to facilitate digital economies, use smart contracts and provide the substrate necessary for the 'internet of things' to come into existence. Not only is Bitcoin a prerequisite innovation to the digital economy, it is also the hardest monetary technology ever invented.

The Infinite Hardness of Bitcoin [1]

Bitcoin is the hardest form of money in existence. Its money supply is enforced mathematically and, like the other rules of Bitcoin, cannot be broken or changed. Only 21 million Bitcoins can and will ever exist:

$$\frac{\sum_{i=0}^{32} 210000 \left\lfloor \frac{50*10^8}{2^i} \right\rfloor}{10^8}$$

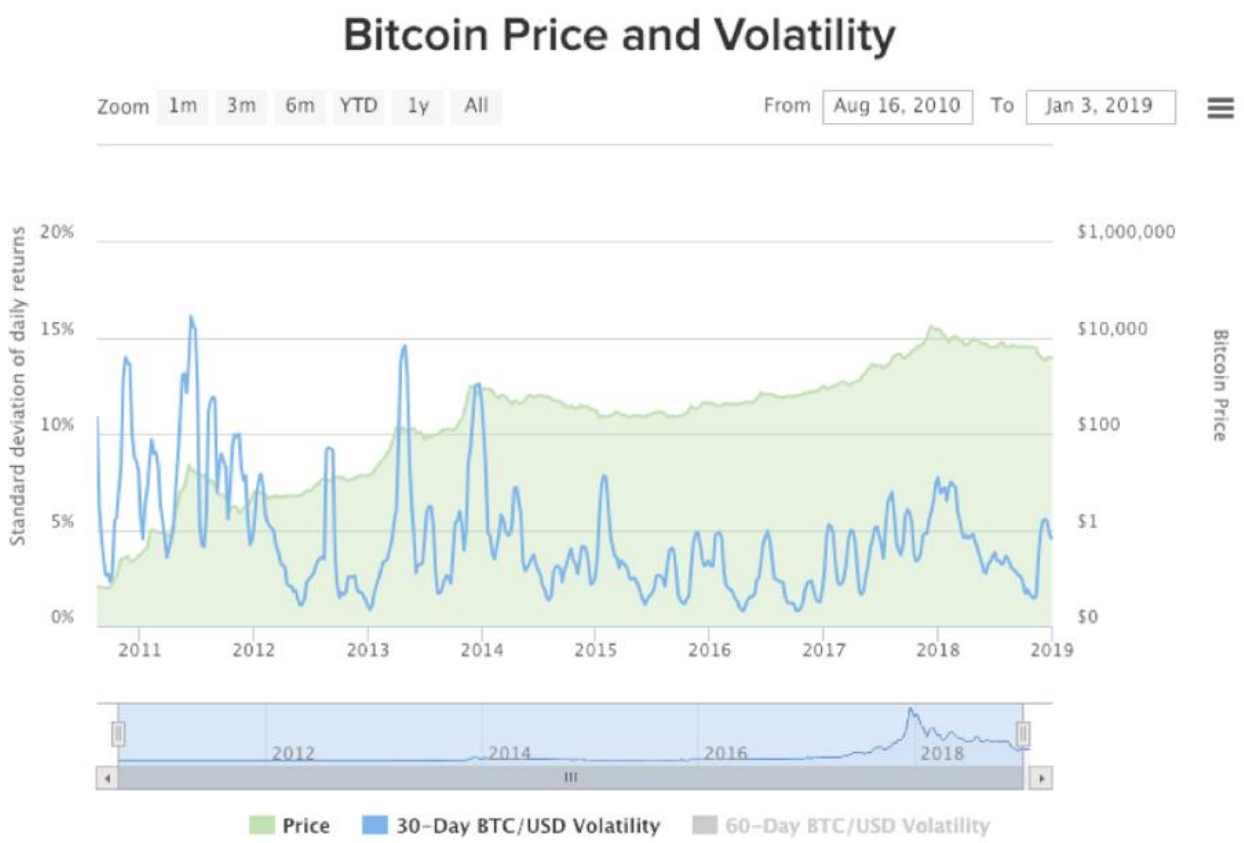
The monetary policy of Bitcoin is set in (mathematical) stone.

This strictly limited supply makes it the first monetary technology exhibiting absolute scarcity . Unlike gold and other monetary metals, no matter how much demand for Bitcoin increases there will never be any units produced in excess of its fully transparent, predictable and unchangeable monetary policy.

Before Bitcoin, only time itself had achieved the property of absolute scarcity.

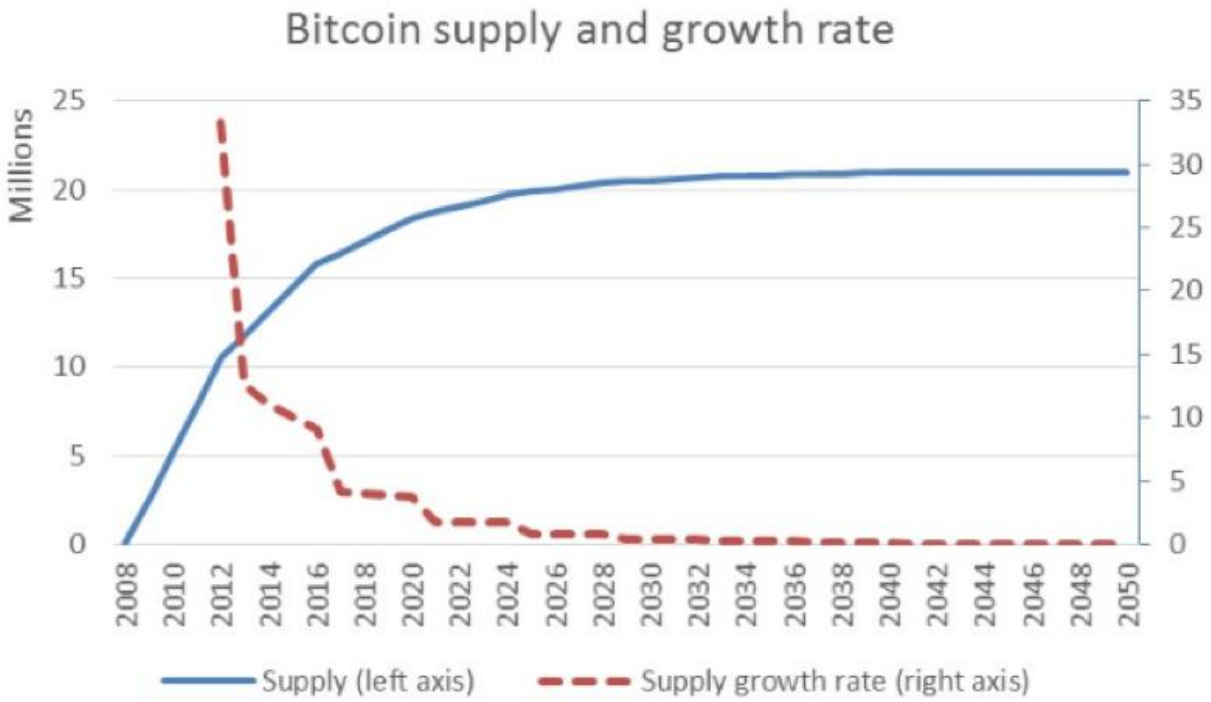
Since increased demand for Bitcoin cannot affect its supply, it can only be expressed in its price. Bitcoin has perfect price inelasticity of supply, meaning that it has zero supply-side response to increases in its price. Unlike gold and all other physical commodities, where an increase in demand will inevitably lead to larger supplies being produced over time, Bitcoin can only express an increase in demand by becoming more expensive (and a more secure network). A perfect price inelasticity of supply no doubt contributes to the notorious price volatility of Bitcoin it is exhibiting at the earliest stages of its growth we are witnessing today.

Absolute scarcity greatly exacerbates Bitcoin's price volatility. As its network continues to grow, the value of Bitcoin as an unstoppable payments channel and uninflatable money is steadily increasing over time while its price is constantly attempting to find it, dramatically overshooting and undershooting along the way. With a totally inflexible supply schedule, as long as Bitcoin is growing quickly, its price will behave like that of a startup company stock undergoing meteoric growth. Should Bitcoin achieve sufficient market penetration that its growth slows down, it would stop attracting high-risk investment flows and become a stable monetary asset expected to appreciate slightly each year as demand increases due to productivity and population growth—like any mature hard money should. As expected, over the long-run we are already seeing a decrease in Bitcoin's price volatility:



As expected, the price volatility of Bitcoin is gradually declining as its network value grows.

Bitcoin's immutable monetary policy ensures that its supply will continue to grow at a decreasing rate and will reach its maximum of 21 million units sometime in the year 2140. To maintain salability across scales, Nakamoto designed each Bitcoin to be further divisible into 100 million units, which are now commonly called Satoshis in his honor. Once the last Bitcoin is mined, its stock-to-flow ratio will become infinite as its flow will completely and irreversibly cease. Beyond this point, miners will be compensated exclusively by transaction fees. Bitcoin's decreasing growth rate means that the first 20 million coins will be mined by the year 2025, leaving the last 1 million to be mined over the subsequent 115 years:

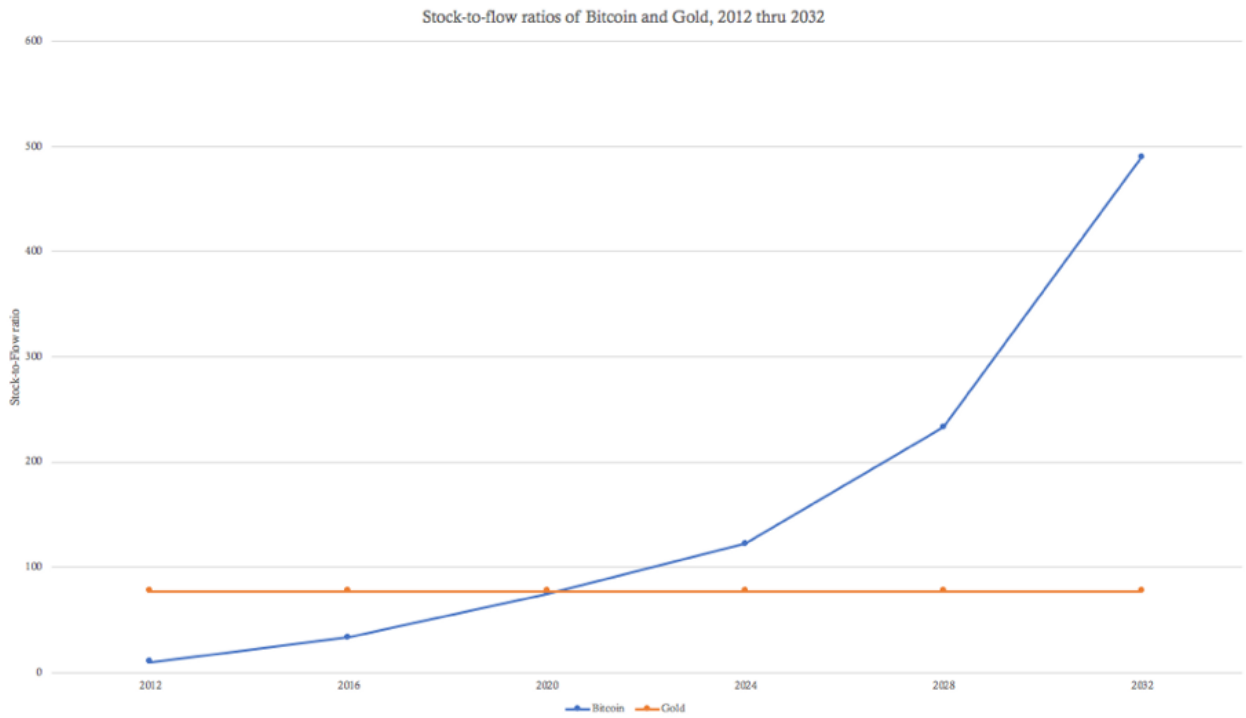


Due to its decreasing supply growth rate, over 95% of all Bitcoins will be mined by the year 2025.

This predictable, transparent and immutable supply schedule gives Bitcoin a significant advantage as it competes for the trust of the people to become a reliable store of value. Unlike government money or even gold, people know with absolute certainty that Bitcoin will never have its salability across time compromised by unexpected supply increases.

Bitcoin is uninflatable money in a world where wealth is continuously stolen via inflation.

As is the case with its other immutable laws, Bitcoin's monetary policy is enforced by the inviolable laws of mathematics. Inevitably, Bitcoin will surpass gold around the year 2020 to become the hardest form of money in history:



As sure as 1+1=2, Bitcoin will soon surpass gold to become the hardest form of money in history.

By virtue of its natively digital nature, Bitcoin is (critically) highly resistant to centralization. As we have learned, it was the centralization of gold that led to government money backed by gold, which made gold more salable across scales and encouraged a gold standard to flourish throughout most of the world. However, as the temptation to expand money supplies seems to be irresistible for humans, governments soon took control of the banking sector, printed money in excess of its gold reserves, eventually severed their currencies peg to gold and thereby destroyed the hardness of government money completely.

Historically, people who adopted hard money systems flourished—such as the Romans under Caesar, The Byzantines under Constantine and the Europeans under the gold standard—and people who had the hardness of their money compromised suffered enormous consequences—such as the Yap Islanders, West Africans using glass beads and the Chinese under a silver standard in the 19th century. Moving a society away from a hard money system has been a harbinger of economic crisis and societal decay, an outcome that can be explained as a social contract rescission.

Bitcoin's Social Contract [10]

Social contract theory starts with an assumed hypothetical state of nature full of violence that is unbearable for people to live in. Driven by a desire to improve their circumstances, people come together and collectively agree to sacrifice some of their freedoms to establish a social contract and empower an institution to protect them. Government is the result of a social contract: people sacrifice some of their freedoms to give the state control over the monetary system and armed forces. The state, in turn, uses that power to manage the economy, redistribute wealth and fight crime. In the United States, our current social contract grants the government monopoly control of money (via the Federal Reserve) and violence (via the Police and Military).

Similarly, money itself can be thought of as a social contract. If enough people are unhappy with a barter economy, they can collectively agree to use money instead. This social contract entails sacrificing certainty (requiring trust that dollars will maintain their value over time) in exchange for convenience (using dollars as a medium of exchange). The social contract for money, as we have seen, emerges and evolves spontaneously based on market-driven natural selection. Each person continuously decides which outcomes they prefer and how best to achieve them. If enough people seek the same outcome, we call the result a social contract.

Throughout history, almost every government (a form of social contract) put in charge of the monetary system (another, often interrelated, form of social contract) has abused its power by forcibly confiscating assets, censoring private transactions and printing money to steal wealth via inflation. Using the virtually unlimited financial means provided by control over money supplies, these governmental social contracts grew in successive bureaucratic layers. The larger and more valuable these social contracts became; the more freedoms were forfeited and the more others sought control over them. This led to many instances of conflict (warfare or social revolution) in which old social contracts (dictatorships or tyrannical regimes) were rescinded in favor of new ones (new laws, treaties or governments). The principal point here is that people can agree they are in a terrible situation and come together to change it, but the resultant social contract is only as strong as its credibility and enforceability.

The invention of Bitcoin can be regarded as a new implementation of the social contract for money. Nakamoto settled on the following rules for this new implementation:

Only the owner of a Bitcoin can produce the digital signature to spend it (confiscation resistance)

Anyone can transact and store value in Bitcoins without permission (censorship resistance)

There will only be 21 million Bitcoins, issued on a predictable schedule (inflation resistance)

Anyone will always be able to verify all the rules of Bitcoin (counterfeit resistance)

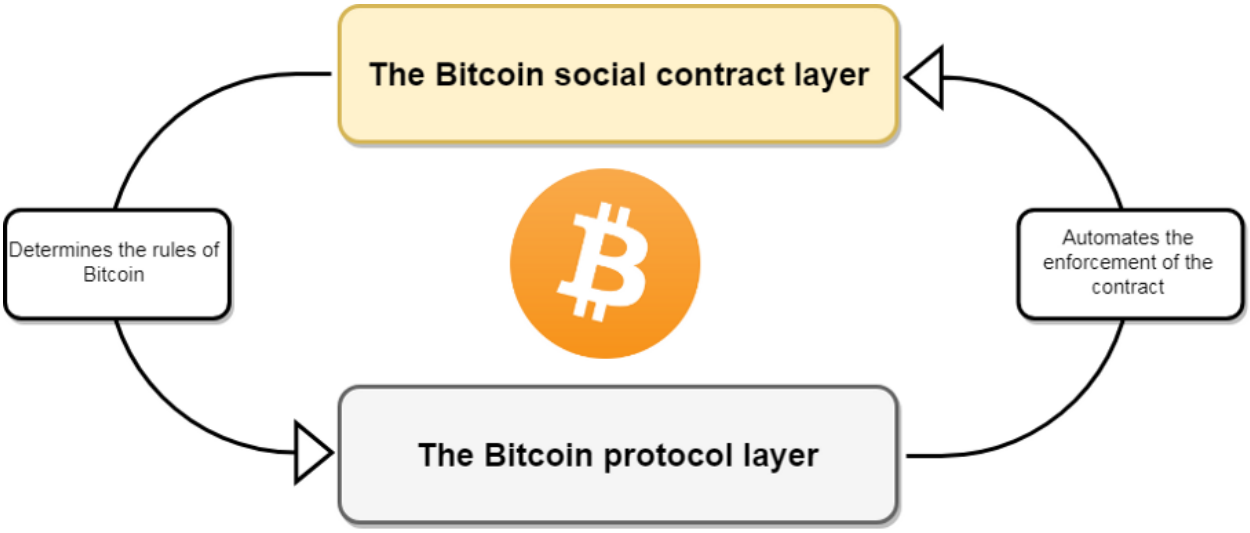
Historically, social contracts intended to protect people, such as governments and their central banks, eventually became controlling and ultimately turned abusive. When a social contract loses sufficient trust of the people, it falls apart or is overthrown, by ballot or by bullet. This dynamic has resulted in a continuous cycle of rising and falling social contracts throughout history. Bitcoin is intended to break this cycle in two ways:

Instead of seeking security from a powerful central entity (like a government or central bank) that can be corrupted or overthrown, Bitcoin creates a hypercompetitive market for its own protection. It turns security into a commodity and the security providers (miners) into harmless commodity producers.

By requiring its security market participants (miners) to incur real world costs to generate their economic reward (skin in the game), Bitcoin incentivizes the market to reach consensus over who owns what at any given point in time.

In this sense, the Bitcoin social contract is composed of two distinct, self-reinforcing layers: the social layer and the protocol layer. The social layer is the social consensus itself, which determines the rules of

Bitcoin and establishes its value. The protocol layer simply automates the enforcement of the rules set by the social layer:



In this sense, Bitcoin is more than just a technology. Indeed, it is a new institutional form. Viewing it in this way, we are better able to answer some of the more existential questions about Bitcoin:

Who Can Change the Rules of Bitcoin?

Since the rules of the Bitcoin social contract are decided at its social layer and enforced at its protocol layer, who can actually change its rules? Bitcoin, as computer network, comes into existence when people run implementations that follow the same ruleset (think of these rulesets as speaking the same language). You remain in the network by following the same rules as everyone else. If you decided to change the ruleset on your local computer, you would simply be evicted from the network (you no longer speak the same language as everyone else). Your unilateral decision to change the rules would not impact the actual Bitcoin network in any way whatsoever.

The only way to change the rules of the Bitcoin social contract is to convince people to voluntarily accept your proposed rule changes at the social layer. As each network member is self-interested, they will only adopt rules that benefit them. Seeing as its current rules are already optimal for Bitcoin holders (resistance to confiscation, censorship, inflation and counterfeit) it would be extremely difficult to convince a majority of the approximately 30 million network participants to change rulesets. This asymmetrical governance dynamic virtually rules out any contentious changes from succeeding, as they would never get broad social consensus. Therefore, the Bitcoin network can be upgraded in ways that align with the collective best interests of its members and is at the same time highly resilient to changes that contradict these interests.

Can a Software Bug Kill Bitcoin?

In September 2018, a software bug arose in the main implementation of Bitcoin that opened up two potential attack vectors which theoretically could have been exploited to circumvent its counterfeit and inflation resistance properties. Bitcoin developers quickly fixed the bug before either vector was

exploited, however this event left many people wondering what would have happened had the vulnerabilities not been discovered in time.

Any time the social layer and protocol layer diverge in the Bitcoin social contract, the protocol layer is always wrong. Again, all rules are set at the social layer whereas the protocol layer is only responsible for automating their enforcement. Had the software bug not been discovered in time, Bitcoin's blockchain would have undergone a fork — meaning its protocol layer would have been split it into two networks, one with the bug and one without it. Every Bitcoin holder would then have an equal number of coins in each network, but the value of these coins would be determined solely by the free market. This is true for all forms of money, as social consensus determines the value of money. At the social layer, each Bitcoin owner would then choose either the implementation with or without the bug. To protect the value of their Bitcoin, holders would rationally choose to migrate to the mended network and its blockchain would continue without interruption.

When the Bitcoin protocol layer successfully automates the enforcement of the rules determined at its social layer, the two layers are in sync. If they diverge for any reason, the social layer supersedes, and the protocol layer is mended to reflect the economic reality of the social consensus surrounding Bitcoin. Software bugs are inevitable, and Bitcoin's 2-layer social contract construction ensures that it can withstand them.

Can Forks Compromise the Immutability of Bitcoin's Rules?

Since Bitcoin is open-source software, anyone in the world can copy its code, change it and launch their own version. This is also a chain fork which, as established earlier, affects only the protocol layer of the Bitcoin social contract. Without changing the rules at the social layer first, a protocol layer fork only evicts you from the true Bitcoin network. To successfully change the rules of Bitcoin, you must successfully fork its social layer first. To accomplish this, you would need to convince as many people as possible that your proposed ruleset is meaningfully better for them, so that they take the risk of adopting your proposed software changes. Forks like these are difficult to pull off in reality because they require buy-in from thousands of people to be successful. This asymmetry between the cost of campaigning for ruleset changes and their potential benefit to network participants makes the Bitcoin network exhibit an extremely strong status quo bias when it comes to governance.

The key to understanding this is that the value of any form of money is purely a social construct or, in other words, is derived from social consensus. Individual Bitcoins, like US dollars or any other currency, receive their value exclusively from the shared belief of their users. Forking Bitcoin's protocol layer is worthless without forking the social layer from which it derives its value. In the rare cases that the social layer itself splits, as was the case with the Bitcoin Cash fork, the result is two weaker social contracts, each agreed upon by fewer people than before. The complete failure of the Bitcoin Cash fork (its price has declined from 0.21 to 0.04 Bitcoin over the past year) is yet another battle scar for Bitcoin that pays testament to its governance model and exemplifies the winner take all dynamics inherent to monetary competition.

So long as Bitcoin network participants continue to act in accordance with their own individual self-interest, the rules of Bitcoin (resistance to confiscation, censorship, inflation and counterfeit) are

immutable and, therefore, as reliable as the laws of mathematics. It's clear from this perspective that Bitcoin is more than just a technological innovation. Although Bitcoin as a network and monetary technology is groundbreaking in many respects, its social contract implementation is revolutionary. Bitcoin is the first technology that incorporates human nature as one of its core moving parts.

In essence, by believing that mathematics and individual self-interest will persist, we can reliably believe in Bitcoin's value proposition and its ongoing successful operation.

Over the past 10 years, by inventively aligning human self-interest with its own self-interest, the Bitcoin network has managed to grow organically from $0 to $80B in value.

A New Form of Life [1]

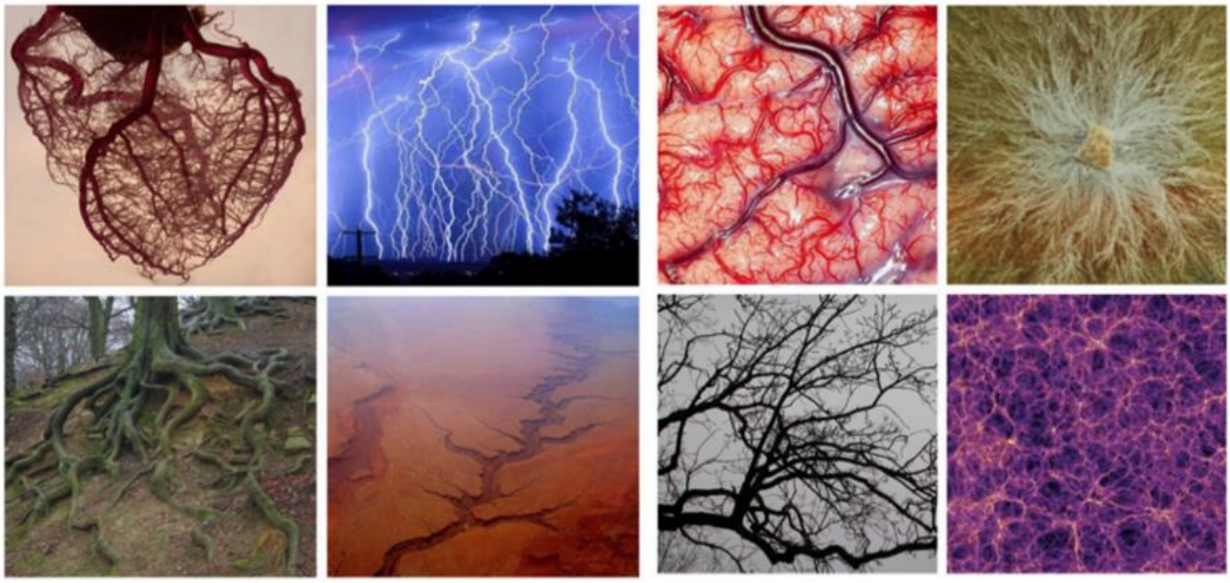
Although Bitcoin is intended to be a monetary technology, it is a totally unique compared to other forms of money. Ralph Merkle, famous cryptographer and inventor of the Merkle tree data structure, has a remarkable way of describing Bitcoin:

"Bitcoin is the first example of a new form of life. It lives and breathes on the internet. It lives because it can pay people to keep it alive. It lives because it performs a useful service that people will pay it to perform. It lives because anyone, anywhere, can run a copy of its code. It lives because all the running copies are constantly talking to each other. It lives because if any one copy is corrupted it is discarded, quickly and without any fuss or muss. It lives because it is radically transparent: anyone can see its code and see exactly what it does. It can't be changed. It can't be argued with. It can't be tampered with. It can't be corrupted. It can't be stopped. It can't even be interrupted. If nuclear war destroyed half of our planet, it would continue to live, uncorrupted. It would continue to offer its services. It would continue to pay people to keep it alive. The only way to shut it down is to kill every server that hosts it. Which is hard, because a lot of servers host it, in a lot of countries, and a lot of people want to use it. Realistically, the only way to kill it is to make the service it offers so useless and obsolete that no one wants to use it. So obsolete that no one wants to pay for it, no one wants to host it. Then it will have no money to pay anyone. Then it will starve to death. But as long as there are people who want to use it, it's very hard to kill, or corrupt, or stop, or interrupt."

Bitcoin is a technology, like the hammer or the wheel, that survives for the same reason any other technology survives: it provides benefits to those who use it. It can be understood as a spontaneously emergent protocol that serves as a new form of uninflatable money and an unstoppable payments channel. Structurally, the Bitcoin network reflects a quintessential manifestation commonly found in nature.

The Decentralized Network Archetype [7]

The Bitcoin network mirrors one of the most successful evolutionary structures found in nature, the decentralized network archetype:



Clockwise from the top left: the human heart, lightning, the human brain, a fungal mycelium network, roots from a tree, an aerial view of the Grand Canyon, branches from a tree and a cosmic web of galactic superclusters in the deep Universe (which is the largest observable structure in the known Universe at over 1 billion lightyears across).

The decentralized network archetype is prevalent in nature because it is one of the most energy efficient structures possible. Energy is the fundamental commodity of the universe and nature always optimizes for its utilization. Atoms, bubbles and stars (in a state of equilibrium) always form spherical shapes, which is the most energy efficient form for minimizing surface area, precisely because they are energy conservation structures. Minimal surface area output per unit of energy input ensures that these structures optimally expend the finite energy of which they are composed. Spheres are figures of equilibrium with equal distribution their own inherent energy.

Conversely, decentralized networks always form in these tendrilled, circuitous and redundant shapes, which is the most energy efficient form of maximizing surface area, precisely because they are energy exchange structures. Maximal surface area output per unit of energy input ensures that these structures achieve the highest degree of spatial exposure to optimize the likelihood of successful exchange — whether their purpose is pumping blood, imbibing groundwater or seeking sunlight. Spheres and decentralized networks are antithetical in purpose and archetype. Decentralized networks are figures of disequilibrium which both disperse and gather energy within their environments. A decentralized form in organic systems confers advantages such as distributed intelligence, invulnerability to singular attack vectors and accelerated adaptivity.

The decentralized network archetype found in nature is the antecedent to paradigm shifting innovations throughout history such as the railroad system, the telegraph, the telephone, the power distribution grid, the internet, social media and now Bitcoin.

To illustrate the power of this natural archetype, let's consider the story behind the design of the Tokyo subway system. Scientists conducted an experiment where an ancient fungus, the slime mold, was

incentivized to recreate the Tokyo subway system. Each subway stop (node) was marked with oat flakes, the favorite food of the slime mold. In a single day, the slime mold grew to connect all the subway stops in a more energetically efficient design than that proposed by the central planning committee of engineers who spent many months at great expense to the Japanese government in the design process:

Japanese subway design

As the Scientists later reported:

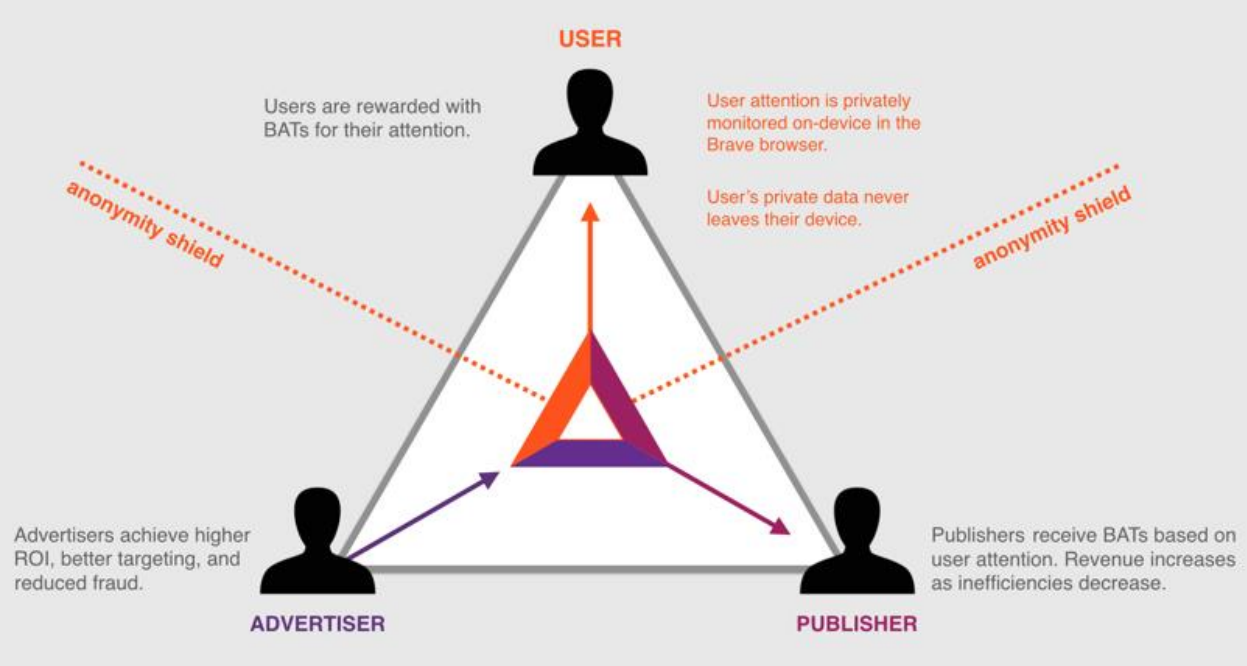
"Transport networks are ubiquitous in both social and biological systems. **Robust network performance involves a complex trade-off involving cost, transport efficiency, and fault tolerance. Biological networks have been honed by many cycles of evolutionary selection pressure and are likely to yield reasonable solutions to such combinatorial optimization problems. Furthermore, they develop without centralized control and may represent a readily scalable solution for growing networks in general.** We show that the slime mold Physarum polycephalum forms networks with comparable efficiency, fault tolerance, and cost to those of real-world infrastructure networks—in this case, the Tokyo rail system. The core mechanisms needed for adaptive network formation can be captured in a biologically inspired mathematical model that may be useful to guide network construction in other domains."

In a similar vein, Bitcoin and its network participants receive signals from the market to create features that satisfy unmet demands or improve the functionality of its network. When block space demand exceeds capacity, as it did it late 2017, transaction fees spike and encouraged the development of a second layer protocol to increase transaction throughout (the Lightning network discussed earlier). As rent-seeking businesses, like Western Union, continue charging exorbitant fees for international remittances, market demand shifts to Bitcoin's much more cost effective and permissionless payment channel. When governments crack down on Bitcoin exchanges, trading volume on peer-to-peer exchanges like LocalBitcoins.com flourishes. To enhance Bitcoin network accessibility, Blockstream launches satellites that provide global coverage for node synchronization. The Bitcoin network is constantly adapting to optimize for its own expansion and the interconnectedness of its participants. Perhaps Bitcoin is less so digital gold, and more so digital slime mold (just kidding, or am I?).

In most forms of life, genes are only passed from parent to offspring in a process called vertical gene transfer . Certain fungal networks, which are modeled after the decentralized network archetype, are able to steal competitive advantages directly from physical contact with other similar organisms in a process called horizontal gene transfer . These fungal networks can grow to gargantuan sizes—indeed, the largest organism on Earth, at nearly 4 kilometers across, is a honey fungus in Oregon that is slowly consuming an entire forest. Fungal networks live in constant competition as they fight off predators, pests and pollutants. This environmental stress causes them to naturally synthesize a variety of enzymatic and chemical countermeasures and, when one of these measures is successful, it is stored in the distributed mind of the entire fungal network. The next time it encounters a menace for which it has even once synthesized an effective countermeasure, the fungal network will use it to neutralize the threat, no matter where the latest encounter occurs. Amazingly, these fungal networks are capable of absorbing countermeasures created by competitors in the same ecosystem purely from physical contact. Such

organisms exhibit distributed intelligence, meaning they learn at the edges and distribute the lessons throughout their vast networks.

There is a common misconception that an alternative cryptoasset could develop a superior feature that will eventually outcompete Bitcoin. Similar to certain fungal networks, Bitcoin is able to subsume features that have been proven in the marketplace from cryptoasset competitors. For example, an alternative cryptoasset called Basic Attention Token (BAT) is designed to power an internet browser called Brave that allows users to shield themselves from advertisements:



BAT is a cryptoasset designed to allow web browser users to monetize their own attention. Using a set of open-source software extensions, today you can perform browser-based microtransactions similar to BAT but using Bitcoin instead. This effectively eliminates the need for a cryptoasset like BAT. The capacity of Bitcoin to subsume market-proven features from competitive cryptoassets fortifies it from disruption.

Brave users are then given the option to open their browsing sessions up to advertisements and are paid in BAT for their attention. This blockchain-based digital advertising solution is intended to allow users to monetize their own attention, whereas in most browsers advertising revenues are allocated mostly to the content publishers. Given Bitcoin's open-source nature, it is able to absorb competitive features like this in a process similar to horizontal gene transfer. Today, by using the Lightning Joule browser extension and running a full Bitcoin node, you can perform browser-based microtransactions similar to BAT but using Bitcoin instead. This effectively eliminates the need for a cryptoasset like BAT. Further, the technologies combined to make Bitcoin all came from previous attempts at digital cash, reiterating the point that open-source software is amenable to feature absorption. This ability accelerates the adaptivity of the Bitcoin network and insulates it from competitive disruption which further reinforces its position as the market leader.

Antifragility [1,11]

Seeing the ubiquity of the decentralized network archetype throughout nature in this way makes the invention of decentralized digital money seem less novel and more inevitable. An open and decentralized nature also enables Bitcoin to benefit from adversity. In light of its track record, Bitcoin is an excellent incarnation of Nassim Taleb's concept of Antifragility:

"Wind extinguishes a candle and energizes fire... Some things benefit from shocks; they thrive and grow when exposed to volatility, randomness, disorder and stressors and love adventure, risk and uncertainty. Yet, in spite of the ubiquity of the phenomenon, there is no word for the exact opposite of fragile. Let us call it antifragile. This property is behind everything that has changed with time: evolution, culture, ideas, revolutions, political systems, technological innovation, cultural and economic success, corporate survival, good recipes, the rise of cities, legal systems, equatorial forests, bacterial resistance... even our own existence as a species on this planet."

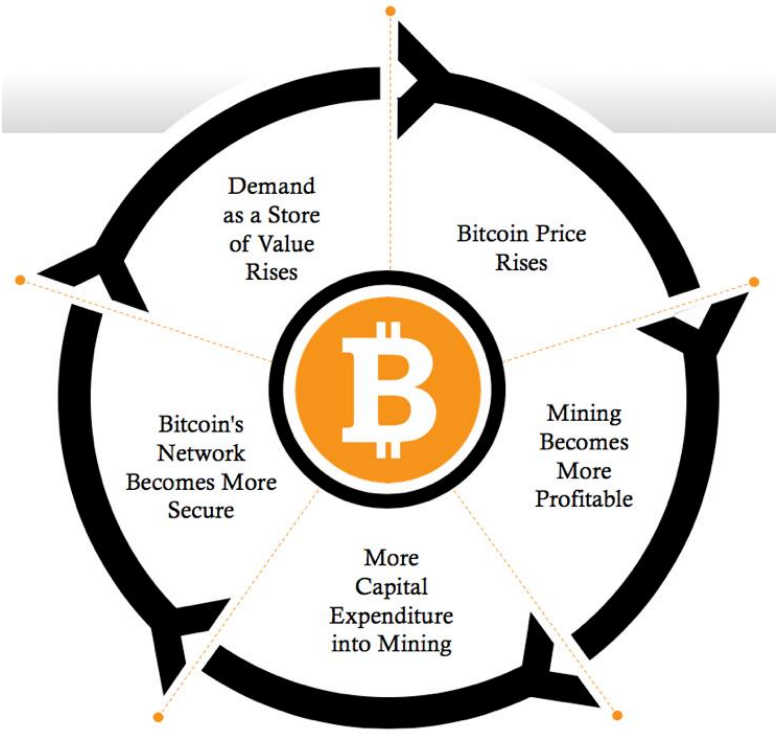
Fragility can be defined as sensitivity to disorder, whereas robustness is insensitivity to disorder. Antifragility is a property of anything that benefits from disorder, stress or adversity. The many failed attempts at killing Bitcoin thus far have only made it stronger by drawing attention to attack vectors or vulnerabilities that its global team of self-interested, volunteer programmers can then fix. These improvements have only increased the network's operational efficiency. Also, each time it withstands an external attack or a chain fork (as we are witnessing with the abject failure of Bitcoin Cash), its reputation for network security and immutability is strengthened. The resiliency of Bitcoin is hardened by hostility.

As Bitcoin has fluctuated wildly in price over the years, each new crash has triggered widespread declarations of its demise. Over 330 prominent articles declaring the death of Bitcoin, known as Bitcoin obituaries, have been written over the past 10 years. These publicity attacks on Bitcoin brought it to the attention of ever-wider audiences. As obituaries intensified, Bitcoin's network processing power, transaction volume and market capitalization all continued to ascend relentlessly—a confirmatory example of the saying 'all publicity is good publicity'.

When China took a heavy-handed approach to regulation by shutting down Bitcoin exchanges in 2017, we witnessed several informal exchanges and OTC markets appear following the demise of each centralized exchange. Although the liquidity for Bitcoin was negatively impacted initially, soon transactions started happening off exchange in China, with volume on websites like localbitcoins.com exploding. The regulatory attack also encouraged people to hold Bitcoin for longer periods, as evidenced by a steep decline in sell volumes, which only reduced the amount of Bitcoin being traded and put upward pressure on its price. Also, these regulatory actions backfired by triggering the Streisand Effect, which is a phenomenon whereby an attempt to hide, remove or censor information has the unintended consequence of publicizing the information more widely, usually facilitated by the internet. As the world watched the situation in China unfold, both the Bitcoin price and global internet searches for the term Bitcoin reached new all-time highs.

Bitcoin's Positive Feedback Loop [1,4]

All of the adversity Bitcoin has faced so far has only fed its growth. Absent any top-down authority, Bitcoin is organic in the sense that it has grown from the bottom-up based solely on its own merits as money. Bitcoin perpetuates the expansion of its network and maintains truthful records by relying on asymmetric economic incentives that make fraud far costlier than its potential rewards. Network participants are all rewarded economically for their interactions with Bitcoin, which creates a flywheel effect on its price and network security:



Bitcoin autonomously proliferates its network by economically rewarding everyone who interacts with it.

As the Bitcoin network adapts to better meet the demands of its constituents, it in turn recruits more network participants. This positive feedback loop promotes the sustained growth of its network and fuels powerful, multi-sided network effects.

Bitcoin's Network Effects [1,4,5]

Bitcoin's meteoric growth has been both supported and protected by its unique multi-sided network effects. The basic example of a powerful 1-sided network effect is a social network (or a telephone network, as outlined earlier). The more people on a social network, the more valuable it is for others to be on it, as there are exponentially more possible connections. It can, however, be disrupted by a competitor that provides a more valuable service to its single customer cohort, the users, who might then transition to the new service (as happened when Facebook disrupted MySpace).

Successful 2-sided markets (like eBay or Craigslist) are significantly more difficult to disrupt. Consumers want to be there because merchants are there, and merchants want to be there because consumers are there. To disrupt a 2-sided network, you have to simultaneously introduce a superior value proposition for both parties, otherwise nobody moves. That is why Craigslist, despite its limited innovation over the years, has been able to leverage its early 2-sided lead and is still a dominant website today.

Bitcoin has a unique 4-sided network effect that insulates it from disruption and supports its growth. These are the four constituencies that participate in expanding the value of Bitcoin as a result of their own self-interested interaction with its network:

Consumers who pay with Bitcoin

Merchants who accept Bitcoin

Nodes that maintain the distributed ledger

Developers and entrepreneurs who are building onto and on top of Bitcoin

This 4-sided network effect makes Bitcoin's first mover advantage seemingly indomitable. As an adaptive monetary technology, its network effects encompass the liquidity of its market, the number of network participants, the community of software developers who support it and Bitcoin's brand awareness. Large investors will always seek the most liquid market for ease of entry and exit. Consumers, merchants and developers tend to join the largest of each of their respective Bitcoin communities, which only reinforces their social interconnectivity and cohesion. Brand awareness is innately self-reinforcing, as any cryptoasset competitor will inevitably be mentioned in comparison to Bitcoin.

An aside on Bitcoin's brand awareness: As we have learned, the value of any money is derived from its social consensus, or the mutual beliefs of its users. The notion of a "believer" has religious connotations, as the notion of one having an epiphany once the "truth" is revealed. Such religious undertones are prevalent in most forms of money (In God We Trust on the US Dollar) and they are also part of Bitcoin's aura (The Genesis Block, Bitcoin Evangelists). The most important of these quasi-religious ideas is the mythological bedrock Nakamoto laid with his enigmatic appearance in 2008 and then with his mysterious disappearance 3 years later. Whoever he/she/they were, Nakamoto gave Bitcoin its creation myth . As market strategist Nicolas Colas said:

"In business, creation stories reinforce the role of the individual as a societal agent of change and speak to a core audience of customers. They are the bedrock for what marketers call a brand and the source waters for Wall Street's shareholder value."

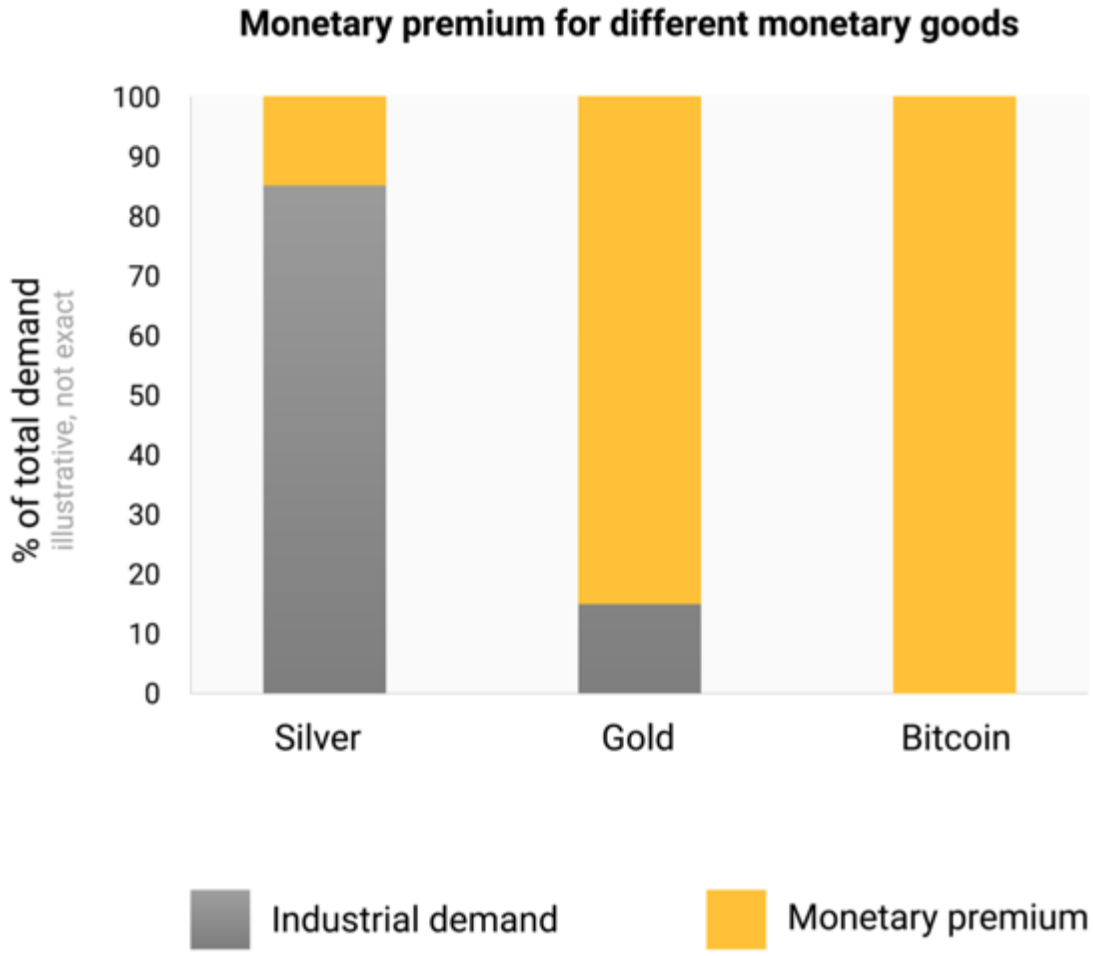
Assuming Nakamoto was a lone wolf, it is arguable that his disappearance transformed him from a person into a mythological figure. This mystery fuels the brand awareness of Bitcoin and reinforces its quality of decentralization, as there is no single individual to vilify, denigrate or otherwise target in an attempt tarnish Bitcoin's symbolism. Like a super hero with a secret identity, all we have is the icon of Nakamoto as a cryptic genius—the godhead of Bitcoin.

As we have learned, the value of a network is a reflection of the total number of possible connections it allows. Therefore, each new Bitcoin owner increases the value of the Bitcoin network, which benefits all existing owners. This new owner is then incentivized to evangelize the benefits of Bitcoin to others, creating the next wave of new owners, and the cycle continues. As the price increases, so too do the incentives to secure the network which draws in more capital expenditure from miners, making Bitcoin's network effects even stronger and self-reinforcing as price appreciation reflexively energizes Bitcoin's positive feedback loop outlined earlier.

Since money is a social network, the price of a monetary good is a reflection of how widely adopted it has become or is expected to become. The price of a monetary good in excess of its industrial demand is its monetary premium . This is the only rational basis for the common criticism that Bitcoin is a bubble, as it

is purely a monetary technology and has no industrial demand whatsoever. However, this premium is the defining characteristic of all forms of money, as all monetary value is based on the optionality it gives its user for exchange across scales, space and time.

Actual bubbles occur when price exceeds fair value, such as the market distortions created by central bank monetary manipulation. However, some mistake monetary premia for bubbles since they cause prices of monetary goods to exceed their underlying industrial values. If monetary premia are bubbles, then money is the bubble that never pops. Paradoxically, in this sense a monetary technology can presently be both a bubble and significantly undervalued if it later achieves widespread adoption:



As a pure bred monetary technology, Bitcoin derives none of its value from alternative uses.

Although there is no established price pattern for a digital good that is becoming monetized, Bitcoin's price appears to follow a fractal (a recursive, self-similar shape) wave pattern of increasing magnitude commensurate with its level of user adoption. The volatility of this price pattern is exacerbated by Bitcoin's perfect price inelasticity of supply (as discussed earlier). Each iteration of the fractal wave pattern appears to match the standard shape of the Gartner hype cycle, which provides a graphical and conceptual representation of emerging technologies undergoing five phases of maturation:

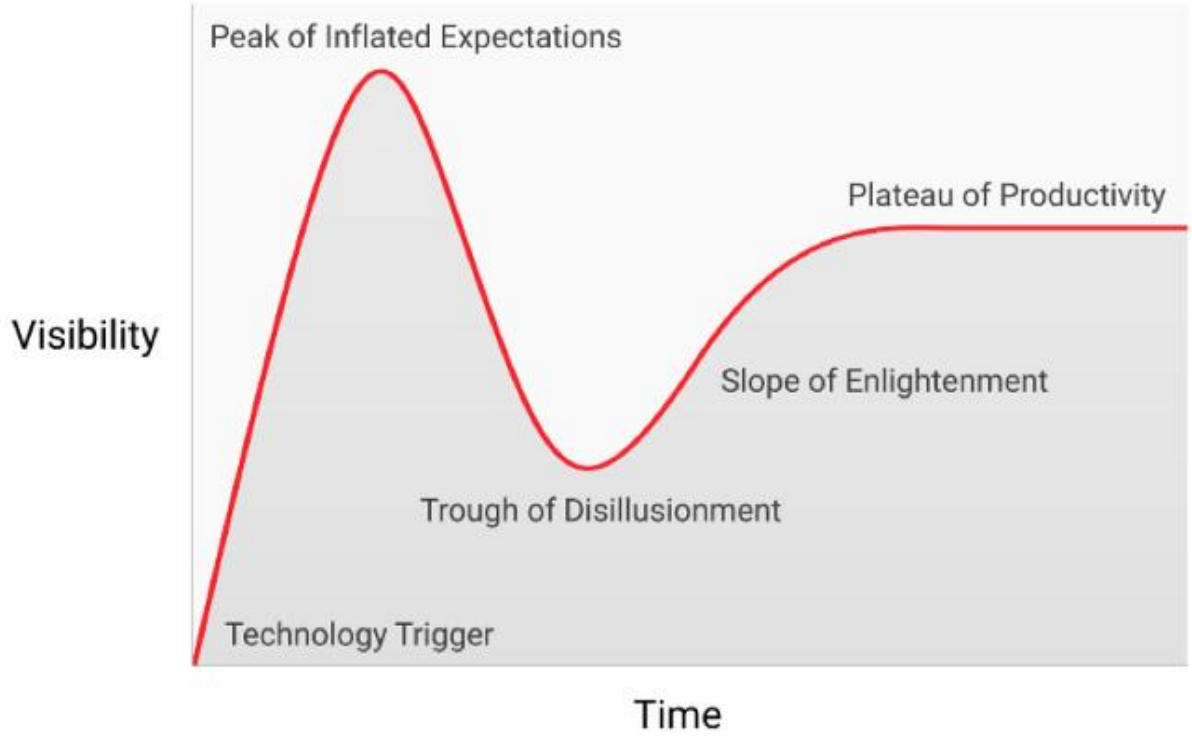
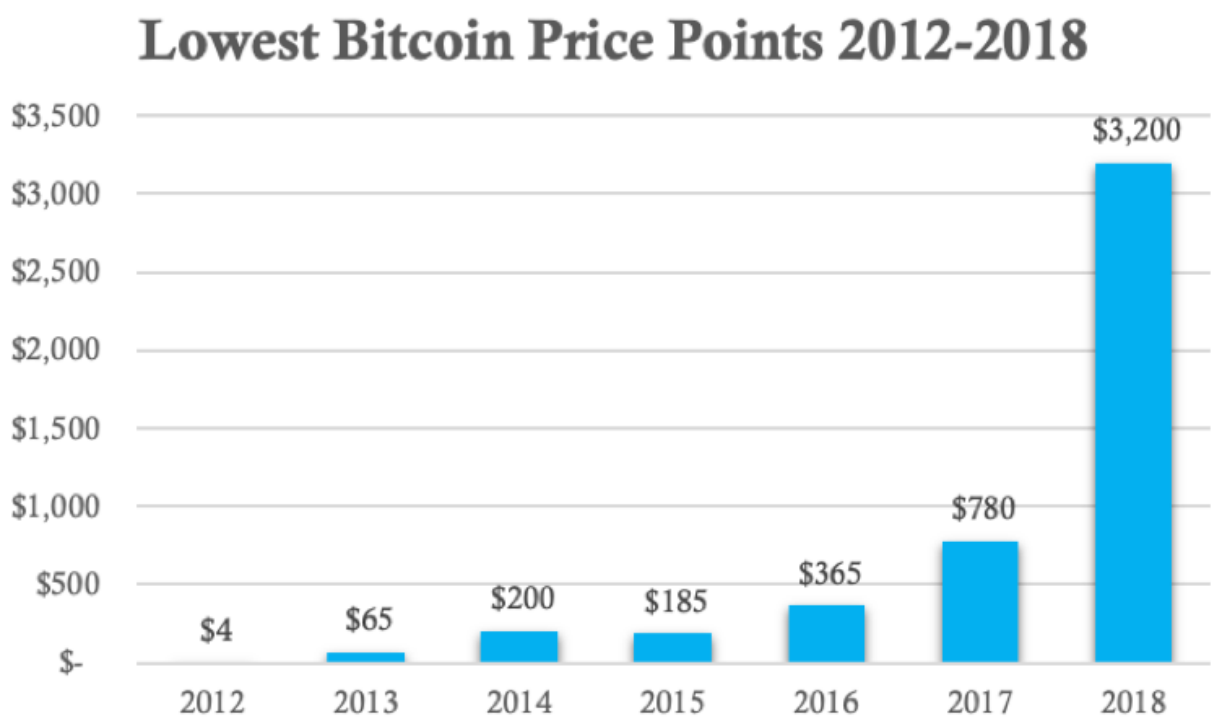


Figure 1 Bitcoin's price appears to follow a fractal wave pattern based on the archetypal Gartner hype cycle.

Bitcoin's growth, in terms of price and transactions, has been dramatic to say the least. Indeed, it is the fastest growing asset in history. Its price has gone from $0.000994 on October 5, 2009, in its first recorded transaction, to about $4,000 today—a total increase of over 400,000,000% in 10 years. By its 10th birthday, Bitcoin had processed about $1.38T USD worth of transactions, with USD value calculated at the time of each transaction. Here we show Bitcoin's entire price history, from a logarithmic perspective, with the Gartner hype cycle fractal wave pattern iterations located inside boxes:

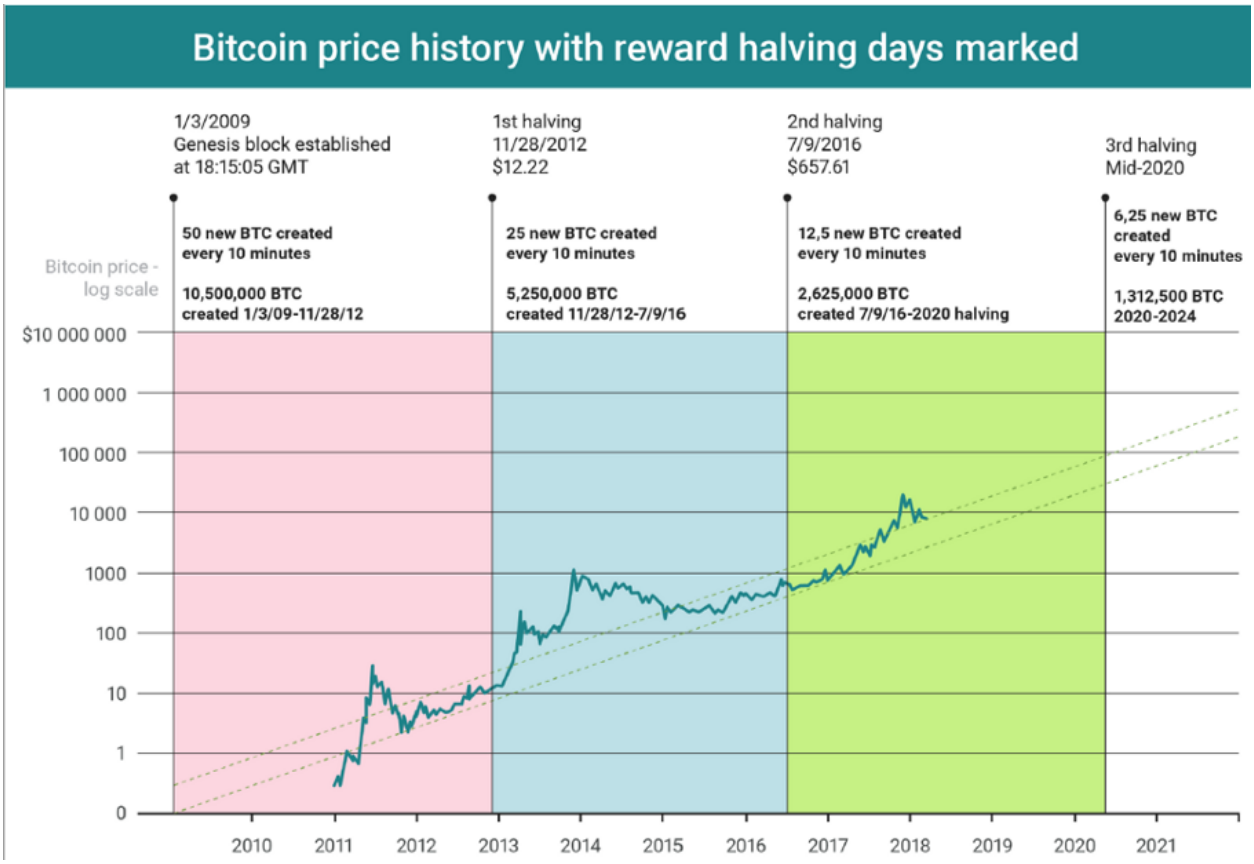
Bitcoin is the fastest growing and most volatile asset in history, although both are leveling off as it grows.

These extreme price cycles draw in new Bitcoin owners as each fractal wave crests. Some of these new owners buy in near the peak, only to be crushed in the trough. Most will capitulate, but those who remain because of their long-term conviction in Bitcoin (typically the most studious of history and monetary evolution among them) become the newest hodlers of last resort . Hodl, which began as a chat room typo in the early days of Bitcoin, has morphed into a memetic phrase that denotes "hodling" Bitcoin long term without regard to its price volatility. Layers of these stubborn hodlers have been added throughout each of Bitcoin's four major price cycles. A good proxy for the depth of these layers is the lowest price Bitcoin hits each year, which indicates the rising collective obstinacy of these hodlers:



The annual low prices of Bitcoin provide an effective proxy for the collective intransigence of its hodlers.

These layers form the base for the next iteration of each fractal wave pattern. As more observers recognize the survivability of Bitcoin following each price crash, they realize that investing in it may not be as risky as they once thought. This larger base of believers sets the stage for the next iteration of the fractal wave pattern which will support a much larger set of newcomers at a far greater magnitude of peak price. Few people are able to accurately predict how high prices will go in each fractal wave cycle, and they usually reach levels that would seem absurd to most investors at the earliest stages of the cycle. The best proxy for the timing of these fractal wave patterns has been the quadrennial Bitcoin inflation rate adjustment, when the amount of new Bitcoin rewarded at the close of each block is reduced by half, an event commonly known as the halving. Historically, Bitcoin achieves a new all-time high price within 18 months of its last halving. The next halving will occur in May 2020:



Every four years, the Bitcoin supply growth rate is cut in half. Each halving also cuts the Bitcoin sell pressure from miners in half and creates upward pressure on its price. Historically, this quadrennial event is the best proxy for the timing of Bitcoin price fractal wave patterns.

The fractal wave patterns inevitably crescendo and begin to crash, usually attributed to myriad factors by mainstream media. However, the Gartner Hype cycle is an archetypal market pricing pattern that is driven entirely by human psychology, game theory and the ultimate exhaustion of market participants reachable in each iteration. The magnitude of each cycle is exacerbated by Bitcoin's absolutely fixed supply schedule, as increases in demand are expressed exclusively through its price, which historically leads to market frenzies at each peak. The long game for Bitcoin, and its final fractal wave pattern, will begin when and if central banks begin accumulating it as a reserve asset (more on this later). In this way, the bedrock of the Bitcoin network's expansion is the intransigency of its hodlers of last resort. Although they constitute a small minority of the whole, these stubborn hodlers will contribute to ongoing Bitcoin adoption in a meaningful way.

Minority Rule [3]

When it comes to group preferences, certain types of minorities — those who stubbornly insist on a particular preference — that constitute even a small level of the total population (often less than 4%) can cause the majority to submit to their preferences. Another clever concept from Nassim Taleb, called the minority rule, is the result of complex system dynamics, like those inherent to human interaction.

The nature of complex systems (society) is that the collective behaves in a way not predicted by its individual constituents (people). The interactions between its constituents matter more than their individual natures. Studying individual ants will never give us an idea on how the ant colony operates. For that, one needs to understand an ant colony as an ant colony, not just a collection of ants. This is called an emergent property of the whole. In other words, the whole is more than the sum of its parts because what matters is the interactions between the parts. These interactions, while complex, can obey simple rules, like the minority rule (or the rule that barter economies settle on a medium of exchange or that the hardest form of money always outcompetes). Many domains are impacted by the minority rule such as:

Markets — Market prices are not the consensus of market participants, but instead reflect the activities of the most motivated buyers and sellers. In 2008, a single $50B order, less than 0.2% of the stock market's total value of about $30T, caused the market to drop by almost 10%, causing losses of around $3T. The order was activated by the Parisian Bank Société Générale who discovered a hidden trade by a rogue trader and wanted to reverse the purchase. The market reacted disproportionately because there was only a desire to sell and no way to change the stubborn seller's mind.

Science — Similar to markets, science is not the consensus of scientists, it is the minority body of knowledge remaining after removing disproven hypotheses.

Law — A law abiding citizen will never commit criminal acts but a criminal will readily engage in legal acts, and criminal behavior has been shown to be contagious within certain social groups.

Imports — In the United Kingdom, where the (practicing) Muslim population is only around 4%, a very high proportion of the meat we find is halal (or Kosher). Close to 70% of lamb imports from New Zealand are halal. The same population and import proportions hold true in South Africa (the case of imports is closely related to the example below).

Today, in the United States and Europe, companies are selling more and more non-GMO food precisely because of the minority rule. Given the possibility of food containing GMOs, food not bearing the label "non-GMO" may be assumed by some to contain GMOs which, according to the minority, contain unknown risks. People who eat GMO food will readily eat non-GMO food, but not the reverse. Assuming the price and distribution costs differences between GMO and non-GMO are sufficiently small and the intransigent minority is distributed somewhat evenly throughout the population, this will have the effect of disproportionately increasing the demand for non-GMO food in the long run. This dynamic of scale can be explained quantitatively. In mathematical physics, renormalization groups are an apparatus that allow us to see how things scale up or down.

Here we show how the minority rule can renormalize the preferences of the majority.

Our graphic depicts:

Three vertically-stacked large boxes, each representing one sequential step in the minority rule renormalization process

Four medium boxes in each step, each representing a family of four

Four smaller boxes contained within each medium box, each representing an individual member within each family of four

Assume that in Step 1, the daughter in the family of four is the intransigent minority (the small pink box) who eats only non-GMO food. As we move to Step 2, the group renormalizes as the stubborn daughter manages to impose her rule on her three family members (who are now all pink) as they are flexible on the matter and consistency simplifies their grocery shopping and administrative process. In Step 3, the family of four goes to a backyard barbecue attended by three other families. As their family is known for their strict eating habits, the host will only serve non-GMO food as the other families are flexible and consistency simplifies the food preparation process, thereby making all four families (which are now all pink) adopt the minority rule originally set by the intransigent daughter in Step 1.

This minority rule will continue imposing and proliferating itself as these families attend other social events, which gradually shifts customer preferences in the neighborhood and eventually causes the local grocery store to switch to non-GMO foods to simplify its procurement processes, which impacts the local wholesaler, and so on up the supply chain. The real world result of this dynamic is the preferences of 4% of a population (practicing Muslims) driving the market preferences of 70% of their respective populations (in the UK, New Zealand and South Africa). As we can see, the minority rule spreads by interaction and renormalizes the entire group to conform with its preferences. Its proliferation is accelerated if there are incentives to switch, low switching costs or anticipated future benefits from switching (as superiorly hard digital cash money, Bitcoin offers all three). In this example, a minority constituting 6.3% of the total population imposed its rules on the majority using pure intransigence. In reality, the minority rule often takes effect when minorities become 4% or less of the total population.

Languages also often adhere to the minority rule. For instance, French was originally intended to be the language of diplomacy as civil servants from aristocratic backgrounds used it, while English was reserved for those engaged in commerce. In the rivalry between the two languages, which are still considered two of

the international languages (a third, Spanish, was added later because of its widespread use), English won as commerce came to dominate modern life. This gives us some intuition as to how the emergence of Lingua Franca languages, those commonly spoken across cultures, can come from minority rules. As Taleb puts it:

"Aramaic is a Semitic language which succeeded Canaanite (that is, Phoenician-Hebrew) in the Levant and resembles Arabic; it was the language Jesus Christ spoke. The reason it came to dominate the Levant and Egypt isn't because of any particular imperial Semitic power or the fact that they have interesting noses. It was the Persians –who speak an Indo-European language –who spread Aramaic, the language of Assyria, Syria, and Babylon. Persians taught Egyptians a language that was not their own. Simply, when the Persians invaded Babylon they found an administration with scribes who could only use Aramaic and didn't know Persian, so Aramaic became the state language. If your secretary can only take dictation in Aramaic, Aramaic is what you will use. This led to the oddity of Aramaic being used in Mongolia, as records were maintained in the Syriac alphabet (Syriac is the Eastern dialect of Aramaic). And centuries later, the story would repeat itself in reverse, with the Arabs using Greek in their early administration in the seventh and eighth's centuries. For during the Hellenistic era, Greek replaced Aramaic as the lingua franca in the Levant, and the scribes of Damascus maintained their records in Greek. But it was not the Greeks who spread Greek around the Mediterranean – Alexander (himself not Greek but Macedonian and spoke a different dialect of Greek) did not lead to an immediate deep cultural Hellenization. It was the Romans who accelerated the spreading of Greek, as they used it in their administration across the Eastern empire."

There is an asymmetry that those who do not have English as their first language usually know basic English, but native English speakers knowing other languages is less likely. If a meeting is taking place in an international office in say, Istanbul, among twenty executives from a sufficiently international corporation and one of the attendees does not speak Turkish, then the entire meeting will be run in English (the commercial Lingua Franca). This is the minority rule in action.

Money is an emergent property, as it is an expected result of complex human interactions within a barter economy. Similar to language, it is a means of expression, only it is used to express value instead of information or emotion. The US Dollar is the Lingua Franca of money today, as it belongs to one of the world's largest economies (an economy which also happens to effectively control the global banking system).

As the digital age matures and the world becomes increasingly interconnected, ever-more commerce and administration will be conducted over the internet. Also, fully interconnected trade networks will level the terrain of commerce and increase free market competition among different forms of money. Considering the significant market lead already enjoyed by Bitcoin, its superior hardness, its multi-sided network effects, the impotency of capital controls on digital cash and the winner take all dynamic inherent to monetary competition; it's likely that Bitcoin will continue to outcompete and its adoption rate will increase. By considering the application of the minority rule to adoption of Bitcoin in the digital age, we can reasonably expect the following:

Once a sufficient minority of the world's population, say 4% or less, have realized the advantages of hard money and digital cash money, their intransigent hoarding of Bitcoin will drive its price upward (Gresham's Law) and begin imposing itself economically on all other holders of money in the world. This will put downward price pressure on government fiat money, further accelerate Bitcoin's adoption rate and drastically improve Bitcoin's chances for global acceptance over the long run.

As the first natively digital form of cash money, Bitcoin will become the Lingua Franca of digital commerce and the dominant value exchange protocol, thereby capturing nearly all the value transacted online (e-commerce alone is estimated to be nearly $5T annually by the year 2021) over the long run.

Bitcoin may also become the base layer for other tools of cryptographic certainty in commerce, such as smart contracts and TrustNet applications (more on these later).

The minority rule is based on a fundamental asymmetry between the intransigence of the minority and the flexibility of the majority. The minority rule shows us that a small number of unyielding people with skin or soul in the game can change the shape of the majority. Bitcoin already has the advantage of being the hardest form of money ever invented, and its rules are immutable, which is the highest form of intransigency possible. It also has unrivaled brand awareness, fed by the mystery of its creation myth, and the support of free market fanatics all over the world. Once its obstinate minority reaches a certain size, the unbreakable rules of Bitcoin will begin to stubbornly impose themselves on the established economic order. In the words of Margaret Mead:

"Never doubt that a small group of thoughtful, committed citizens can change the world; indeed, it's the only thing that ever has."

A Superior Species of Money [1,4,12]

Bitcoin also introduces three new traits of money never before seen — censorship resistance, adaptivity and programmability. Censorship resistance means that no group or individual in the world can stop payments made on its network. Bitcoin gains censorship resistance by virtue of its decentralized architecture. Adaptivity refers to the ability for Bitcoin's network to become more secure as it stores more value, its open-source nature which aligns the incentives of its global team of volunteer programmers with its own to ensure it is always up to date with state-of-the-art software enhancements and its ability to subsume features from competitors that have been proven in the marketplace. Programmability refers to the digital nature of Bitcoin and its ability to interface with smart contracts and other decentralized applications. As we have learned, the free market for money is a competitive environment that is shaped by continuous market-driven natural selection; as a competitor in this domain Bitcoin is a superior species:

Bitcoin is a Superior Species of Money

Money is a social technology used to solve a problem which has persisted for all of humanity's existence: how to move economic value across time and space. Competition is at all times alive between different forms of money, subject to market-driven natural selection.

Traits of Money	Gold	Government Money	Bitcoin
Fungibility (interchangeable units)	High	Medium	High
Hardness (stock-to-flow ratio)	Medium	Low	High
Portability	Medium	High	High
Durability	High	Medium	High
Divisibility	Low	Medium	High
Security (cannot be counterfeited)	Medium	Medium	High
Easily Transactable	Low	High	High
Scarcity (predictable supply)	Medium	Low	High
Self-Sovereign (permissionless)	High	Low	High
Government Issued	Low	High	Low
Decentralized (censorship resistant)	Low	Low	High
Smart (adaptive & programmable)	Low	Low	High

The technology that is enabling Bitcoin to compete effectively in the market for money is also being applied to create new markets or disintermediate other existing markets. In technical parlance, the Bitcoin network is the world's first decentralized application. A decentralized application is a service that no single entity owns or operates. It is a new form of software and human organization that eliminates single points of failure, resists external attacks and reduces the need for intermediaries. Decentralized applications are enabled by cryptoassets. In the same way corporate equities serve companies and government bonds serve nations, cryptoassets serve decentralized applications. Owning a cryptoasset (like Bitcoin) is the only way to own a piece of a decentralized application (like the Bitcoin network). Technically, a cryptoasset is a cryptographically protected digital token representing rights within an economic network. A cryptoasset is to a decentralized application what oil is to an engine; it provides functionality and liquidity for the network and its constituents. A defining feature of cryptoassets and decentralized applications, and arguably their most alluring, is their organic nature; they are not centrally owned, governed or developed—making them highly resistant against censorship and manipulation.

Bitcoin (the OG cryptoasset) is superior in the market for money because it possesses all the ideal features of digital cash money and enjoys a market dominant position by virtue of its serendipitous first mover advantage which is fortified from disruption by its open-source design and multi-sided network effects. With the invention of Bitcoin, the world finally has a synthetic form of money with a stock-to-flow ratio

that is guaranteed to increase (until it reaches infinity) and an unstoppable, permissionless payments channel. Its digital nature makes it salable across space in a way never before seen, as it can be stored in the human mind and transmitted at the speed of light. The deep divisibility of each Bitcoin into 100 million Satoshis makes them supremely salable across scales. Its informational and nonperishable nature, when considered in combination with its superior hardness, gives Bitcoin unprecedented salability across time. This design makes it an impeccable store of value. Finally, by eliminating all intermediary control (which is inherent to government money) Bitcoin resists debasement, censorship and confiscation. It removes the central banks, macroeconomists, politicians, presidents, dictators and military leaders from monetary policy and payments authorization once and for all. The masterful book (from which much of this essay adapted) titled "The Bitcoin Standard" by Saifedean Ammous sums up Bitcoin's historical relevance nicely:

"If the modern world is ancient Rome, suffering the economic consequences of monetary collapse, with the dollar our aureus, then Satoshi Nakamoto is our Constantine, Bitcoin is his solidus, and the Internet is our Constantinople. Bitcoin serves as a monetary lifeboat for people forced to transact and save in monetary media constantly debased by governments... the real advantage of Bitcoin lies in it being a reliable long term store of value, and a sovereign form of money that allows individuals to conduct permissionless transactions."

Bitcoin is a tool for freedom. As the most accessible asymmetric bet in history, Bitcoin is also a unique investment opportunity.

Investing in Bitcoin [1,5,13]

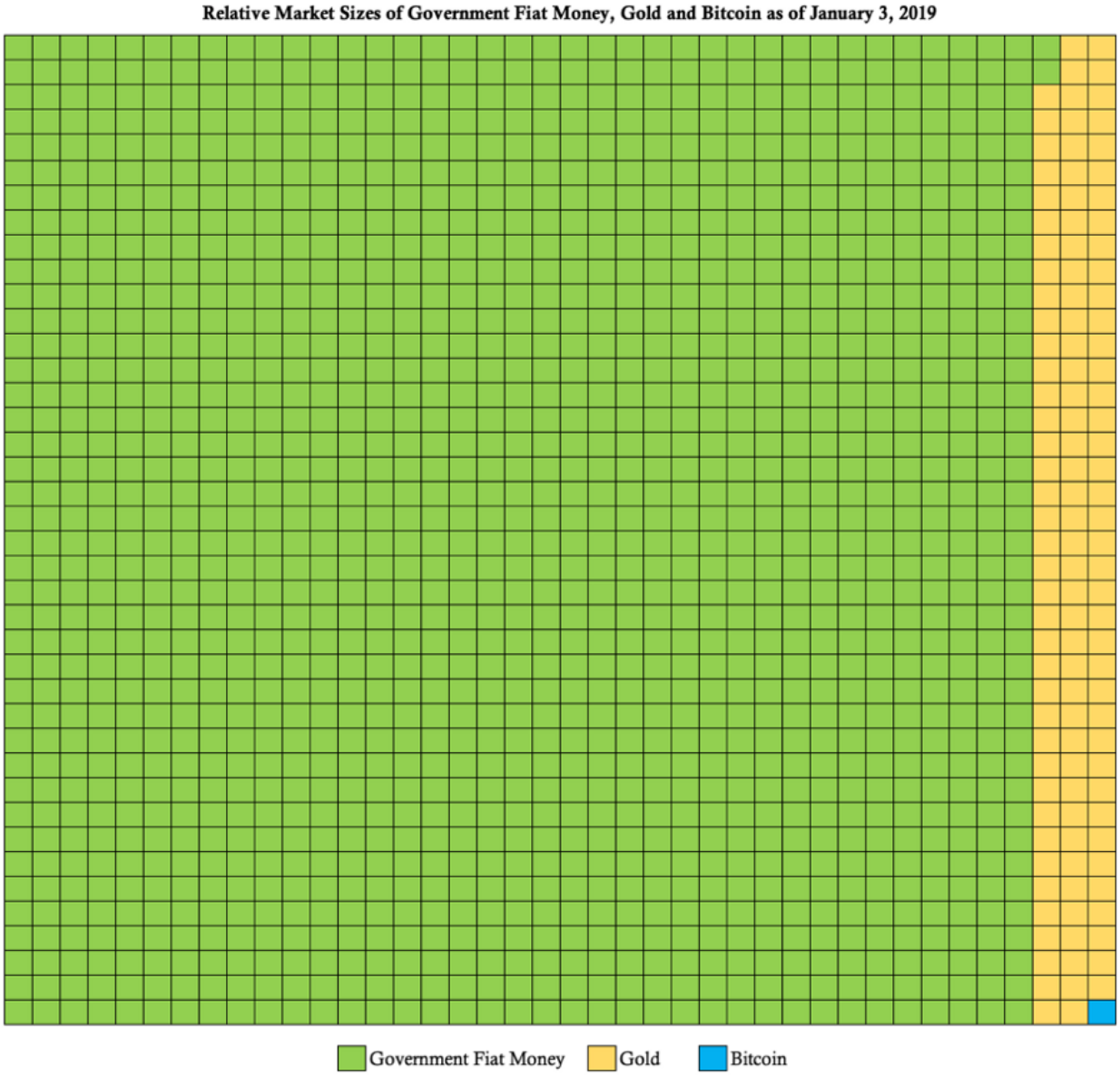
Investing is all about taking intelligent risks. As Daniel Kahneman, a Nobel Prize-winning psychologist, describes it:

"Intelligent risks are based on wide and voracious data gathering checked against gut instinct; while dumb decisions are built from too narrow a base on inputs."

Bitcoin is often referred to as digital gold, in reference to its hardness, self-sovereignty and as an instrument for final settlement. Following this analogy, there will only be one digital equivalent to gold (due to winner take all dynamics inherent to the free market for money), and if you were going to bet on which one will succeed you'd want to bet heaviest on the biggest (due to its deep liquidity and multi-sided network effects), most renowned (due to the minority rule) and the longest lived (due to the Lindy Effect, more on this later). As people tend to think by analogy, this comparison to gold mostly works well, although it is incomplete.

As we have seen, Bitcoin is a far superior monetary technology to the golden inert metal. Technologically, Bitcoin needs little to no protocol improvement to continue to compete effectively in the market for money. There are no unsolved computer science problems standing between Bitcoin and its widespread adoption. Therefore, its primary aim is to remain extant as digital cash money, hence its minimal level of protocol functionality and the status quo bias it exhibits in relation to governance. By merely existing, Bitcoin provides a gateway for people to opt out of the prevailing inflationary monetary order. As long as it continues to operate successfully in its current form, Bitcoin will function healthily as the stateless base

money protocol for the digital age — which makes it a viable contender in the $100T market for global money:



Bitcoin is competitively superior to both gold and government fiat money, and has plenty of room to grow.

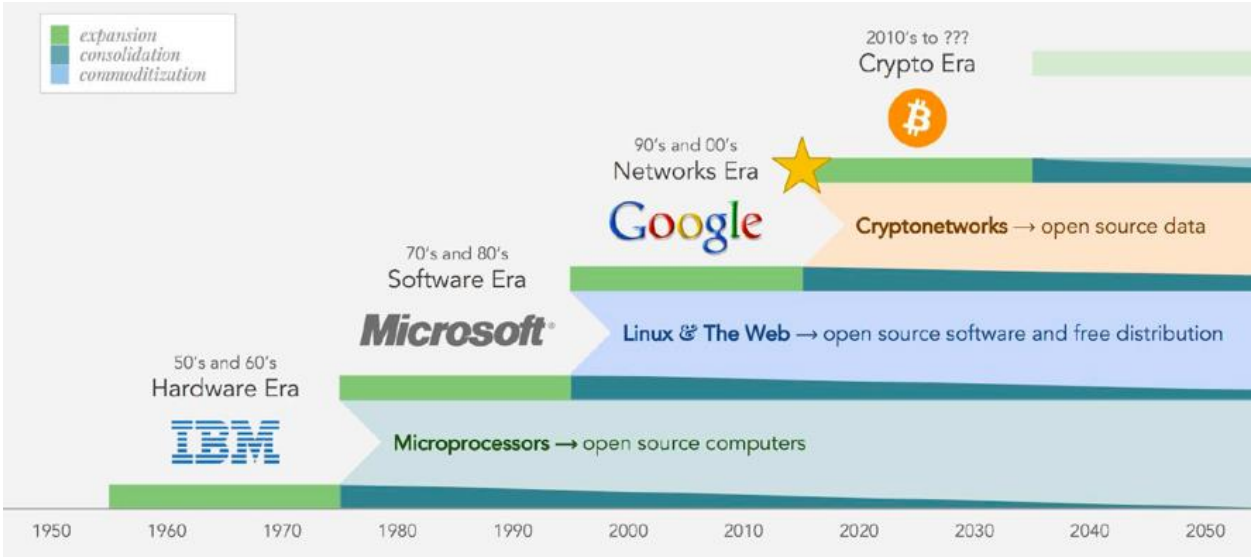
Since it is still extremely small relative to its total addressable market, which consists mostly of gold and government fiat money, Bitcoin still has room to grow by orders of magnitude in both its network size and price. Like a call option, a bet on Bitcoin is asymmetric, meaning that an investor's downside is limited to 1x whereas their potential upside is 100x or more. Should Bitcoin achieve a majority share of the global market for money, its level of demand will become far more predictable and steady, leading to a stabilization in its price.

Investing in Bitcoin can be considered a bet on its adoption as an uninflatable, politically neutral store of value and as an unstoppable, permissionless payments channel.

Bitcoin may also become part of a much bigger wave of innovation. Although the Bitcoin network and the decentralized applications it has inspired are poorly understood by most today (similar to the internet in the early 1990s) we believe that the world will gradually awaken to the paradigmatic shift that is underway for money and markets in general. The greatest wealth is created by being an early investor in innovation. Making such investments requires believing in something before the majority of people understand it — which also often entails enduring mockery, ridicule and criticism for your non-consensus perspective. As Mark Yusko, one of my favorite hedge fund managers, describes the coming crypto era:

"Technology follows 14-year innovation cycles. These began with the Mainframe in 1954, then the Microchip in 1968, the Personal Computer in 1982, the Internet in 1996 and most recently the Mobilenet in 2010. As a result of the innovations introduced by Bitcoin, soon we will christen 2024 as the dawn of the Trustnet."

The TrustNet can be thought of as the dawn of trustworthy computing. In theory, it will enable new technologies such as the internet of things, decentralized autonomous organizations, self-owning commercial assets, decentralized internet provisioning, decentralization of energy distribution, reputation markets, computing power markets, stateless identity, immutable media, AI-run organizations, token curated registries, prediction markets and circles of trust. This anticipated innovation wave is consistent with a multi-decade cycle of information technology expansion, consolidation and commoditization:



As innovations in information technology age, they inevitably become commoditized and create the bedrock upon which future waves of innovation are built.

Bitcoin, as the original and driving force of this innovation expansion cycle, will likely function as the systemic core and base money system of the Trustnet. During this cycle, all markets that are enabled by this technology will likely rely on the Bitcoin blockchain as a common value system, final settlement mechanism and temporal anchor point.

A Momentous Innovation [1,4,5,7,8,10]

Bitcoin is a momentous innovation of the digital age. As such, it has many unique characteristics, properties and capabilities never before seen in a monetary technology:

Immutable Monetary Policy — Predictable, transparent and unchangeable money supply schedule. The most critical aspect to outcompeting in the free market for money, as people will naturally come to favor the hardest form of money available to them (uninflatable money).

Digital Scarcity — Necessary to solve the double-spend problem and bring the speed and finality of physical cash settlement into the digital

Absolute Scarcity — The only asset in the world which has an absolutely finite supply, like time itself.

Global Final Settlement System — A permissionless, unstoppable payments system with zero counterparty risk (like gold, only digital) that can be used to quickly and efficiently provide finality of settlement across scales and space.

Self-Sovereign Network — A self-sovereign monetary good (an informational bearer instrument) whose network operates autonomously in full accordance with its own immutable rules as reliably as the laws of mathematics.

Stateless Money — The first globally connected payments system that is politically neutral. Possible catalyst for the separation of money and state over the long

Revolutionary Social Contract Implementation — A unique 2-layer social contract implementation that decentralizes power among its constituents and creates a hypercompetitive market for its own network security. A new form of social institution.

Global Consensus — Perhaps the only truly objective set of facts in world history, its distributed ledger is created by converting processing power into indisputable truth.

Global Energy Buyer of Last Resort — Enables anyone in the world to convert excess electricity into digital gold on demand. A perpetual incentive for everyone in the world to develop more energy efficient innovations.

A New Form of Life — Feeds on human self-interest and electricity to provide uninflatable money, an unstoppable payments channel and immutable governance.

Adaptive Security — By virtue of the mining difficulty adjustment, as more value is stored on its network, the network adapts to become more secure.

Adaptive Functionality — As an open-source software project, programmers around the world are constantly improving Bitcoin's codebase, however it is up to the users to adopt these changes, which creates a governance equilibrium in which only those changes that are in the collective best interests of users will be adopted. Enables Bitcoin to subsume superior features from competitors that are market-proven, making it highly resilient to disruption.

Programmability – As a digitally native form of money, it can be used as a form of payment, collateral or fuel for a variety of smart contracts (self-executing software or commercial agreements). Can interface with other decentralized applications. Could function as the core value system for the TrustNet, the anticipated wave of innovation triggered by the emergence of Bitcoin.

Bitcoin has made a major impact in the world in its 10 years of existence, and it still holds a great deal of promise for the future. All in good time. Given its inextricable relationship with money and Bitcoin, the concept of time is worth exploring more deeply. It turns out that time's role in our lives, individually and collectively, is the key to understanding prosperity and the ways in which Bitcoin could play a key role.

Synthesized Works & Further Reading

[1] *The Bitcoin Standard: The Decentralized Alternative to Central Banking* by Saifedean Ammous (a masterful work on which much of this essay is based)

[2] *The Rational Optimist* by Matt Ridley

[3] *Skin in the Game* by Nassim Nicholas Taleb

[4] *The Bullish Case for Bitcoin* by Vijay Boyapati

[5] *The Age of Cryptocurrency* by Paul Vigna and Michael J. Casey

[6] *Sapiens* by Yuval Harari

[7] Bitcoin is a Decentralized Organism, *Part 1* and *Part 2* by Brandon Quittem

[8] *PoW is Efficient* by Dan Held

[9] *The Fifth Protocol* by Naval Ravikant

[10] *Unpacking Bitcoin's Social Contract* by Hasu

[11] *Antifragile* by Nassim Nicholas Taleb

[12] *Letter to Jamie Dimon* by Adam Ludwin

[13] *Placeholder VC Investment Thesis Summary* by Joel Monegro and Chris Burniske

[14] *Diffusion of Innovations* by Everett M. Rogers

[15] *Why America Can't Regulate Bitcoin* by Beautyon

[16] *Hyperbitcoinization* by Daniel Krawisz

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Money, Bitcoin and Time: 3 of 3

By Robert Breedlove

Posted January 26, 2019

This is part 3 of a 3 part series

7 The Simple Truth about Time: Time is the ultimate resource. Its absolute scarcity bounds the entirety our stories, both as individuals and societies. With economics, we strive to use it more effectively. As the destroyer of all things and the healer of

The Ultimate Resource [1]

Scarcity is the starting point of all economics. It is commonly believed that natural resources are inherently scarce, which is true in a sense, as there is only so much gold within the Earth, for instance. However, this finite quantity of gold in the Earth is still too large for humans to even measure and in no way constitutes an actual limit to the amount we can conceivably mine. We have literally 'just scratched the surface', as our mining efforts haven't even taken us half way into the Earth's crust, its thinnest and outermost layer. Driven by need, humans have always found a way to explore farther and dig deeper to uncover ever-more natural resources. Therefore, the actual practical limit to the quantity of any natural resource is always and only the amount of human time, effort and ingenuity devoted to its production. For human beings then, the only truly scarce resource is time.

Individually, the only scarcity we face is our limited time on Earth. As a society, the only scarcity we deal with is the total amount of human time, effort and ingenuity available to be directed at the production of goods. This scarce resource, which we will call human time, is the ultimate societal means of production. Humans have never fully exhausted any single natural resource. The price of all natural resources, in terms of human time, has always decreased steadily over the long-run as our technological advancements have dramatically increased our productivity. Not only have we not depleted any natural resource, but the proven reserves (the amount of natural resources still within the Earth) continue to increase despite our increasing rates of production, as new technologies enable us to discover and excavate ever-more natural resources.

Oil, the lifeblood of the industrial economy, is a great example of this concept. Even as oil production has increased every year, its proven reserves increase at an even faster rate. According to data from BP's statistical review, annual oil production increased 50% from 1980 to 2015. Oil reserves, on the other hand, have increased 148% during the same 35 year period, around triple the increase in oil production. Similar statistics exist for all natural resources prevalent in the Earth's crust. Some are more common (iron, copper) and some are rare (gold, silver) but the limit of how much we can produce of any particular natural resource is always and only the amount of human time directed at its production. The best evidence of this simple fact is gold: if the annual production of the one of the rarest metals in the Earth's crust goes up every year, then it makes no sense to consider any other natural resource being scarce in any practical sense. Echoing back to the fundamental market realities related to deferred consumption and investment—the real cost of anything is always its opportunity cost in terms of goods forgone to produce it. In terms of natural resources, only human time is truly scarce, which makes time the ultimate resource.

Frozen Time [1]

As more humans exist, there is more human time to direct towards the extraction and production of natural resources. As we have learned, productive output per unit of human time (productivity) can be amplified by leveraging technological solutions to problems (tools). In economics, a tool or technology is considered to be both:

A non-excludable good—once one person invents something, all others can copy it and benefit from it

A non-rival good—a person benefiting from an invention does not reduce the utility that accrues to the others who use it

For example, once one person invented the wheel, everyone else could copy its design and make their own, and their use of this design would in no way reduce others' ability to benefit from it. Innovations like this spread and their benefits compound over time, leading to ever-higher productivity and division of labor. Like the candle whose flame burns undiminished even after igniting a thousand others, the benefits of innovation ultimately accrue to everyone without detracting from the innovator in any way.

Natural resources and innovation are always and only the product of human time. Therefore, in terms of production, human time is the ultimate resource and essence of value. To keep score, people needed a way to reliably store the value they produce with their time, so that they can exchange it in the future for other peoples' time, effort and ingenuity. Conceptually then, money is frozen time. It is earned by sacrificing human time and can be traded for commensurate sacrifices from others. The age-old problem faced by people is collectively deciding which monetary technology can best serve this purpose.

Technologically, money is a spontaneous emergent property that humans ascribe to a particular good. People, acting in self-interest, live within technological and economic realities that shape their decisions and provide them incentives to persist, adapt, change or innovate. It is from the countless collisions of these complex human interactions that spontaneous monetary orders have emerged and decayed. History has shown us myriad cases of a good being subjected to market-driven natural selection, achieving a monetary role and subsequently having its role taken by a superior technology.

Whatever monetary media people chose as a store of value was always subject to being produced in greater quantity, so the producers could acquire the value stored in it. The Yapese witnessed this play out when O'Keefe produced Rai Stones using explosives. West Africans had their wealth confiscated by Europeans who shipped in boat loads of cheaply produced glass beads. Citizens in modern economies continuously have their wealth usurped as central banks gradually or quickly erode the value of government fiat money. Gold came close to solving this problem as it is indestructible, expensive to mine and its flow is relatively predictable. However, gold's physicality led to its centralization within bank vaults and its compulsory replacement with soft government money.

Until the invention of Bitcoin, all forms of money were subject to having their value stolen by producers of the monetary good. This made all monetary technologies before Bitcoin imperfect in their ability to store value across time. Bitcoin's finite supply makes it the best medium to store the value produced by finite human time. In other words, Bitcoin is the best store of value humanity has ever invented, as it is the only monetary technology that cannot be debased over time. The informational, intangible and purely digital nature of Bitcoin enables it to achieve absolute scarcity, a property that was previously exclusive to time itself.

The absolute scarcity of Bitcoin makes it the perfect modality for freezing and transacting the only other absolutely scarce resource — time.

No matter how many people use the network, how advanced mining equipment becomes or how much its price increases, there can only ever be 21 million Bitcoins in existence. In time, it is likely that Bitcoin will be regarded as the best technology for saving ever invented.

Time Arbitrage [2,13,14]

Innovations of this magnitude are virtually impossible to predict; however, they do follow a familiar adoption pattern. The book titled 'Diffusion of Innovations' lays out a framework that seeks to explain how, why and at what rate new ideas and technologies spread. Diffusion is the process by which an innovation is communicated and adopted by participants in a social system over time. There are four main elements that influence the spread of the new idea:

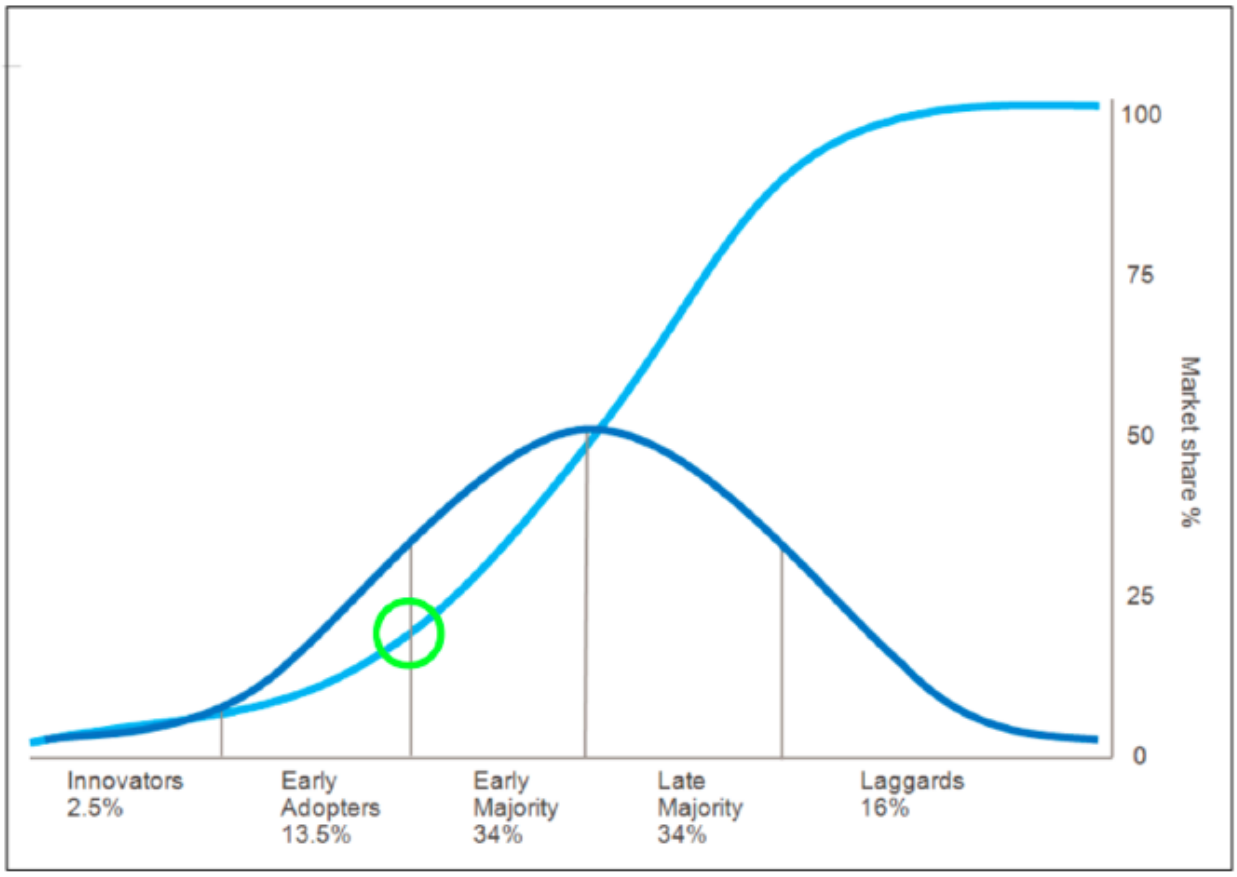
The nature of the innovation

Communication channels

Time elapsed since ideation

The social systems under which it is adopted

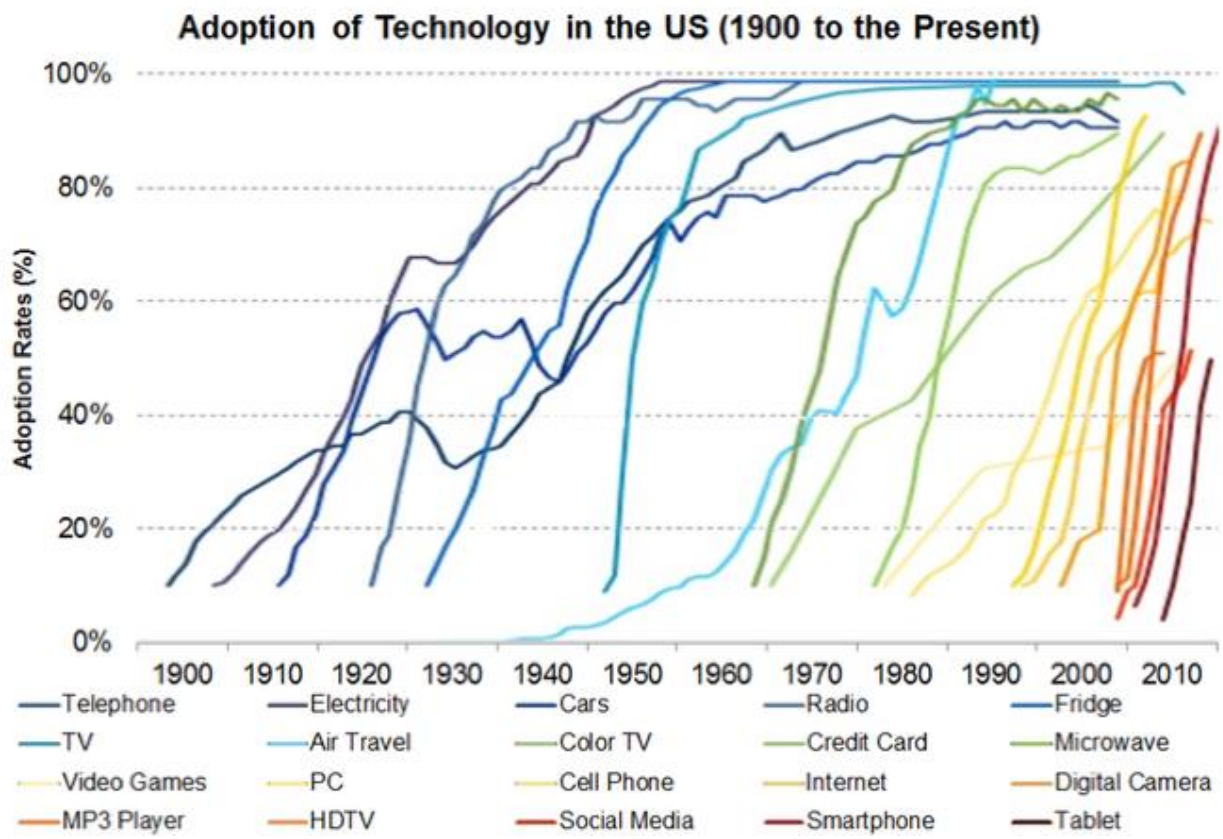
Once a certain rate of adoption is achieved, the innovation reaches a tipping point and its continuous spread becomes practically unstoppable (a concept of preferences closely related to the minority rule discussed earlier) as people naturally prefer superior technology solutions. Such an adoption curve is especially true of, and often completed faster for, network-based technologies such as the internet and Bitcoin; as their general acceptance is driven harder and faster by network effects. Based on its estimated number of users, we are just beginning to enter the early adopter phase for Bitcoin:



The S-curve of adoption. As succesive groups adopt a new technology or idea market share rises. The tipping point (green circle) marks an inflection point and leads to rapid growth in adoption.

In investing, the concept of time arbitrage refers to an asset becoming oversold based on a short-term or emotional market sentiment despite its long-term outlook or investment fundamentals remaining unchanged or even improving. Time arbitrage is essentially another form of the old investment adage "Buy on bad news, sell on good news". Times such as these present savvy investors with an opportunity to enter a position with the same or improved value fundamentals at a lower price point.

All ubiquitous technologies today, beginning as fledgling innovations themselves, have traversed this path to mainstream adoption. Here we show some of the most impactful innovations since the year 1900 and the rapidity with which they were adopted:



telecommunication networks have become more advanced and ubiquitous, the user adoption rates of new innovations have accelerated dramatically.

As we can see, advances in telecommunications and distribution methods have accelerated the pace with which new innovations are adopted. Today, the internet causes breakthrough innovations to spread like a wildfire throughout the minds of people all over the world. Since it is a nascent monetary technology that is not fully understood by the vast majority of the world, Bitcoin still has low levels of adoption and therefore significant upside prospects. Also, owning a piece of the Bitcoin network today is over 80% cheaper than about a year ago even though its utility in terms of throughput, transaction fee efficiency and network security have all improved substantially over the same period. This confluence of factors indicates that now is an opportune time to take advantage of time arbitrage and invest in the Bitcoin network. Also, as a technology, the Bitcoin network's value will continue to grow with every passing day that it successfully operates.

Lindy Effect [4,11]

Things in this world fall into one of two general categories: perishable and nonperishable. The distinction between the perishable (humans, single items) and the nonperishable is that the latter does not have a natural, unavoidable expiration date. The perishable is typically physical in nature, meaning it is subject to physical degradation, whereas the nonperishable is typically informational in nature. A single car is perishable, but the automobile as a technology has survived for a century and can be reasonably expected to persist for at least another one. An individual man will die, but his genes (which are digital) can be

passed on for innumerable generations. This heuristic from Nassim Taleb, known as the Lindy Effect, can be summarized as follows:

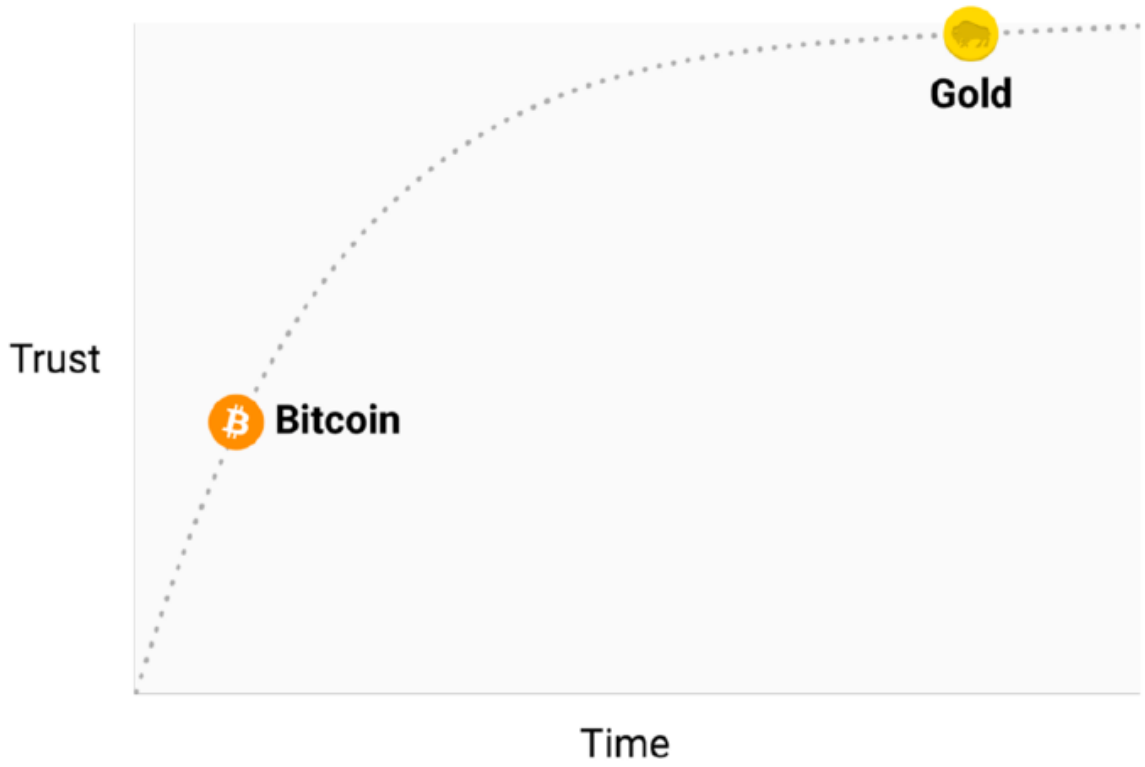
For the perishable, every additional day of life translates into a shorter additional life expectancy.

For the nonperishable, every additional day of life may imply a longer life expectancy.

The only effective judge of things is time, as time is the ultimate destroyer of all things. The Lindy Effect is closely related to antifragility, as the ravages of time are a potent form of adversity. Anything that gains from temporally-driven increases in disorder is antifragile and benefits from the Lindy Effect. Using arbitrary math for simplicity, if a book is still in print after 50 years, it can be expected to remain in print for another 50 years. If it's still in print for another 50 years after that, then perhaps it can then be expected to remain in print for at least an additional 120 years. At some point, the Lindy Effect may imply an unlimited life expectancy. A book like the Bible, which has been in print for thousands of years, can be reasonably expected to remain in print for the rest of human history.

If you had conducted a survey in 1995 and asked people whether they believed the internet would be a permanent feature of their lives, you would have probably received mixed responses. If you conducted the same survey today, people would resoundingly agree that the internet is here to stay. A technology, being informational rather than physical in nature, does not age in the same way humans do. A technology like the wheel is not "old" in the sense of experiencing degradation, it is a technological design that has persisted for millennia and can be reasonably expected to persist for many more.

So, the longer a technology lives, the longer it can be expected to live. Since Bitcoin is a technology, every day that it continues to successfully operate increases its life expectancy. Further, as we have learned, the core moving parts of Bitcoin are mathematics and human nature—two concepts which are very "Lindy" and can be reasonably expected to persist for the rest of human history. Bitcoin's ever-growing life expectancy increases its perceived trustworthiness and eventually it will be regarded as a permanent feature of our modern lives in the same way the internet is today. This heuristic helps explain why gold will likely continue to be regarded as a monetary metal for many years to come, whereas Bitcoin is still in the process earning people's trust:



Hard monetary technologies become more trusted over time as they offer peace of mind to their users.

The Lindy Effect is universally applicable across time. The same competitive dynamics that caused the ascent of gold into a dominant monetary role are now driving Bitcoin adoption. In this sense, the future is in the past. As the Arabic proverb says: he who does not have a past has no future. Notwithstanding the past century of central bank coercion, hard money is the norm of human history and we are witnessing its reemergence with the rise of Bitcoin. As Bitcoin continues to persist, knowledge of its fundamental nature and functional capabilities will continue to spread. Threatened by its continued growth, incumbents will ratchet up their efforts to prevent Bitcoin's ascent and protect the monopoly on money they have enjoyed over the past century.

Future of Regulation [1,4,5,15]

There is a good reason why the gold standard was forcibly ended and no good store of value has yet risen to fill the void. To preserve seigniorage profits governments must enforce an inflationary monetary policy. Otherwise, if a sound store of value existed that was accessible to its citizenry, their business model would be jeopardized as people would exit depreciating fiat currencies to shield their wealth from further confiscation. As Alan Greenspan, former Chairman of the Federal Reserve (the central bank of the United States) said in 1966:

"In the absence of the gold standard, there is no way to protect savings from confiscation through inflation. There is no safe store of value. If there were, the government would have to make its holding illegal, as was done in the case of gold.** If everyone decided, for example, to convert all his bank deposits

to silver or copper or any other good, and thereafter declined to accept checks as payment for goods, bank deposits would lose their purchasing power and government-created bank credit would be worthless as a claim on goods. **The financial policy of the welfare state requires that there be no way for the owners of wealth to protect themselves."**

Clearly, central banks are aware that free market competition against hard money poses significant risk to the continuity of their socialistic business model. To protect central bank monopoly positions, governments have resorted to passing onerous laws against their citizens. Governments seek to insulate their national currencies from free market competition employing legal measures such as:

Capital Controls — which prohibit the movement of money into or out of a country

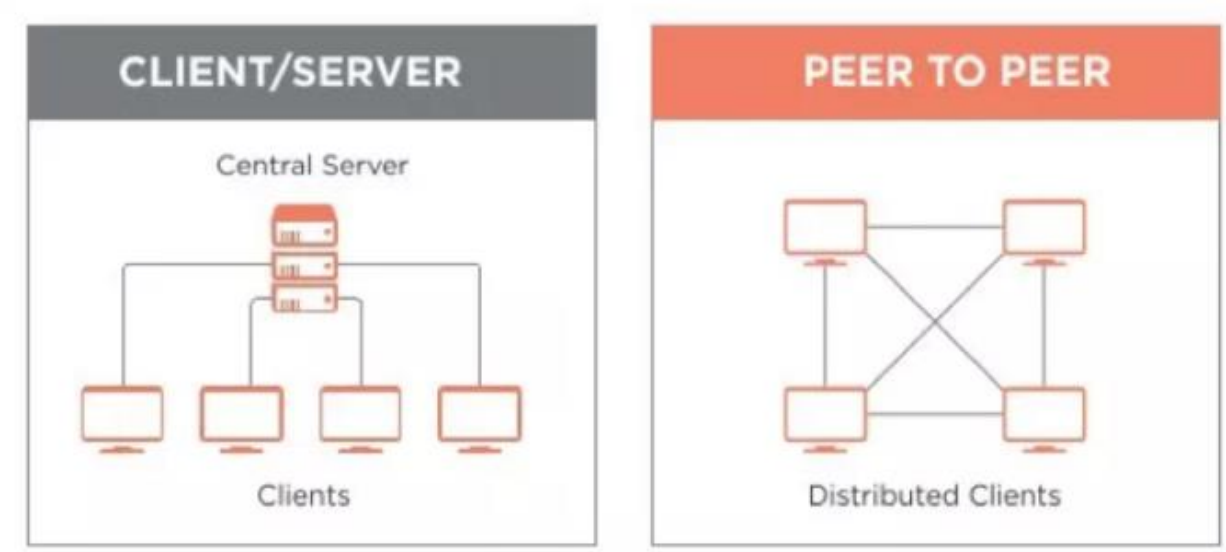
Confiscatory Orders — forceful seizure of assets, like Executive Order 6102 in 1933 which outlawed private ownership of gold in the United States

Legal Tender laws — which create artificial demand for government fiat money by requiring that it be accepted in settlement of debts

With Bitcoin, regulators face a unique dilemma. Bitcoin exists orthogonally to the law, and there is virtually nothing that any authority (or anyone for that matter) can do to affect its operation. Regulations were designed to govern people and entities and are not equipped to deal with a decentralized network that autonomously proliferates itself. Regulators are really good at targeting centralized marks, like an individual business or its CEO, and enforcing laws against them. However, regulations have proven to be largely impotent against decentralized services.

To understand this point, consider the case of BitTorrent, a decentralized peer-to-peer file sharing service. In the earlier days of the internet, file sharing platforms like Napster and Kazaa had become an extremely popular way for users to share movies, music and other media directly with one another. With these free services, users would upload media to and download media from the companies' computer servers. This client-server file sharing directly threatened media monopoly profits, as it completely circumvented copyright law. Incumbent organizations quickly responded with heavy litigation. Since services like Napster and Kazaa were hosted by centralized companies complete with a headquarters, executive team and computer servers, they were vulnerable to being shut down. Filing a lawsuit, knocking on some doors, levying some fines and decommissioning some computer servers was all it took to shut down these services and protect media industry monopolists.

The introduction of BitTorrent, an open-source decentralized protocol for peer-to-peer file sharing, was a game changer. Once installed on a computer, BitTorrent enables user nodes to upload and download movies, music and other media directly from one another using encrypted communication channels. Since files on its network do not come from a single source, BitTorrent was also able to offer superior download speeds by fragmenting the media files and pulling from multiple nodes simultaneously. Unlike the failed client-server models of centralized platforms, the BitTorrent protocol never holds any of the media files, it only facilitates the transfer of files between individual users:



Like the proven model of BitTorrent, Bitcoin sports a decentralized architecture that makes it highly resistant to external attack and censorship.

Architecturally, the entire software codebase of the protocol exists on every user machine that downloads it, making it virtually impossible for a regulator to target and shutdown as there is no single point of vulnerability (censorship resistance). The BitTorrent protocol exists everywhere and nowhere by virtue of its decentralized network architecture, a model that would be later employed by Bitcoin. Indeed, without a centralized target to shut down, regulators were incapable of stopping BitTorrent and the other protocols it inspired. By 2009, peer-to-peer file sharing using decentralized protocols like BitTorrent accounted for up to 70% of internet traffic worldwide.

Bitcoin has already exhibited similar properties to BitTorrent as regulators have been incapable of containing the expansion of its network or shutting it down. It cannot be contained by capital controls, as it exists entirely outside the legacy financial system. Confiscation of Bitcoin, unlike that of gold, is extremely difficult given its informational nature. This leaves legal tender laws, which are still enforceable and could therefore require Bitcoin users to convert some of their holdings into government fiat money to pay their taxes. So, the exchanges and OTC markets where Bitcoin is traded are the only viable targets for regulators. As such, these financial gateways that connect Bitcoin to the traditional financial system are likely to see continuous intensification of regulatory scrutiny and enforcement actions. However, as we saw in China, escalated efforts will likely only highlight the need for Bitcoin, expand its brand awareness and spawn off exchange transactions (Streisand Effect).

In essence, open-source software projects like Bitcoin are just information — software written in a computer language called code. Since it is just code, Bitcoin can be printed out, written down, spoken or memorized. Bitcoin is also a form of money, so it makes money and information the same thing. This concept was summed up nicely by Naval Ravikant in 2017:

“This is one of the crazy things about this concept because money and speech turned out to be the same thing — money, information and math - they’re the same thing. In a Bitcoin world, I can literally write down my Bitcoin address and keys on a piece of paper and put it in a safety deposit box. It’s basically in

cold storage, I could even put it in my head. I can memorize the key phrases and I could cross national borders with $1 billion in my brain. It's a very powerful but literally mind bending concept in that sense."

The First amendment of the United States Constitution guarantees that all Americans have the power to exercise their right to publish and distribute anything they like, without restriction or prior restraint — which includes software code like that which constitutes Bitcoin. Established legal precedent in the United States explicitly protects software code under the First Amendment. Consider the case of PGP:

"In 1995, the US Government had on the statute books, laws that restrict the export of encryption software products from America without a license. These goods are classified as 'munitions'. The first versions of the breakthrough Public Key Encryption software "Pretty Good Privacy" or "PGP", written by Philip Zimmerman had already escaped the USA via Bulletin Board Systems from the moment it was first distributed, but all copies of PGP outside of the United States were "illegal". In order to fix the problem of all copies of PGP outside of America being encumbered by this perception, an ingenious plan was put into motion, using the first Amendment as the means of making it happen legally. The source code for PGP was printed out . It's as simple as that. Once the source code for PGP was printed in book form, it instantly and more importantly, unambiguously, fell under the protection of the First Amendment."

Bitcoin unambiguously falls under the Freedom of Speech Protections offered by the First Amendment to the United States Constitution.

For these reasons, it is unlikely that any major government would attempt to ban Bitcoin outright as, not only would it contradict freedom of speech laws, it would also create a tidal wave of publicity (again, Streisand Effect). Central banks have acknowledged this reality. Former chairwoman of the Federal Reserve Janet Yellen confirmed:

"The Federal Reserve simply does not have the authority to supervise or regulate Bitcoin in any way."

So, Bitcoin can't be shut down, is virtually immune to regulation and leverages economic incentives to grow relentlessly. Its very existence is a game changer for almost everyone in this world, especially central banks who now face an existential threat to their business model.

The Long Game [1,4,16]

Money is how we keep score in the game of life. Game theory explores how rational people make strategic decisions in different scenarios. It is based in purely mathematical terms and has applications in any domain where people must choose whether to cooperate or compete with each other. The standard game analyzed by game theory is the Prisoner's Dilemma:

Two members of a criminal gang, Alex and Bobby, are arrested and imprisoned. Each prisoner is in solitary confinement with no means of communicating with the other. The prosecutors lack sufficient evidence to convict the pair on the principal charge, but they have enough to convict both on a lesser charge. Simultaneously, the prosecutors offer each prisoner a bargain. Each prisoner is given the opportunity either to betray the other by testifying against them, or to cooperate with the other by remaining silent. The possible decisions and outcomes are:

If Alex and Bobby both betray each other, each of them serves 2 years in prison

If Alex betrays Bobby but Bobby remains silent, Alex will be set free and Bobby will serve 3 years in prison

If Bobby betrays Alex but Alex remains silent, Bobby will be set free and Alex will serve 3 years in prison

If Alex and Bobby both remain silent, both of them will only serve 1 year in prison (on the lesser charge)

This game decisions and its outcomes are summarized in this table:

		Bobby's decisions	
		Bobby stays silent (cooperates)	Bobby testifies (betrays)
Alex's Decisions	Alex stays silent (cooperates)	Alex and Bobby each serve 1 year	Alex serves 3 years, Bobby goes free
	Alex testifies (betrays)	Alex goes free, Bobby serves 3 years	Alex and Bobby each serve 2 years

Game theory shows us that adversaries will often behave contrary to their mutual best interests.

This Prisoner's Dilemma game converges on a Schelling Point, which is a solution that people will tend towards in the absence of communication or definitive trust (in other words, in an adversarial environment). The Schelling Point in the Prisoner's Dilemma is that Alex and Bobby both choose to betray each other, as each would risk 3 years in prison if one chose to remain silent and the other testified. Since both have an incentive to testify, the optimal strategy for this game is that they both betray, despite their mutual silence offering the best outcome for them both.

Since money is an adversarial game (there are winners and losers) express communications between players cannot always be trusted. Therefore, the Schelling Point of monetary competition is to choose the available good which exhibits the highest hardness, because people (potential adversaries) must be restrained from creating new monetary units to steal the value stored within them. This is exactly the reason market-driven natural selection is so ruthlessly effective at promulgating hard money, as people are constantly seeking to acquire value and store it in the most reliably hard monetary technology available.

Monetary goods, like Bitcoin, are valued based on their game theoretic qualities—meaning each market participant values a monetary good based on their appraisal of whether and how much other participants will value it (in the same way that prisoners Alex and Bobby must anticipate each other's decisions to make effective decisions of their own). The earlier one is able to anticipate the future demand for a monetary good, the greater the advantage conferred to the prognosticator; as it can be acquired more cheaply than when it becomes widely demanded at a later time. Further, when one acquires a good expecting that it will be demanded as a future store of value, it actually hastens the adoption of the good by others for that particular purpose, as their selection of a store of value is partly influenced by their perception of your intentions which drove you to acquire the monetary good in the first place. This seeming circularity is another positive feedback loop that drives societies to converge on a single store of value (another aspect of the winner take all dynamic):

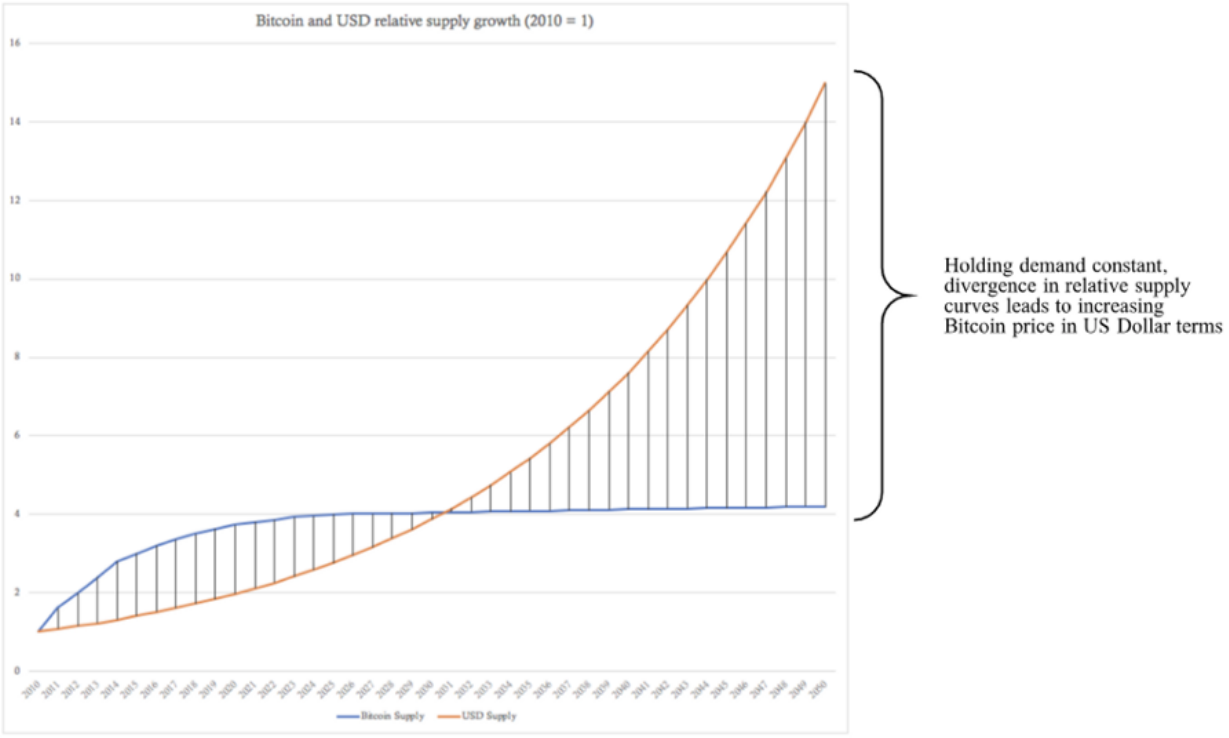
The game theoretic properties of the monetization process encourage people to converge on a singular money

In game theoretic terms, total market dominance by a single store of value with a superior stock-to-flow ratio is known as a Nash Equilibrium—a game state where no player has an incentive to deviate from his chosen strategy after anticipating the most likely choices of all his opponents. Throughout all human history, societal convergence on a single form of superiorly hard money is the Nash Equilibrium of monetary competition. As we saw with gold in the 19th century, when multiple societies converge on a single store of value, they see a substantial decrease in trade costs and an attendant increase in free trade and capital accumulation (La Belle Époque). Only the past century, dominated by government fiat money, is anomalous in this respect.

Hard money is the norm of human history, and we are seeing its reemergence with Bitcoin.

The monetization process, as we saw with gold and are now seeing with Bitcoin, is game theoretic. People must decide individually how best to store the value created by their time spent in production. This decision is based on the anticipated beliefs, decisions and actions of others in relation to the monetary technologies available to them. The complex interaction of these decision dynamics is how people spontaneously ascribe a good the role of money and why the hardest money always wins. In this way, hard money is an emergent property of indirect exchange just like money is an emergent property of direct exchange.

This emergent property perspective is exactly why value stored in softer forms of money is totally absorbed by hard money every time they interact within an economic network. Existing amid the expansionary monetary policies being practiced by every central bank in the world today, Bitcoin's price will continue to increase as the ratio of government fiat money in circulation to Bitcoin units in circulation diverges ever-further:



This graphic, which is strictly illustrative, simply shows that divergence in supply curves of Bitcoin and US Dollars will lead to the appreciation of Bitcoin in US Dollar terms, even without any increase in the demand for Bitcoin (as we have seen, demand for Bitcoin has been surging). The same dynamic is applicable to all modern government monies, as every central bank in the world is engaged in aggressive expansionary monetary policy. In the game of international government fiat monetary competition, the Nash Equilibrium is all currencies inflated into worthlessness. On this race to the bottom, those with easiest access to freshly printed money will expropriate as much value as possible (via the Cantillon Effect) and use it to acquire real estate, gold or other inflation resistant assets (such as Bitcoin). This game theoretic perspective clearly explains why virtually all soft government fiat currencies have trended towards eventual worthlessness.

Next, we show how all major fiat currencies have depreciated almost completely against gold since 1900 (notice the steep decline in 1971 when the peg to gold was completely severed):

All major currencies depreciation v gold

As we have seen throughout history, every time hard money encounters soft money in a trade network, it has outcompeted it into extinction. We saw earlier how gold, possessing superior hardness, demonetized silver with dire economic consequences for those societies that remained on a silver standard the longest, such as China and India. Now it is gold that faces a monetary competitor with superior hardness, and it is likely that it will gradually become demonetized as people convert to Bitcoin for its unparalleled store of value properties. This will happen slowly, and gold may indeed maintain some of its monetary use case given the vast holdings of central banks, mankind's deep history with the monetary metal (Lindy Effect), its relatively high and predictable stock-to-flow ratio and the fact that some people may always prefer a

tangible store of value over a digital alternative. For government money, the competitive situation is much more dire.

The Event Horizon [1,4,16]

Hyperinflation is a particular type of demonetization, unique to government fiat money, that did not exist under the gold standard. Hyperinflation occurs when a government produces new monetary units at an accelerating pace to finance expenditures or service debt burdens, which pushes the value of its currency down at the same accelerating rate. The value of a hyperinflating currency collapses against the most liquid goods available to the society first (like gold or the US dollar) and then, depending on relative availability, against real goods such as real estate and commodities. This sequence is caused by individual's attempting to maximize their exchange optionality as they escape their failing currency and prepare to navigate highly uncertain economic conditions. When hyperinflation intensifies, currencies begin falling against perishable goods. It is common to see grocery stores completely emptied out in societies suffering from the late stages of hyperinflation. Eventually, the society will either devolve to a barter economy or adopt a new medium of exchange, as we saw in Zimbabwe when its failing dollar was ultimately replaced by the US dollar. This process is arduous as the replacement currency is often scarce as foreign banking institutions are either reluctant to or restricted from providing liquidity.

As Bitcoin is the hardest form of money in existence, it will continue to appreciate against a backdrop of hyperinflating, soft government fiat currencies even without any increase in demand for Bitcoin (as illustrated in the above graphic). Eventually, this will lead to an inflection point in some economies where users rush to exit from their failing currency to get into Bitcoin to protect their wealth from further confiscation. This transition will have similar dynamics to other demonetization and hyperinflation events, however it will also be different given Bitcoin's unique properties as a monetary technology. A Bitcoin-induced currency demonetization is called a hyperbitcoinization event and is different from hyperinflation in two critical respects.

First, hyperinflation occurs with restricted competition with other fiat currencies, since a government can easily enforce capital controls that selectively prohibit inflows or outflows of government money, whereas hyperbitcoinization occurs because of direct competition with Bitcoin, which can easily cross borders as it is immune to capital controls. This will cause hyperbitcoinization to happen much faster than a hyperinflation event, since governments will have great difficulty preventing Bitcoin trading within their borders due to its purely informational nature. Given governments' inability to shield their local currencies from direct competition with Bitcoin and the high opportunity cost of holding a depreciating form of money, once a hyperbitcoinization event reaches a critical mass it will happen quickly.

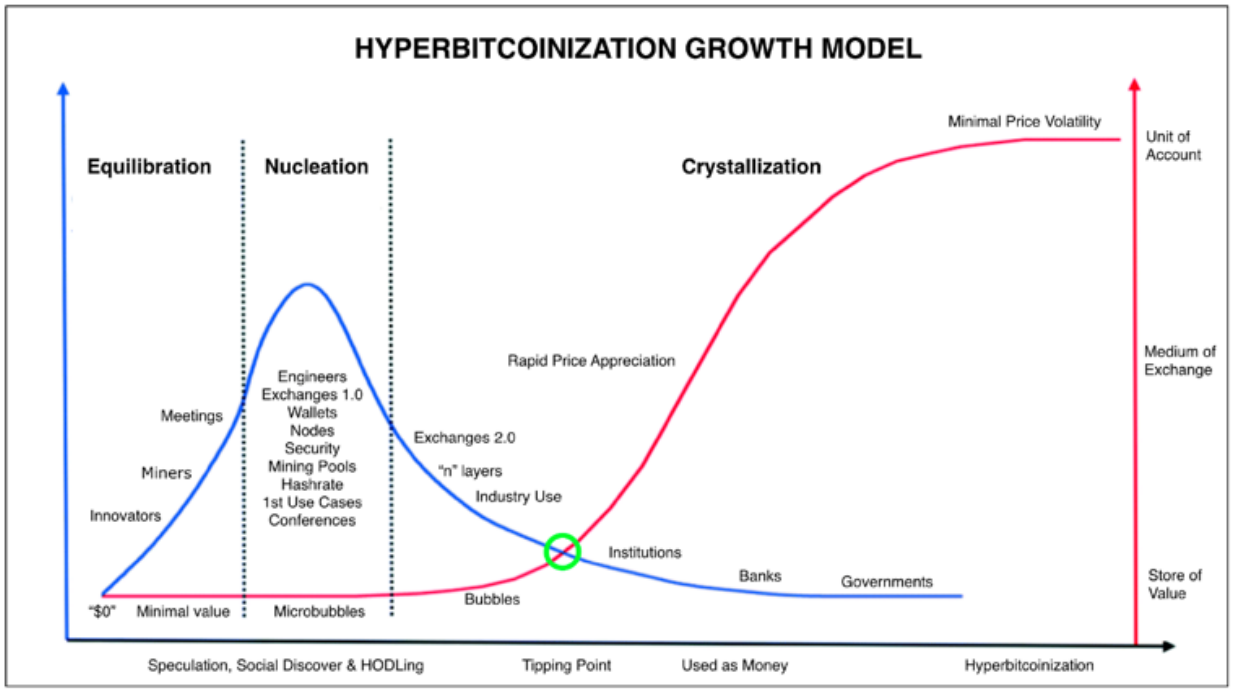
Second, in hyperinflation, the governments expand money supplies in an attempt to outpace people's inflation expectations. As governments forms a habit of inflating money supplies, people form a habit of anticipating rising prices and seek alternative stores of value. Governments, in turn, must print incrementally more money to stay ahead of inflation expectations and generate the same economic effect with each new monetary unit produced. With no alternative monetary media in which to escape, prices surge until a breaking point is reached. Hyperinflation is extremely disruptive to an economy as it forces people to switch from the worst form of government fiat money available to them to some other soft

government fiat money (at best) or ends in total economic collapse (at worst). In hyperbitcoinization, users have a supranational monetary media in which to escape centrally planned economies. Therefore, a hyperbitcoinization event should be much less disruptive to the economy, as people will be trading in an inferior form of money for a superior one. Seeing as hyperbitcoinization should happen fast, people will quickly become accustomed to dealing in Bitcoin, which will protect deteriorating wealth and stabilize economic conditions.

Hyperbitcoinization will likely be a confusing, potentially chaotic, time for many people. Initially, it will probably occur at the periphery, with the countries inflating their currencies the fastest experiencing it first. Stories of this will spread quickly in the digital age and add to the believability of Bitcoin, all while it continues to benefit from the resultant increases in demand, network effects and the Lindy Effect. As more people wake up to the reality of hard money, we would expect the pace of this global transition to accelerate until all soft money is outcompeted into extinction. Fortunately, it will happen relatively quickly, since Bitcoin is immune to capital controls, and act as a stabilizing force for the world economy going forward (since hard money resists market distortions and remains firmly rooted in economic reality).

Like a star orbiting a black hole, any established monetary order that goes beyond the event horizon of hyperbitcoinization will inevitably collapse into Bitcoin's singularity.

Next, we show how a hyperbitcoinization event is likely to unfold:



Once Bitcoin's ecosystem is seeded a crystallization process begins. Growth becomes exponential and self-reinforcing. In this model, the tipping point (green circle) represents a dramatic change at which point many people and oganizations adopt Bitcoin.

The estimates of how valuable Bitcoin would become after global hyperbitcoinization vary based on what weighting is included for different stores of value (gold, government money, real estate, stocks, bonds, art, oil and other commodities are all used for this purpose today) but, using simple math for our directional

analysis, if Bitcoin demonetizes just gold it would be valued at about $400K per coin ($8T/20M coins in 2025). If it demonetizes government money as well, it would be valued at about $5M per coin ($100T/20M coins in 2025). As awareness of Bitcoin and its potential impact spread, the long game becomes even more interesting. Considering Bitcoin represents an existential threat to government fiat money and central banks, we must also consider their decisions from a game theoretic perspective.

Reverse Bank Run [1,4,5]

Although it is still considered magic internet money by most people today, its continued existence and appreciation will attract more attention from high-net-worth individuals, institutional investors and then, possibly, central banks. As we have learned, central banks still rely on gold as a means of final settlement, as it was (before Bitcoin) the only monetary medium entirely free of counterparty risk (cash money). However, transporting and securing gold is an extremely expensive process fraught with operational risk. These costs and risks are the reason final settlements between banks occur very infrequently.

With the transaction throughput available on the Bitcoin network today, the global group of 850 central banks can perform daily final settlement with one another. With each central bank serving an average of 10 million customers, this would more than cover the entire world's population. In a world in which central banks adopted a Bitcoin standard, governments would no longer have the ability to increase the money supply and banks would begin to compete freely with one another by offering various physical and digital Bitcoin-backed monetary instruments and payment solutions. By using the technologies introduced by Bitcoin, cryptographic digital certainty can be applied to bank accounting and help expose those that engage in fractional reserve banking. This may lead to Bitcoin realizing its ultimate use case: the fastest and most efficient system for global final settlement across long distances and national borders. Despite the clear advantages of a system such as this, central banks are unlikely to give up their monopoly control over the existing monetary order willingly.

As people begin to voluntarily exit fiat currencies into Bitcoin to protect their wealth, as is already taking place in countries like Venezuela today, it will likely grab even more attention from central banks. As central banks are effectively losing customers, they will need to hedge the going concern risk posed to their business model. Central banks today hold reserves mainly in US Dollars, Euros, British Pounds, IMF Standard Drawing Rights and gold. These reserves are used to settle accounts and defend the market price of their respective currencies. Should Bitcoin remain on its current trajectory, and considering its superiority as a final settlement layer, it is possible that at least one central bank somewhere in the world will add Bitcoin to its reserves, if for no other reason than to defend the market price of its government fiat money, as is consistent with their strategy for gold.

The most likely scenario is that a central bank will seek to own part of the Bitcoin network as an insurance policy against it succeeding. Strategically, it makes sense for a central bank to spend a small amount acquiring some of Bitcoin's supply today. For example, consider that the authorities of a central bank today judge that, although chances of a hyperbitcoinization event are extremely remote, it would represent an extinction-level event for their business. Mathematically, using Bitcoin's approximate price today of $4K and its expected post-hyperbitcoinization price of $5M, unless the central bank is more than

99.92% certain that this event will NOT happen then it is prudent to allocate at least 0.08% of their assets into Bitcoin as a perfect hedge against its success (since price growth from $4K to $5M is a 1250x increase, an allocation of 0.08% of assets would keep a central bank at even-money should a hyperbitcoinization event play out).

Game theory tells us that the first central bank to buy Bitcoin will trigger a reverse bank run, as its decision will alert the rest of the central banks who will be compelled by self-interest to follow suit. The first purchase by a central bank will cause the price of Bitcoin to rise significantly, causing others to move in based on their anticipation of future demand and compounding the effect as more central banks enter the market; making it progressively more expensive for later entrants. As central banks keep trying to anticipate the moves and strategies of one another, a game theoretic positive feedback loop will ensue that converges on a hard money Schelling point similar to that of free market monetary competition, thus triggering a global competition among central banks for maximal Bitcoin accumulation. A smart play for a central bank under the circumstances would be for it be the first to buy a small share of the Bitcoin network. An even smarter play would be for a central bank to purchase Bitcoin without announcing it, allowing it to begin accumulation at lower prices.

Similar to the transition to the gold standard in the 19th century, network effects would eventually take hold as more central banks bought some Bitcoin, increasing its liquidity and making it more marketable, thus creating ever-larger incentives for other central banks to join. After a sufficient minority of central banks have purchased part of the Bitcoin network, the minority rule will reach its final step and begin imposing the immutable rules of Bitcoin on the established monetary order. Once this reverse bank run on Bitcoin became public knowledge (as tends to happen easily in the digital age), it would be the ultimate seal of legitimacy for Bitcoin adoption and would add even more force to its ascent in the marketplace as this global game of Bitcoin accumulation would reach a fever pitch. Even at the largest scales of the financial system, Bitcoin converts individual self-interest into the growth of its network.

You may find this prospect hard to believe. About 25 years ago, handheld touchscreen supercomputers with wireless global interconnectivity were hard to believe too. Change keeps happening faster and faster. Remember, each central bank will value Bitcoin based on its appraisal of whether and how much other central banks will ultimately value it. As they will all be conducting the same strategic analyses, they will undoubtedly realize the dilemma they face—either ignore Bitcoin and watch it continue to outcompete and accelerate the failure rate of fiat currencies thereby loosening their control over the established economic order or choose to adopt Bitcoin as a reserve asset and trigger a game of accumulation against other central banks and legitimize it as an asset which will culminate in the loss of their monopoly position in the market for money. Operating in an adversarial environment, game theory tells us that so long as Bitcoin continues to operate in its current form, central banks (like the prisoners Alex and Bobby) will eventually be faced with strategic choices such as these to protect their own interests. At some point, the substantial advantage imparted to the central bank that moves first will become an overwhelming incentive to at least one, causing it to be the first to make its move, thereby triggering the reverse bank run on Bitcoin.

A Path to Prosperity [1–16]

Making predictions is risky business, wrong answers are innumerable, and the right answer is singular. Accurate predictions are rare. By weaving together historical knowledge and awareness of current trends, one can develop a perspective on what technological innovations are possible. The biggest mistakes people make when making such predictions are:

Forming an opinion on the innovative potential without considering it deeply (Blockbuster quickly reaching a decision to pass on buying Netflix for $50M)

Disregarding an innovation because it contradicts a closely held worldview (Kodak refusing to accept the disruptive potential of digital photography as they spent 100 years building a business model centered on chemical film)

Overlooking an innovation because it is too small or threatens a position of power (major newspapers refusing to develop an online presence early on)

Practicing a beginner's mindset and reasoning from first principles is critical for effective foresight. Pulling together everything we have discussed in this paper, we will now propose a potential path forward for Bitcoin based on the historical competitive dynamics of money, current macroeconomic trends and game theory. We will start from the inception of Bitcoin:

Bitcoin is first perceived as an internet toy for cryptographers (Minority Rule — Step 1)

Its rapid price increase makes a small group of people rich, engages free market fanatics and brings media attention. Its hyper-volatile price presents itself early (Hodlers of Last Resort — Layer 1).

The media, financial and tech establishments — having failed to buy Bitcoin early and benefit from its meteoric rise — denounce it as a Ponzi scheme, the MySpace of Cryptocurrencies and the greatest bubble of all time (Streisand Effect).

A large number of scammers jump onto the Bitcoin hype-train and create their own cryptocurrencies claiming to be superior though lacking critical qualities including decentralization, security and immutable governance. Bitcoin's serendipitous first mover advantage, multi-sided network effects and its brand awareness fueled by the Nakamoto creation myth preserves its market dominant position.

Retail investors, venture capitalists and hedge funds — lacking understanding of monetary economics and applying inappropriate valuation models — invest into other cryptocurrencies, creating more noise and confusion as the prices of these altcoins increase at a rate higher than

Well-connected venture capitalists and hedge funds are given discounts on the investments only to then dump much of what they bought onto retail investors.

Given their high correlation to Bitcoin and lacking utility, the world watches as the bear markets continue to wipe out more and more alternative cryptoassets as most fail to deliver any useful product, although some succeed in other market spaces. Features that are proven in the market by other cryptoassets are subsumed by Bitcoin (Decentralized Network Archetype). Bitcoin price volatility persists but annual low prices continue to ascend relentlessly (Holders of Last Resort — Layer 2).

Trust in Bitcoin increases over time (Lindy Effect) and its market price continues its upward yet volatile trajectory (Fractal Wave Patterns).

People, burned in the altcoin craze, witness and learn about Bitcoin's undisputed superiority across all monetary characteristics, especially its hardness (Holders of Last Resort — Layer 3).

On the eve of and during the next bull markets, Bitcoin's absolute scarcity and antifragile characteristics exacerbate investor FOMO (Game Theoretic Positive Feedback Loop). Some investors are inevitably caught in the subsequent Bitcoin price crash (Fractal Wave Pattern)(Hodlers of Last Resort — Layer 4).

Hyperinflating fiat currencies are further contributing to the adoption of Bitcoin as it becomes the only means of preserving wealth for many people, making Bitcoin a legitimate store of value. Governments scramble to try and enforce capital controls and create propaganda against Bitcoin, just like they did to gold in the 20th century. Capital controls prove to be impotent and the propaganda against Bitcoin incites internet and media narratives that regard it as a tool for freedom (Antifragility). Government dissent highlights the need for Bitcoin in the first place (Streisand Effect).

Investors and high net-worth individuals are convinced to allocate a small portion of their assets into Bitcoin to capture further growth, hedge against inflation and increase the risk adjusted returns of their traditional portfolios (Minority Rule — Step 2)

Increases in demand for Bitcoin necessarily involve a reduction in demand for fiat currencies, causing even higher inflation rates (Gresham's Law). At great expense and effort, governments messily issue their own cryptocurrencies but fail to relinquish control over monetary policy, which makes them uncompetitive against Bitcoin (Market-Driven Natural Selection). Governments covertly attempt to attack the Bitcoin network, which only strengthens it (Antifragility). Media coverage about Bitcoin shifts towards its use as hard money (Skin in the Game) and its importance for prosperity (Hodlers of Last Resort — Layer 5).

Activists share the message that soft money creates social inequality (Soul in the Game) by disproportionately taxing the poorest via inflation (Cantillon Effect). This message spreads fast in a world of ever-more crashing fiat currencies and people rush to exit their local currencies for the safety of Bitcoin, triggering the first hyperbitcoinization events (Hodlers of Last Resort — Layer 6). Bitcoin mining hardware becomes commoditized and many citizens join mining pools (Decentralized Network Archetype)(Skin in the Game).

Central banks, in an attempt to adapt to the new conditions and hedge going concern risks, quietly start to accumulate Bitcoin as a reserve asset, consistent with their gold strategy. A former central bank employee leaks a confidential strategy document regarding Bitcoin (Soul in the Game) which triggers other central banks to begin purchasing Bitcoin, causing its price and perceived legitimacy to increase at an accelerating rate (Game Theoretic Positive Feedback Loop)(Final Fractal Wave Pattern)(Hodlers of Last Resort — Layer 7).

Bitcoin's market capitalization reaches tens of trillions in US Dollar terms. Bitcoin's volatility subsides as both its market capitalization and liquidity are larger than ever (Mature Hard Money).

Early Bitcoin investors are now sitting on significant unrealized gains and are willing to part with some of their Bitcoin to pay for their purchases. With its purchasing power stabilized, the opportunity cost of transacting with Bitcoin is diminished and its use as a Medium of Exchange increases.

With the world more digitized than ever before, people increasingly demand to be paid in Bitcoin now that it has proven to be a good store of value given its disinflationary, and later deflationary, monetary policy (Schelling Point)(Hodlers of Last Resort — Layer 8).

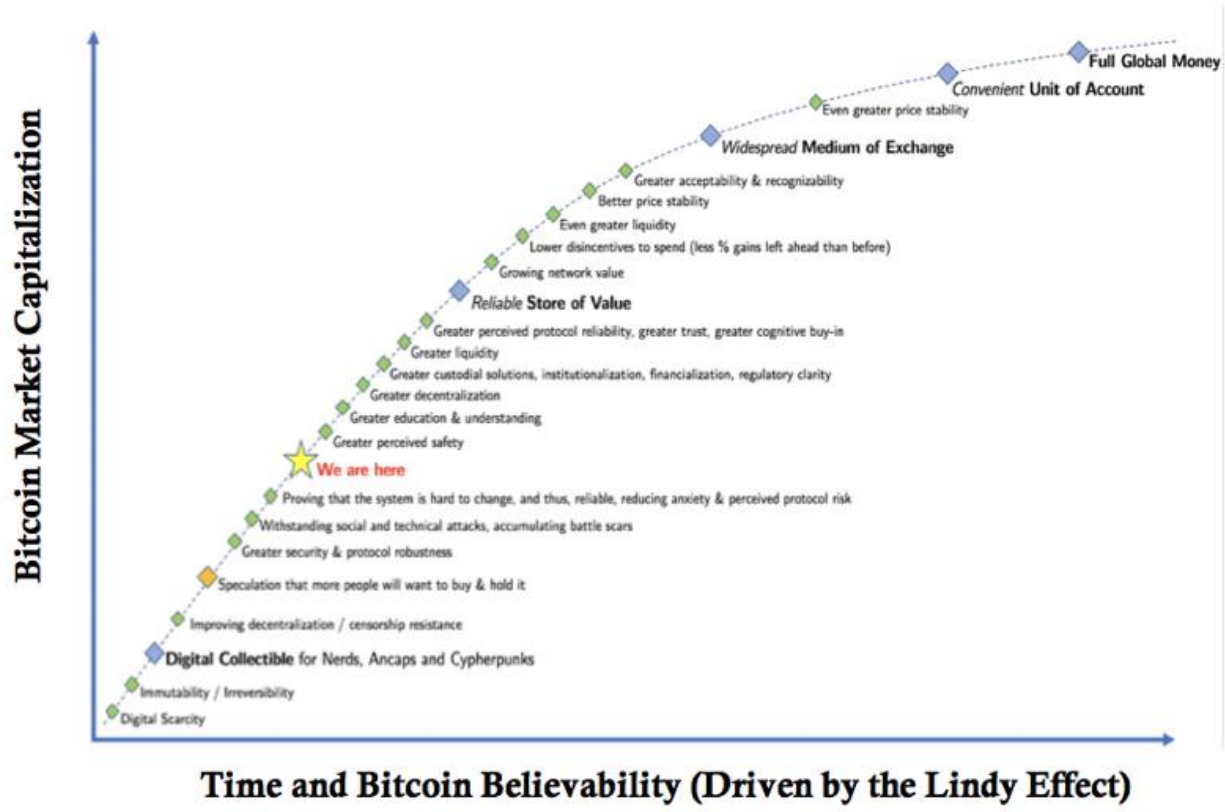
With the addition of highly performant transaction layers, Bitcoin's use as a Medium of Exchange becomes a widespread. Bitcoin, functioning as the core of a new innovation wave called the TrustNet, is christened as a momentous innovation.

As more consumers and merchants become accustomed to transacting in Bitcoin, it gradually becomes used as a Unit of Account.

Due to the emergence of a superior, uninflatable monetary standard, people increasingly store their wealth in Bitcoin rather than fiat currencies (Minority Rule — Step 3)(Hodlers of Last Resort — Layer 9).

Central bank monopolies on money are described by historians as a relic of the past. Bitcoin is regarded as the catalytic innovation behind the separation of money and state. A free market for money is now the defining feature of free market capitalism (Nash Equilibrium).

This path to full global money will take Bitcoin through many stages:



Time Will Tell

All time beyond the present is unknown. All predictions should always be taken with a grain of salt. The future is uncertain, and the end can always be near. Anyone who claims they can tell you what is going to happen in the future is wrong. All we can do is study the patterns of the past and use them as our map to navigate the ever-advancing territory of the future.

In a free market, hard money has always outcompeted soft money into extinction. Hard money has been the norm throughout all of human history, except for the past 100 years in which we have been coerced into using soft government fiat money. Societies operating on hard money systems optimize for the allocation of the ultimate resource, human time, which increases prosperity for everyone.

In the digital age, markets are increasingly interconnected. Bitcoin is digital cash money. It is a new social institution that lives in accordance with its own laws. Its core components are human self-interest and mathematics. Bitcoin is the hardest monetary technology in history. Will it continue to outcompete and win the throne of full global money?

Only time will tell.

Synthesized Works & Further Reading

[1] *The Bitcoin Standard: The Decentralized Alternative to Central Banking* by Saifedean Ammous (a masterful work on which much of this essay is based)

[2] *The Rational Optimist* by Matt Ridley

[3] *Skin in the Game* by Nassim Nicholas Taleb

[4] *The Bullish Case for Bitcoin* by Vijay Boyapati

[5] *The Age of Cryptocurrency* by Paul Vigna and Michael J. Casey

[6] *Sapiens* by Yuval Harari

[7] Bitcoin is a Decentralized Organism, *Part 1* and *Part 2* by Brandon Quittem

[8] *PoW is Efficient* by Dan Held

[9] *The Fifth Protocol* by Naval Ravikant

[10] *Unpacking Bitcoin's Social Contract* by Hasu

[11] *Antifragile* by Nassim Nicholas Taleb

[12] *Letter to Jamie Dimon* by Adam Ludwin

[13] *Placeholder VC Investment Thesis Summary* by Joel Monegro and Chris Burniske

[14] *Diffusion of Innovations* by Everett M. Rogers

[15] *Why America Can't Regulate Bitcoin* by Beautyon

[16] *Hyperbitcoinization* by Daniel Krawisz

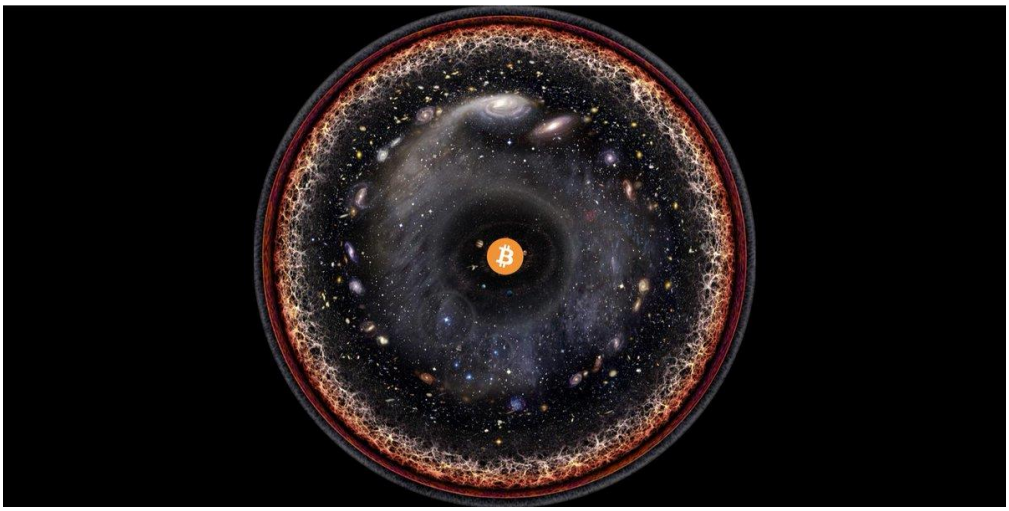
Tweetstorm: The Bitcoin Common Tongue

By Robert Breedlove

Posted June 20, 2019

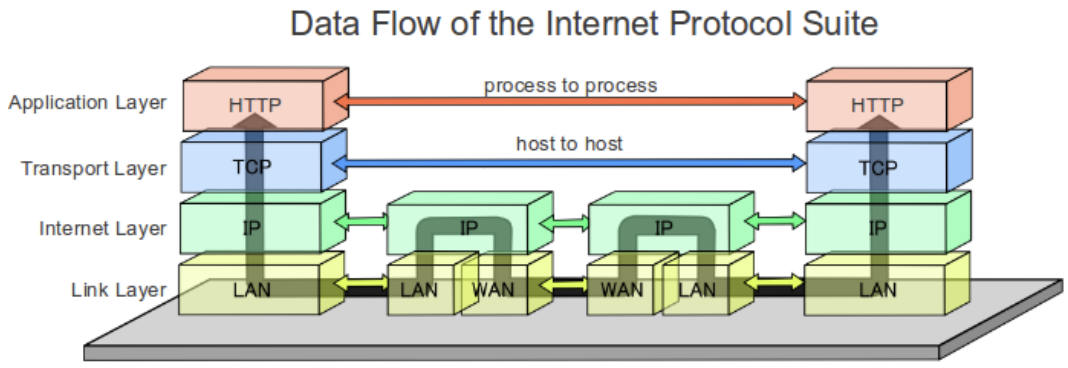
1/ As ambassadors of #Bitcoin, I believe we must speak the common tongue and avoid esoteric language so that our message can penetrate minds far and wide. Here, I will shed some light on the Bitcoin and cryptoasset universe in an exoteric nutshell. Let's begin...

Thread ↓

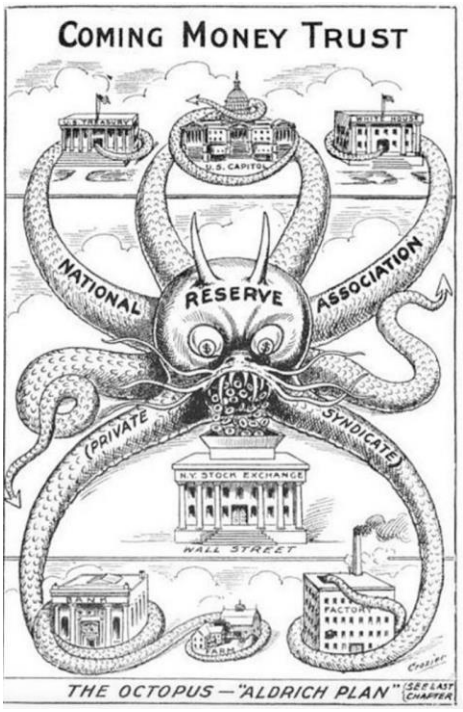


2/ When we look at the cryptoasset universe, there are two distinct hemispheres: 1) Bitcoin and 2) everything else, which are commonly known as Alternative Cryptoassets or Alts

3/ Bitcoin is more akin to the internet itself, which is composed of an open-source protocol stack called the internet protocol suite (consisting of http, TCP/IP, etc.)



4/ In the same way the internet is a set of open protocols for exchanging information, Bitcoin is a set of open protocols for exchanging value. Hence its common nickname "the internet of value"



5/ Bitcoin can be thought of as the latest layer in the internet protocol suite and, we believe, will grow to touch everything and everyone that the internet touches today

6/ This perspective also gives us a useful analogy when thinking about how one could stop Bitcoin: The analogous question is: 'How does one permanently turn off the entire Internet worldwide?'

7/ Bitcoin is free market money competing against monopoly money (pun intended). Bitcoin is disintermediating the market for money, which today is monopolized by central banks

8/ In the other half of the cryptoasset universe, we have Alternative Cryptoassets (also called Alts or Altcoins)

9/ Alts have adopted the open-source technology underpinning Bitcoin to attempt to compete against it directly, disintermediate other markets, or enable new markets

10/ So far, the use cases for Alts are mostly unproven (with the possible exception of Ethereum) and Bitcoin is positioned to capture the vast majority of the value created during this entire wave of innovation

11/ Alts are venture capital investments that can be launched at extremely low cost and are subjected to little, if any, professional due diligence (hence their other nickname - shitcoins)

12/ Some alts may one day succeed meaningfully, however these venture-style investments are much more risky than Bitcoin

13/ Intriguingly, although Bitcoin is a modern innovation, to understand its value proposition fully we must first dive deep into the history and nature of money...

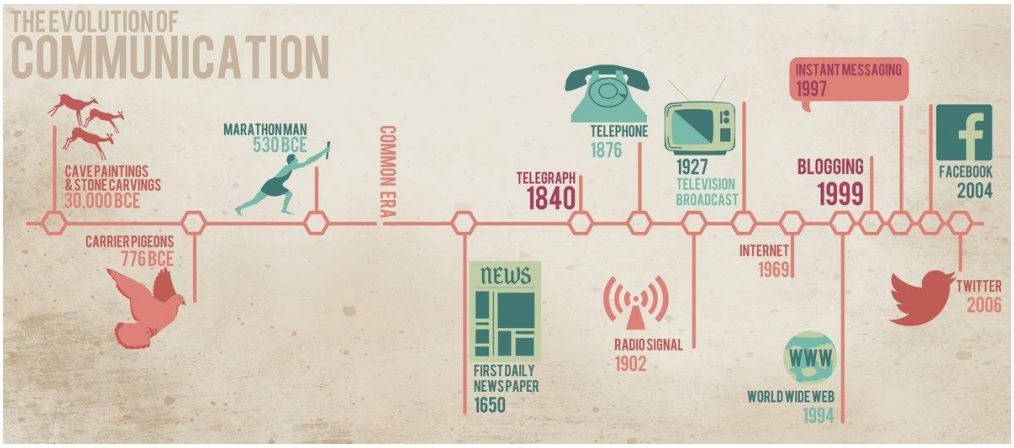
14/ Throughout history, money has evolved many times – it has taken the form of seashells, salt, cattle, stones, precious metals and most recently government paper

15/ Monetary technologies are always in competition with one another and undergo market-driven natural selection which gives rise to new forms of money and leads old forms to extinction

16/ Monetary evolution, a market-driven technology selection process, is somewhat similar to the evolutionary process we see in telecommunications technologies:

17/ No matter what technology is used to accomplish it, the purpose of telecommunications remains the same: to communicate information across space and time

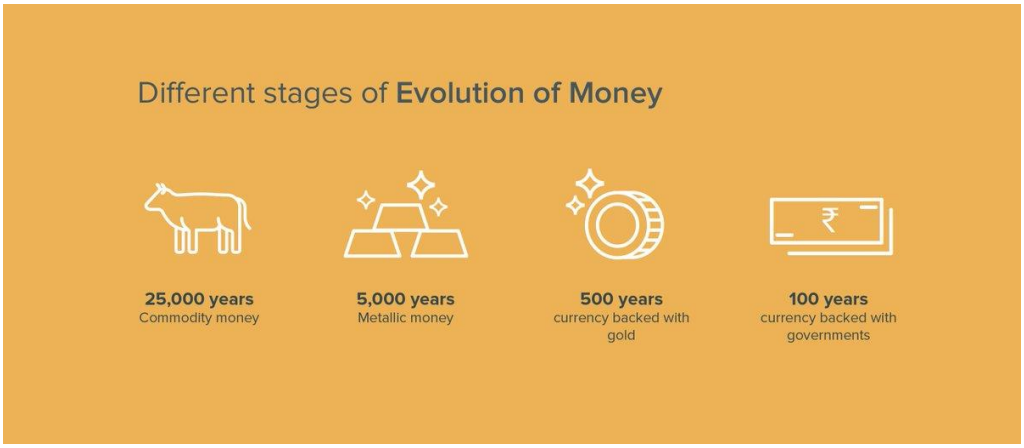
18/ However, the telecommunications technologies we use to communicate evolve over time (from cave paintings to carrier pigeons to newspapers to telegraphs to telephones to digital media)



19/ As newer telecommunications technologies are invented that provide higher speed, fidelity, reliability, traceability or mobility - they become the dominant means of communicating information across space and time

20/ Similar to the purpose of telecommunications, the purpose of money also remains the same: to communicate value across space and time

21/ However, the monetary technologies we use to communicate value also evolve over time (from seashells to salt to cattle to stones to precious metals)



22/ As newer monetary technologies are invented that provide higher hardness, divisibility, portability, durability or recognizability - they become the dominant method of communicating value across space and time

23/ Money has many characteristics, but the primary trait which determines whether it succeeds or fails in the free market is called 'Hardness' (on which we will now focus)

24/ Hardness is the difficulty to produce an incremental unit of the monetary instrument (ie. the energy expenditure necessary to mine an ounce of gold or produce a US dollar, for instance)

25/ Hardness is quantified by the stock-to-flow ratio. Stock is the existing money supply. Flow is the newly produced money supply over a given time period. The higher the stock-to-flow ratio, the Harder (or sounder) the money

26/ Each time an additional monetary unit is created, the other monetary units become less scarce and lose purchasing power, an effect commonly called inflation (the inverse of the stock-to-flow ratio)

27/ Inflation, a euphemistic term, is actually the dilution of monetary value and an insidious form of taxation without representation. Inflation can be easily understood with a baseball card analogy:

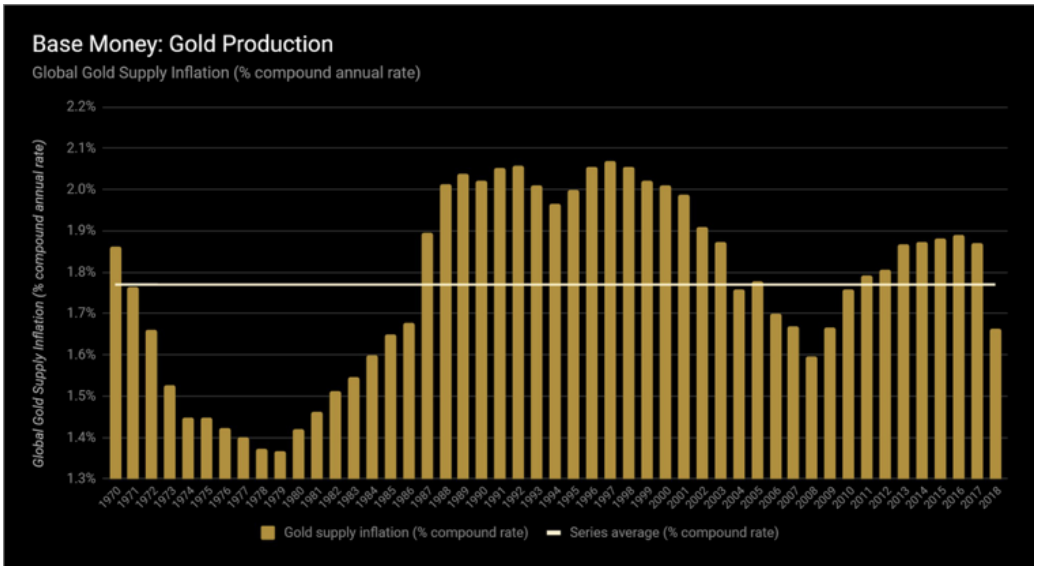
28/ If I have 1 of the 100 Babe Ruth rookie baseball cards in the world, each time someone discovers another Babe Ruth rookie card mine becomes less rare and therefore less valuable. The same is true with money, each time a new unit is created all other units decline in value

29/ In a free market, people naturally and rationally choose to store their wealth in the monetary technology which is hardest to inflate (by mining, printing, counterfeiting, etc.)

30/ Gold eventually became global standard for money precisely because of its Hardness (as quantified by a superior stock-to-flow ratio)

31/ Gold is virtually indestructible, so nearly every ounce ever mined throughout history remains extant today (high stock)

32/ Gold is rare in the earth's crust and it takes time and energy to extract it (low flow)



33/ The Hardness of gold resulted in it outcompeting silver several times throughout history and is the reason silver is almost entirely demonetized today. This competitive dynamic is easily explained from a game theory perspective:

34/ Since gold is harder than silver, anyone who profits from silver production (where marginal revenue > marginal cost) will seek to store their profits in the hardest form of money available, thus triggering investment flows from silver (or any other softer money) to gold

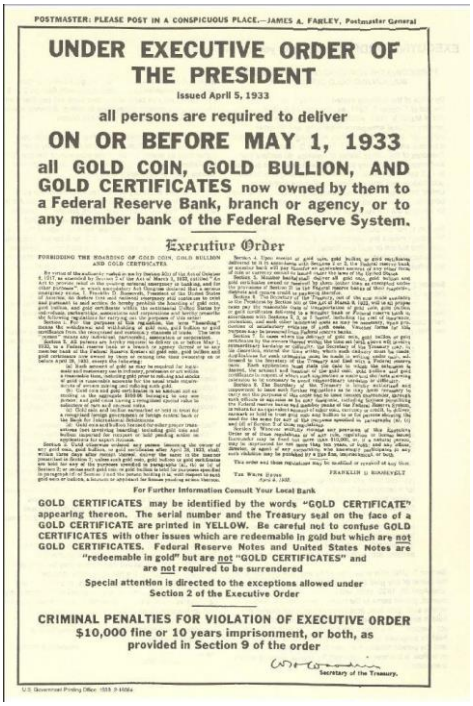
35/ However, gold has one major drawback, the divisibility problem: Gold is heavy and difficult to deeply subdivide, which makes it difficult to use as a medium of exchange (ie. buying coffee with gold coins is not practical)

36/ Gold's divisibility problem is what gave silver some marginal utility as a medium of exchange throughout history whereas gold was more typically reserved for settling large transactions

37/ Eventually, national governments stepped in and solved the divisibility problem of gold by issuing bank notes (essentially paper IOUs), which are light and easy to transact with, that were fully redeemable for gold

38/ This caused the centralization of gold within bank vaults which became too tempting for governments and their newly formed central banks to resist expropriation of, thus catalyzing the fractional-reserve banking practices now ubiquitous in the modern world economy

39/ As governments created more bank notes than they could support with their gold reserves, they started revoking bank note redeemability for gold, thus implementing the 'money backed by nothing' we all use now - fiat currencies


POSTMASTER: PLEASE POST IN A CONSPICUOUS PLACE.—JAMES A. FARLEY, Postmaster General

UNDER EXECUTIVE ORDER OF THE PRESIDENT

Issued April 5, 1933

all persons are required to deliver

ON OR BEFORE MAY 1, 1933

all GOLD COIN, GOLD BULLION, AND GOLD CERTIFICATES now owned by them to a Federal Reserve Bank, branch or agency, or to any member bank of the Federal Reserve System.

Executive Order

FORBIDDING THE HOARDING OF GOLD COIN, GOLD BULLION AND GOLD CERTIFICATES.

FRANKLIN D. ROOSEVELT

For Further Information Consult Your Local Bank

GOLD CERTIFICATES may be identified by the words "GOLD CERTIFICATE" appearing thereon. The serial number and the Treasury seal on the face of a GOLD CERTIFICATE are printed in YELLOW. Be careful not to confuse GOLD CERTIFICATES with other issues which are redeemable in gold but which are not GOLD CERTIFICATES. Federal Reserve Notes and United States Notes are "redeemable in gold" but are not "GOLD CERTIFICATES" and are not required to be surrendered

Special attention is directed to the exceptions allowed under Section 2 of the Executive Order

CRIMINAL PENALTIES FOR VIOLATION OF EXECUTIVE ORDER

$10,000 fine or 10 years imprisonment, or both, as provided in Section 9 of the order

Secretary of the Treasury.

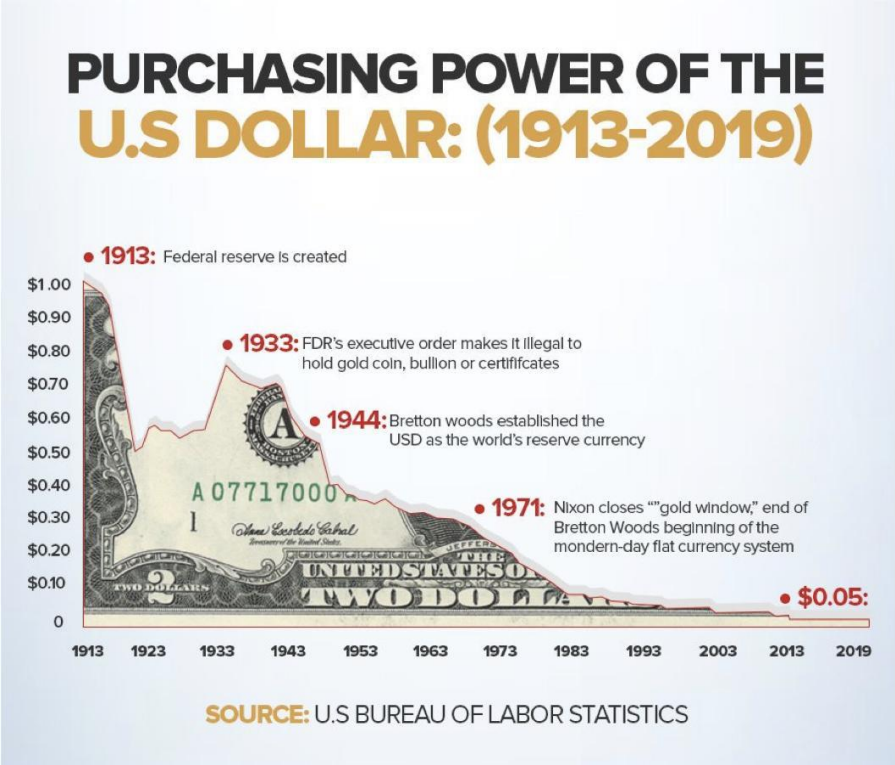
40/ A brief history of fiat currencies: In 1933, executive order #6102 required all US citizens to exchange their gold holdings for US dollars under the threat of up to 10 years imprisonment

41/ During WWII, The US became a safe haven for European gold hoards as a means of protection from Nazi plundering, thus positioning it to rewrite the rules of the global economic order

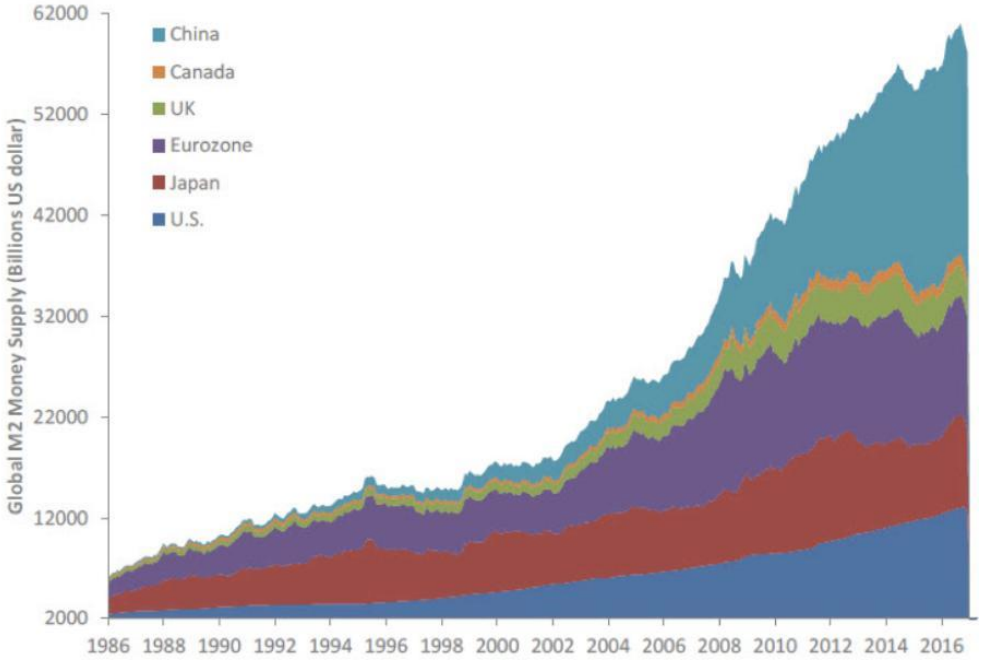
42/ At the conclusion of WWII, The US established itself as the global central bank, in which all international currencies would be pegged to the US dollar, which itself was to be pegged to gold, at the Bretton Woods Conference

43/ In 1971, US President Nixon unilaterally cancelled the direct international convertibility of the US dollar to gold and promised that the US would eventually return to the Gold standard, which of course never happened, leaving the world on a fiat standard

44/ So today, the world is dominated by government fiat money which is backed by absolutely nothing and is in fact the Softest form of money that has ever existed (the cost to produce an additional unit of fiat money is near-zero)



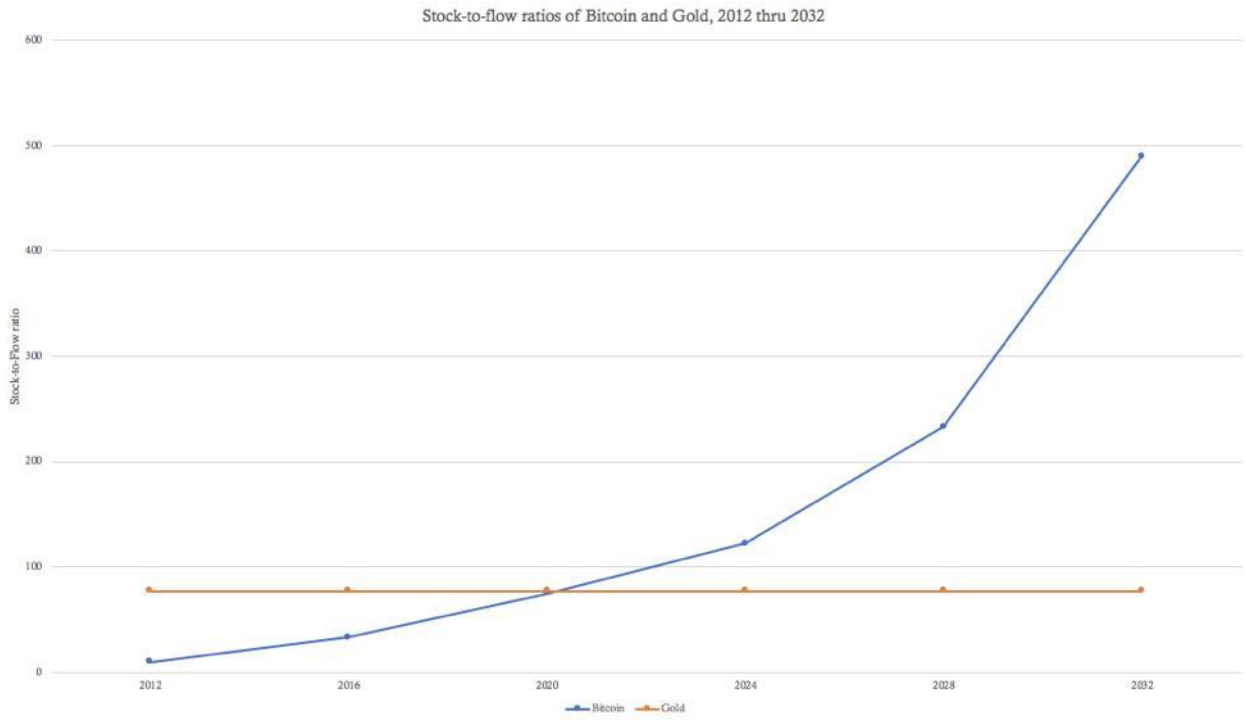
45/ In the wake of the 2008 Great Recession, when central banks all over the world were busy printing more fiat currencies to reflate their respective economies, Satoshi Nakamoto released an open-source software project into the world called Bitcoin



46/ Bitcoin is the Hardest form of money that has ever existed. This momentous innovation is made possible by an ever-rising production difficulty that requires expenditure of real world energy (in a process called proof-of-work or mining)

	Annual Cost ($USD)	Energy Consumption (GJ)	$USD per GJ
Gold Mining	$ 105,000,000,000	475,000,000	$ 221
Gold Recycling	$ 40,000,000,000	25,000,000	$ 1,600
Government Fiat Money Production	$ 28,000,000,000	39,000,000	$ 718
Banking System	$ 1,870,000,000,000	2,340,000,000	$ 799
Governments	$ 27,600,000,000,000	5,861,000,000	$ 4,709
Bitcoin Mining	$ 4,500,000,000	183,000,000	$ 25

47/ Bitcoin's stock-to-flow ratio increases inevitably every 4 years will surpass that of gold in May 2020. Bitcoin's monetary policy is enforced by unbreakable cryptography, hence the inevitability (as sure as 1+1=2)



48/ Bitcoin is also the world's first incarnation of an asset with perfect price inelasticity of supply, as changes in its price have absolutely no impact on its supply flow. This means increases in demand for Bitcoin can only be expressed in its market price

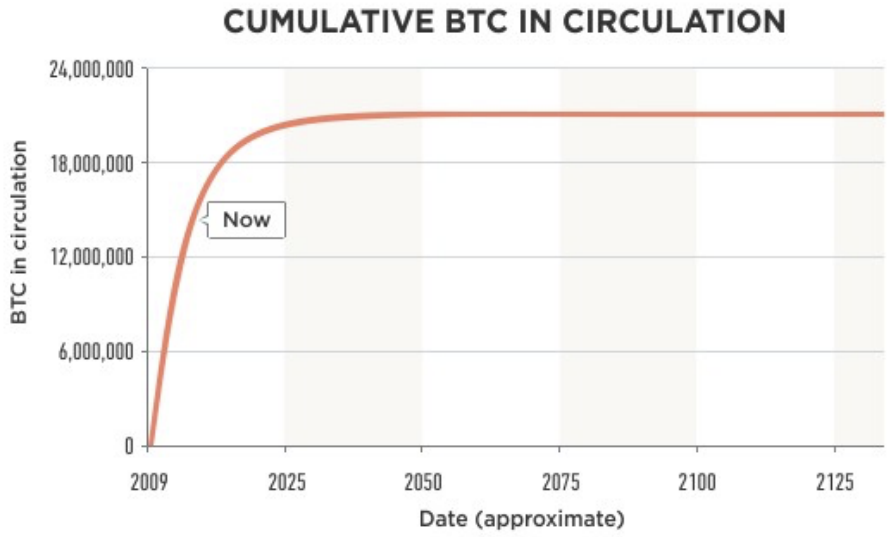
49/ If the price of gold increases, its new supply flow will increase as new miners enter the market and new methods of gold mining becoming economically feasible (since the gold miners can sell their product at a higher price), thereby decreasing its stock-to-flow ratio

50/ With Bitcoin, no matter how much its price increases, it is absolutely impossible to create any new supply flow beyond its mathematically enforced and universally transparent production schedule

51/ Bitcoin is also the world's first instance of 'absolute scarcity' as its monetary policy is fixed, only 21M units will ever exist. Before Bitcoin, only time itself was absolutely scarce (the formula for Bitcoin's fixed monetary policy is pictured here)

$$\sum_{i=0}^{32} 210{,}000 \frac{50}{2^i}$$

52/ This means that its stock-to-flow ratio will continue to increase and eventually become infinite when the last Bitcoin is produced sometime in the middle of the 22nd century



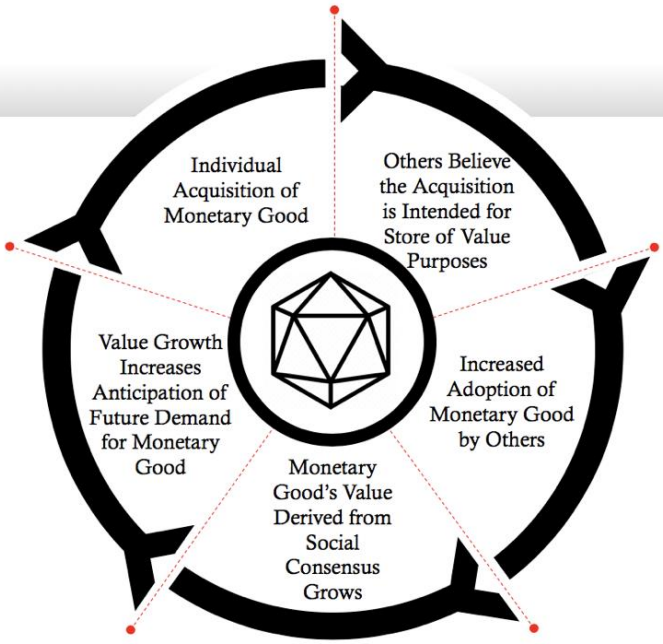
53/ Bitcoin's monetary policy (its new supply flow schedule) is becoming the most trusted in the world as it is fully transparent and unchangeable

54/ Bitcoin runs countervailing to government monetary policy which is uncertain, opaque and subject to change based on the whim of bureaucrats

55/ Essentially, we each must decide if we are to trust the whimsical nature of self-interested bureaucrats or the inviolable nature of mathematics to manage our money supply

56/ So we have Bitcoin, the Hardest form of money in history, competing directly with government money, the Softest form of money in history...

57/ Game theory and history shows us that people will naturally and rationally seek to store their wealth in the Hardest money available to them. This emergent market behavior is based on the anticipated decisions of others and will eventually spiral into an adoption frenzy



58/ So long as Bitcoin continues to exist (and without even considering its other superior traits as a form of money) we believe it will continue to outcompete gold and government money in the free market and appreciate in value

Money is a social technology used to solve a problem which has persisted for all of humanity's existence: how to move economic value across time and space. Competition is at all times alive between different forms of money, subject to market-driven natural selection.

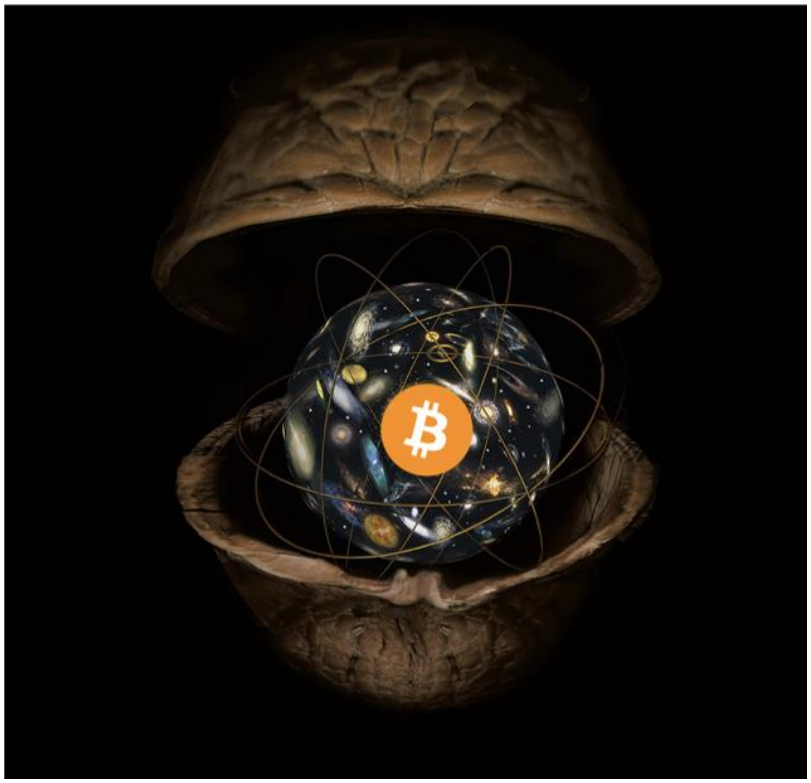
Traits of Money	Gold	Government Money	Bitcoin
Fungibility (interchangeable units)	High	Medium	High
Hardness (stock-to-flow ratio)	Medium	Low	High
Portability	Medium	High	High
Durability	High	Medium	High
Divisibility	Low	Medium	High
Security (cannot be counterfeited)	Medium	Medium	High
Easily Transactable	Low	High	High
Scarcity (predictable supply)	Medium	Low	High
Self-Sovereign (permissionless)	High	Low	High
Government Issued	Low	High	Low
Decentralized (censorship resistant)	Low	Low	High
Smart (adaptive & programmable)	Low	Low	High

59/ Hard money, as selected on the free market, reigned for the first 4,900 out of 5,000 years of human commercial history and we are witnessing its reemergence in the rise of Bitcoin

60/ Bitcoin is the most credible monetary policy in human history disrupting the most untrustworthy monetary policies in human history

61/ A bet on Bitcoin is that the competitive dynamics inherent to the market for money will continue to play out in the same way they have throughout all of history

62/ Thank you for reading. This is the Bitcoin and cryptoasset universe in a nutshell.



With Gratitude: @real_vijay @saifedean @bquittem @danheld @naval @NickSzabo4 @nic__carter @MartyBent @pierre_rochard @APompliano @cburniske @MarkYusko @CaitlinLong_ @timevalueofbtc

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An Open Letter to Ray Dalio re: Bitcoin

An open letter to hedge fund colossus Ray Dalio regarding his worldview, the forces of financial nature, and how Bitcoin is bound to reshape both.

By Robert Breedlove

Posted November 8, 2019

Introduction

Ray, your ability to penetrate the opaque realm of economics and share its secrets in an easy to understand language is one of your greatest gifts to humanity. With your videos, openly published research, and authorship, you have opened the eyes of many to a topic most consider too difficult to comprehend. The world needs more pioneers like yourself writing easy-to-read maps for the nearly incomprehensible territory of economics. Macroeconomists, Academics and Central Bankers rely heavily on deceptive language and universal public ignorance to perpetrate their schemes; your work in converting this esoteric domain into a more exoteric form is therefore commendable.

Let me begin by saying that, like you Ray, I consider myself a "dumb shit" who is more focused on dealing with what I don't know rather than relying on what I do know to navigate life and work — a mindset well accorded with ancient wisdom:

"All I know is that I know nothing." — Socrates

Epistemic reach is finite, as knowledge cannot explain everything in the world and, often, it clouds the truth. So let us explore the territory of economics with a beginner's mind, free of the accumulated clutter commonly called "conventional wisdom". It is from this frame of mind that I present to you this open letter regarding your perspective on Bitcoin through the lens of your stated principles on life and work (in this letter, I sometimes direct my comments at Ray, and sometimes at the audience, so please bear with these shifting perspectives).

We begin with an evaluation of Ray set in the idea-meritocratic style practiced at Ray's firm, Bridgewater. The purpose of these evaluations is to grade your peers candidly, being brutally honest and holding no punches, to ensure that the best ideas rise to the surface — unimpeded by policy, politics, or hierarchy — so that they may be scrutinized and, if useful, acted upon. In Bridgewater's culture, communication is both top-down and bottom-up, so that people feel empowered to share their honest perspectives. For Ray, it's all about getting to the truth by any means necessary, and I appreciate his blunt approach. We will explore all of this more deeply below — so let's dive in.

Evaluation of Ray's Assessment of Bitcoin

Subject: Ray's Assessment of Bitcoin

From: Robert Breedlove

To: Ray Dalio

Cc: Everyone

Attachments: Ray's assessment of Bitcoin available here —

https://www.youtube.com/watch?v=UyVIuNI797w

Ray,

You deserve an "F" for your assessment of Bitcoin's significance and future prospects. Although there are very few of us, everyone who has the requisite depth of understanding in the fields of computer science, monetary history, game theory, economics, and mathematics, and has spent the time intensely studying Bitcoin (it takes a lot), agrees with this harsh evaluation of your short-sighted assessment of this momentous monetary innovation. As one of your biggest fans, I truly believe that if you take another look (a long, hard, thoughtful look), you will see the light. Specifically, your assessment fails for the following three reasons:

1. You claim that you are sold "blockchain technology", despite the only proven use case for "blockchain technology" is as a component of Bitcoin. Contrary to "conventional wisdom", the real breakthrough is Bitcoin, not blockchain.

2. You state that Bitcoin could be disrupted by another "cryptocurrency", however this extremely unlikely: Bitcoin is a path-dependent, one-time invention; its critical breakthrough is the discovery of absolute scarcity — a monetary property never before achieved by mankind. The emergence of Bitcoin cannot be reproduced because absolute irreproducibility is the discovery! The iPhone disrupting Blackberry analogy you cite is irrelevant; Bitcoin is a protocol, not a consumer product.

3. You state that price-stable, central bank issued currencies will be issued, which will likely be attempted, but such currencies would be antithetical to free markets. Further, price stability is an illusion: all economic goods move against one another in ratios of exchange, money is simply the most marketable good, hence the reason money-denominated exchange ratios (prices) tend to be more stable, but are still subject to supply and demand interaction. Since Bitcoin is absolutely scarce and cannot be stopped, it is likely to continue outcompeting all other monetary technologies on the free market. As an economic good monetizing in real time, the exchange ratios between Bitcoin and various fiat currencies is likely to remain volatile for some time, but this volatility will continue to subside as Bitcoin's market capitalization grows, thus making its use as a medium of exchange more practical, before reaching a point of sufficient network value where prices will come to be more commonly expressed in Bitcoin terms (similar to the evolutionary phases gold underwent during its monetization process).

Your assessment is especially disappointing for three reasons: 1) You have consistently exhibited a knack for comprehending, distilling, and communicating highly complex economic concepts in a manner

palatable for general audiences, 2) The depth of knowledge you possess in history, economics, and free market dynamics presents you with a privileged position to best understand the emergence of and demand for this asset, and 3) Your virtually unparalleled reach and reputation as a macroeconomic thought leader, organizational engineer, and cultural innovator is an invaluable platform from which to trumpet to the dire circumstances faced by the prevailing economic order and how Bitcoin has the potential to alleviate them.

In the following open letter, I will show that the fundamental tenants of your worldview, as stated in your book Principles and other writings, are fully consistent with Bitcoin — even though you may not yet realize it. I'll begin with two primer sections: one on the nature of money and its history, and one on Bitcoin's general functionality and economic properties — either or both may be skipped by the reader who has "already fallen down the Bitcoin rabbit hole", so to speak. After these primers, I will walk through many of Ray's most important Principles, one by one, and break them down to better understand their relationship to markets and Bitcoin. Let's begin.

Primer on Money

(this Primer on Money and the following Primer on Bitcoin may be skipped by the reader who understands the traits of money and Bitcoin's general functionality/economic properties)

Money is a tool for moving value across time and space (or spacetime, as Einstein explained, these are actually one in the same). Money is an emergent property of barter (or direct exchange) that purports to solve the three dimensions of its non-coincidence of wants problem; it evolves naturally in the free market as the most exchangeable good in an economy. Although he is silent as to its origins, Ray understands the technological functions of money, as stated in his video assessment of Bitcoin (see open letter attachment above) that the primary functions* of money are:

1. A store hold of wealth: also called a 'store of value' in regard to moving value across time (the first function and evolutionary phase of money)

2. A medium of exchange: in regard to moving value across space (the second function and evolutionary phase of money)

**We will ignore for now the third function and evolutionary phase of money, unit of account, as it isn't pertinent to our discussion here.*

Although the purpose of money always remains the same, to move value across spacetime, the technology fulfilling this purpose is constantly being subjected to market-driven evolutionary pressures. The greater a monetary technology's resistance to value dilution across time — whether by counterfeiting, supply inflation, or deterioration — the more effective it is as a store of value. Once a store of value accrues enough value, people begin to use it for trading purposes. The more widely accepted a form of money is, the higher its value as a medium of exchange, which makes this aspect of its value proportional to the number of its monetary network participants (aka users). When a specific monetary technology, in the form of an economic good, becomes widely accepted in interpersonal exchange (aka trade) it is called "money". Monetary technologies compete to become more widely adopted based on the following traits:

1. Scarcity: resistance to money supply manipulations and, thus, dilutions to its monetary unit value (difficult to produce)

2. Divisibility: ease of accounting and transacting at various scales (separable and combinable units)

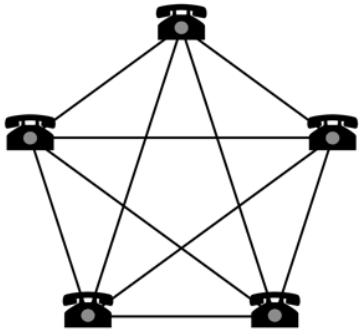
3. Portability: ease of moving value across space (high value-to-weight ratio)

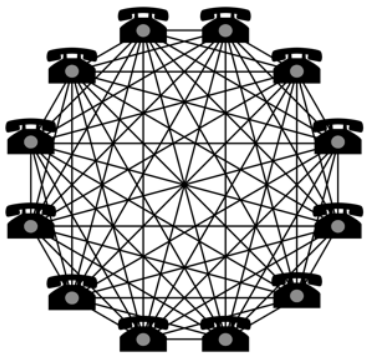
4. Durability: ease of moving value across time (resilient to deterioration)

5. Recognizability: ease of identifying and verifying the monetary value by other parties in a transaction (universally identifiable and verifiable)

Due to the relative advantages competing monetary technologies offer, the particular economic good being used as money can, and does, change over time. Throughout history, mankind has employed seashells, salt, cattle, precious metals, and government paper as money, to name a few. Similar to the price discovery process in a free market — where the collective actions of buyers and sellers are continuously compressed into a single actionable variable called the market price — competing monetary technologies undergo a market-driven discovery process. We can gain a better understanding of this dynamic through an analogy: monetary evolution is (roughly) comparable to the evolutionary process we see in communications technologies.

No matter what specific means is used to fulfill it, the purpose of communications technology remains the same: to move information across spacetime. Similar to the market for money, competition is at all times alive among different communications technologies, in which they are all subjected to a market-driven discovery process. As newer technologies are invented they are market-tested through competition; each survives or dies in terms of its relative speed, message fidelity, reliability, traceability, and mobility. Since these technologies have a singular purpose, people tend to adopt a common technology, a coalescent process that is propelled by network effects.





Network effects, defined as the incremental benefit attained by adding a new member to a network for all of its existing participants, drive people to adopt a primary form of communications technology. As more people migrate to the latest and greatest technology, it encourages others to do the same, as more network participation exponentially increases the number of possible connections. A simple example of this is the telephone: with two phones in existence, only 1 connection is possible; with five phones in the network, the number of connections jumps to 10; and with twelve networked phones, the number of connections increases exponentially again to 66, and so on. (see Metcalfe's Law for a directional explanation of this network effect dynamic):

Network values are based on the number of possible connections they enable; they grow exponentially with the addition of each new constituent (or node)—this property is called network effects.

Since the purpose of communications technology remains singular (moving information across spacetime) despite technological advances, whichever technology is best at fulfilling this purpose has a tendency to become dominant in the marketplace. This tendency, reinforced by network effects, has driven communications technology evolution from carrier pigeons to telegraphs, to the internet today. This is an expression of the winner-take-all (or, winner-take-most) dynamic inherent to many networks, including those of the communications and monetary technology varieties.

Similar to the purpose of communications technology, the purpose of monetary technology is singular: to move value across spacetime. The various monetary technologies used to fulfill this purpose, however, undergo market-driven discovery and, thus, evolve over time based on their respective monetary traits. In respect to the traits of money, the one that takes primacy in determining a specific monetary technology's likelihood of success in the free market is its hardness (also called the scarcity or soundness of money). This trait is of primary importance because it determines a money's usefulness as a store of value, and a money that cannot adequately store value across time necessarily cannot transmit value effectively across space. The relative hardness, or scarcity, of a competing monetary technology is quantified by its stock-to-flow ratio, a valuation metric also common in precious metals markets such as gold:

· Stock is the existing unit supply of monetary units (for example: ounces of gold, quantity of US Dollars, or quantity of Bitcoin)

· Flow is the newly created supply over a specific time span, usually one year

· The stock-to-flow ratio is calculated by dividing the stock of monetary units by its newly created supply flow (can be thought of as the inverse of inflation)

· The higher the stock-to-flow ratio, the greater the hardness (also called soundness or scarcity) of the monetary technology

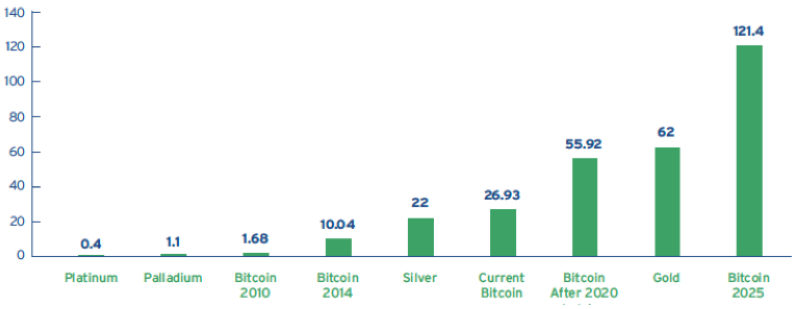
We can think of monetary hardness as the difficulty (or cost) necessary to produce an incremental unit of a monetary technology. For instance, the capital and operational expenditure necessary to extract an ounce of gold from the ground is the basis of its monetary hardness. As producers of gold will always seek to extract it until their incremental cost per ounce is equal to their incremental revenue per ounce (in other words, until marginal cost equals marginal revenue), there is a perpetual financial incentive for producers to maximize new supply flows up to the point of economic breakeven. In comparison to communications technologies, money exhibits much stronger centripetal, winner-take-all network effects that drive users to adopt a single store of value. Those who fail to adopt the hardest money available to them face a debasement of their stored value by those who can produce it at an incremental profit (where MC<MR). Hard money, then, is simply the monetary technology freely selected in an unobstructed marketplace as the most sound store of value available. Historically, gold prevailed as hard money precisely because of its superior stock-to-flow ratio relative to other monetary metals:

Table comparing SF ratios for gold, silver, palladium and platinum

	Stock (tn)	Flow (tn)	SF	Price $/Oz	Market Value
Gold	185,000	3,000	62	$1300	$8,417,500,000.000
Silver	550,000	25,000	22	$10	$308,000,000.000
Bitcoin (BTC)	15,200,000	656,250	23	$11,500	$174,800,000,000
Palladium	244	125	1.1	$1400	$11,956,000.000
Platinum	86	229	0.4	$800	$2,400,000.00

Gold has the greatest SF ratio. At the current flow rate, it will take 62 years to generate the same amount of stock that is currently available. Silver is second, it will take 22 years of silver production to generate the same amount of stock that is currently available. It is clear to see that as Market Value increases as SF ratio also increases.

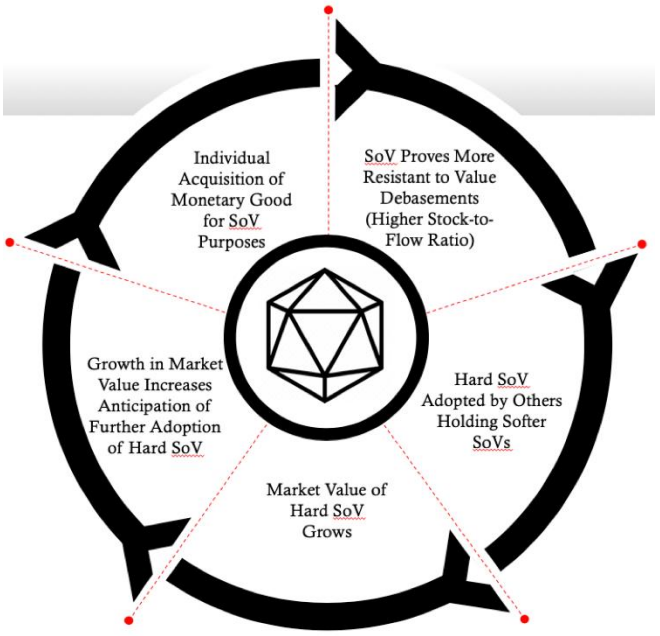
Stock-to-flow Comparison Chart



Relative supply scarcity, as quantified by the stock-to-flow ratio, is a key driver of monetary value.

On the free market, people naturally and rationally choose to store the value created by their work in the monetary technology that is hardest to produce, since producing new units dilutes the value of existing units for all holders of said money. Since gold exhibits superior monetary hardness, it has outcompeted silver and other monetary metals several times throughout history. Gold outcompetes due to the game-theoretic aspects of an evolving store of value:

Propelled by network effects and relative supply scarcities, people coalesce around a single store of value.



Since gold is virtually indestructible, nearly every ounce mined throughout human history remains part of its extant supply; and since gold is relatively rare in the Earth's crust, its new supply flows are a small percentage of its existing stock each year. Taken together, these properties give gold the highest stock-to-flow ratio of any monetary technology in the world (before Bitcoin), meaning that its supply inflates at a relatively low and predictable rate. Superior hardness is precisely why gold became the dominant monetary technology on the free market.

Game theory tells us, and market history proves, that anyone who can, for instance, profit from silver production by selling it at a higher price than it cost to produce, has a

direct financial incentive (the protection of value across time) to store any profits generated in the hardest form of money available to them. As all market participants are subjected to this harsh economic reality, this persistent incentive triggers investment flows from silver (or any other softer monetary technology) to gold (or the hardest form of money available). In this way, free market competition causes people to converge on a single store of value and, therefore, perpetually promulgates hard money. This is not surprising, as free markets tend to zero in on the best possible technological solutions to problems, discarding the rest. And conceptually, in the same way that money is an emergent property of a direct exchange (barter) economy, hard money is an emergent property of an indirect exchange (monied) economy.

The physicality of gold gives it both advantages and disadvantages. Being a precious metal that achieved its monetary value on the free market, gold is a self-sovereign monetary technology, meaning that its value, trust factors, and transactional permissibility as money are not subject to any counterparty risk whatsoever. In other words, gold is equity-based money or a bearer asset. If someone flips you a gold coin and you stick it in your pocket and walk away, then you have just participated in an irreversible transaction. The value of this coin is set by the market and whosoever is in physical possession of it is assumed to be its rightful owner. No bank or payment intermediary can censor or reverse this free market transaction. You have no need trust anyone else, whether you choose to hold or spend your gold. Self-sovereignty is a quality uniquely intrinsic to bearer assets such as gold, silver, or diamonds.

Contrarily, if someone hands you a US Dollar, you assume the counterparty risk of the US Government, who can dilute its value via supply inflation (as we see with all fiat currencies throughout history) or deauthorize its value altogether (as we saw when India deauthorized its 500 rupee bank note). Further, if you received this US Dollar through a payment intermediary, like Paypal or Venmo, you are also exposed to the risk of this payment being censored, reversed, or surveilled. Even when physically hoarding fiat currency, it is still vulnerable to supply inflation as its central bank backer can simply print more, stealing the value stored therein. By transacting in anything other than a bearer asset, which is valued solely based on free market dynamics, you forfeit your personal financial sovereignty to the currency issuer and/or other financial intermediaries.

Although gold's physicality gives it the property of self-sovereignty, it also comes with inherent disadvantages. Its primary drawback is its suboptimal divisibility. Since gold has such high value to weight, it is impractical to pay for coffee using gold coins, for instance. This drawback of gold is what gave silver some utility as a medium of exchange throughout history, as its value to weight was much lower making it more practical to use for everyday purchases (due to its higher divisibility and portability), whereas gold was typically reserved for settling large transactions.

Eventually, gold's divisibility problem was "solved" when central banks which began issuing paper currencies which were fully redeemable for gold. This provided users with a hybrid monetary technology that exhibited the hardness of gold, while offering an ease of transactability (high divisibility and portability) even greater than that of silver. With its marginal utility disrupted by paper currencies (and later, electronic abstractions of paper currencies), silver became completely demonetized and eventually the entire world market for money evolved to a paper-currency-enabled gold standard.

With transactions being executed in gold-backed paper currencies, the global gold standard led to the centralization of gold within bank vaults. These gold hoards became too tempting for governments and their central banks to resist expropriation of, thus catalyzing the fractional-reserve banking practices now ubiquitous in the modern world economy. As governments created more currency units than they could support with their gold reserves, they started revoking currency redeemability for gold, which culminated in the 1971 unilateral decision by US President Nixon to permanently sever the peg to gold (deceivingly, it was declared to be a temporary measure):

https://www.youtube.com/watch?v=iRzr1QU6K1o

Since all other currencies in the world were pegged to the US Dollar, this final act of financial sovereignty usurpation officially abolished the gold standard worldwide. This death-stroke to monetary integrity brought us into the age of the "political debt-based money backed by the future cash flows of taxing authorities" we all are legally coerced into using today — fiat currency. With fiat currencies came the limitless inflation suffered episodically all over the world. Inflation comes to us from the Latin verb inflare meaning "to blow up". This is an apt description since once it sets in, fiat currency inflation has only one possible outcome — dilution into worthlessness:

Central banking made many Zimbabweans the first broke-ass trillionaires, but certainly not the last.

Since breaking its peg to gold, the US dollar has lost over 97% of its relative value. The fiat currency printing press has proven to be the weapon of choice for political leaders to further their agendas and enrich themselves; it has also become the primary means for funding perpetual warfare. During the past century of central banking — which cunningly imposed its dominion over a large swath of the world's gold supply through coercion and confiscation — there has been unprecedented per capita death in warfare, an ever-widening wealth disparity, and an incessant sequence of economic boom and busts fueled by the continual marginalization of paper currencies and, ultimately, the instantiation of fiat currencies. Today,

all semblance of monetary integrity and sanity has been destroyed with citizens left optionless, forced to transact in softest form of money in history.

In the wake of the latest (and arguably the greatest) fiat-currency-fueled economic bust, the 2008 Great Recession, when central banks all over the world were busy printing more fiat currencies to recapitalize their financial institutions via the shadow tax of inflation, Satoshi Nakamoto released an open-source software project into the world. He, she, or they called it Bitcoin.

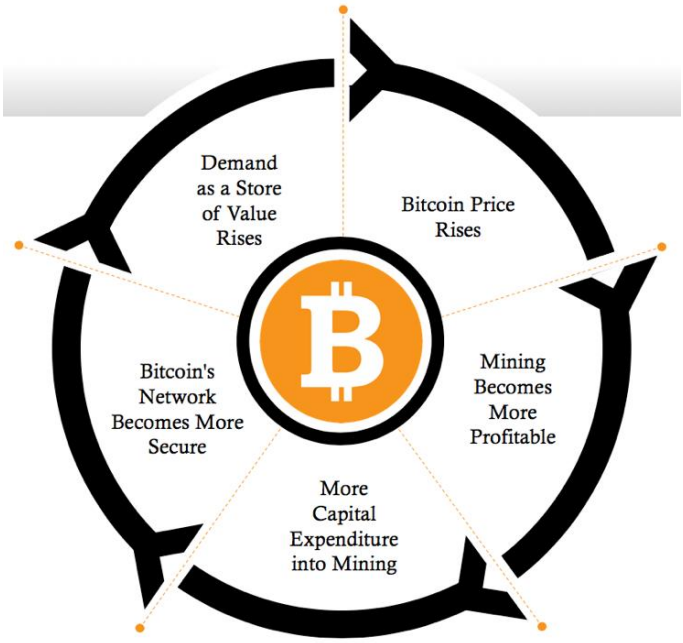
Primer on Bitcoin

(again, this Primer on Bitcoin may be skipped by the reader who understands Bitcoin's general functionality/economic properties)

Bitcoin can be thought of as the first incarnation of self-sovereign money in digital form. Its transactions are irreversible, uncensorable, and unstoppable. In other words, Bitcoin is the world's first digital bearer asset. Possession of Bitcoin is achieved by holding its private key, which is an alphanumeric data string that can be stored in analog, computer, or even human memory. Its absolutely scarce money supply is anchored to the most fundamental commodity in the universe — energy.

Bitcoin's stock-to-flow ratio, the measure of its monetary hardness, increases (inevitably) every 4 years and will be about twice that of gold after its 2024 downward inflation rate adjustment (the halving); at this point, Bitcoin will definitively be the hardest form of money that has ever existed. Bitcoin's uncompromising, apolitical monetary policy is enforced by unbreakable cryptography, hence this inevitability (as sure as 1+1=2). Its unrivaled hardness is made possible by an ever-rising production difficulty that requires expenditure of real world energy in a process called proof-of-work. This anchor to economic reality is also called mining — in an ode to the difficulty of gold production — and is the source of Bitcoin's monetary integrity.

Bitcoin is also the world's first asset with perfect supply inelasticity, as changes in its price have absolutely no impact on its supply flow. This means changes in demand for Bitcoin can only be expressed in its market price. If the price of gold increases, its new supply flow will increase as new miners enter the market and new methods of gold mining becoming economically feasible (since the gold miners can sell their product at a higher price), thereby applying downward pressure to its stock-to-flow ratio. With Bitcoin, no matter how much its price increases, it is absolutely impossible to create any new supply flow beyond its mathematically enforced and universally transparent issuance schedule. Also, a higher market price means a more secure Bitcoin network, as the resources allocated to mining are used to secure it. Like a vault with walls that thicken as more value is stored within it, Bitcoin adapts to become a more secure monetary network as its market capitalization grows. Absolute obstinance of the algorithmically enforced Bitcoin monetary policy drives a virtuous cycle that perpetuates the expansion of its network:



An ingenious composite of unbreakable cryptography and economic incentives causes Bitcoin to grow relentlessly.

Bitcoin's money supply is absolutely scarce, meaning its monetary policy (or money supply) is fixed — only 21M units will ever exist. Before Bitcoin, only time itself exhibited the property of absolute scarcity. This means that its stock-to-flow ratio will continue to increase and eventually become infinite when the last Bitcoin is produced sometime in the middle of the 22nd century. Bitcoin's monetary policy is becoming the most trusted in the world as it is fully transparent and unchangeable.

Bitcoin runs countervailing to government monetary policy which is uncertain, opaque, and subject to change based on the whim of bureaucrats. Essentially, we each must decide if we are to trust the whimsical nature of self- interested bureaucrats or the inviolable nature of mathematics to manage our money supply. Shockingly, whether we decide or not, the harsh economic reality of Bitcoin's superior hardness is likely to be imposed upon us all, as history teaches us the economic consequences of hard money cannot be ignored. As we saw earlier, the free market for money is winner-take-all. Critically, Bitcoin is open-source, like a spoken language, and it is transcendent of regulations and the legal insulations that preserve the monetary monopolies of central banks.

So we have Bitcoin, the hardest form of money in history, competing directly with government money, the softest form of money in history. So long as Bitcoin continues to exist, it will likely continue to outcompete gold and fiat currency in the free market, and its market capitalization will grow. Eventually, each and every holder of any softer form of money (whether its gold or fiat currency) will be faced with the grim reality of a gradually, then suddenly, depreciating asset relative to Bitcoin's ever-constricting new supply flow. Imposition of this harsh economic reality will be applied persistently and each of us will be faced with the same mathematical and market-driven dynamic that has catalyzed the evolution of money throughout history.

Hard money, as selected on the free market, reigned for the first 4,900 out of 5,000 years of human commercial history and all signs indicate we are witnessing its reemergence in the rise of Bitcoin. Before government intervention, money supply was not a matter of policy, but instead was governed by game-theoretic principles, a "policy" rooted in natural law. Since governments have imposed monetary monopolies in the form of central banks, trust has steadily been eroded in their ability to prudently maintain money supplies. Said differently, Bitcoin is the most credible monetary policy in human history disrupting the most untrustworthy monetary policies in human history. A bet on Bitcoin is that the competitive dynamics inherent to the market for money will continue to play out in the same way they

have throughout all of history, thus making money supply a matter to be determined once again by the free market instead of central planners.

Armed with these primers on money and Bitcoin, we will now dive deeper into the various principles that comprise Ray's worldview. Through this exploration, we will gain a more fundamental understanding of history, markets, and Bitcoin. We begin with Ray's most renowned cultural creation — the idea meritocracy.

Idea Meritocracy

(p.540) "Idea-meritocratic decision making is better than traditional autocratic or democratic decision making in almost all cases."

At the pinnacle of Ray's worldview is the cultural paradigm he originated at Bridgewater — the idea meritocracy. As a distinct organizational style, it's intended to eliminate all barriers to the free flow of information between people — including ego, hierarchy, and personal agendas. An idea meritocracy seeks to align itself with reason and become impervious to politics. As Ray puts it, (p.306) "Power should lie in the reasoning, not the position, of the individual. The best ideas win no matter who they come from." Essentially, an idea meritocracy is a free market for ideas — a way of filtering ideas via a (simulated) form of natural selection. Instead of charging ranked positions with the authority of decision-making, an idea meritocracy attempts to foster an environment in which the ideas compete freely based on their own merits:

The idea meritocracy: an open environment for the proliferation and combination of the most meritorious ideas, free from manmade impediments such as ego, policy, and hierarchy.

As a free market capitalist, it is unsurprising that Ray developed this approach to organizational culture, as it has proven to be the most effective system for the most people. It was (repeatedly) well established in the 20th century that free markets (capitalism) function better than centrally planned markets (socialism). At the heart of any economic system is the problem of properly adapting resource allocations to the circumstances faced by people at any particular point in spacetime. In other words, the core economic problem is how to best distribute current knowledge of relative value and scarcity. Knowledge is intrinsically superfluid: it resides within many minds and is constantly changing in accordance with the ceaseless interpersonal interactions among individuals and their assessments (and reassessments) of market realities. The challenge of an economic system is to enable quick, continuous, and effective assimilation and dissemination of this knowledge to properly guide entrepreneurial actions.

Naturally, individual entrepreneurs are always most familiar with the prevailing economic circumstances specific to their time, place, and industry. As they see, hear, and touch the productive factors and influences most pertinent to their domains on an almost daily basis, entrepreneurs gain and maintain an intimate understanding of the ever-changing conditions relevant to their chosen occupation. Said differently, knowledge has a localized dimension to it: it surfaces continuously at all points in spacetime where entrepreneurial actions (involving decisions and trade-offs) and economic realities (involving value and scarcity) interface. Therefore knowledge, by its very nature, is inherently distributed among the minds of many. And free markets, comprised of entrepreneurial actions guided by accurate price signals

(more on these shortly) are the best assimilators and disseminators of these localized pools of knowledge within an economy. Simply, the free market is a nexus in which many minds effectively become one.

Capitalism is an economic system that deals with the distributed nature of knowledge in a true-to-life, bottom-up way. In a free market, each entrepreneur is unobstructed to operate in his own best interest in pursuit of profits. Contending with the ever-present realities of value and scarcity, the actions of entrepreneurs, like the actions of a pilot guiding his aircraft via his navigational instruments, are guided by the market prices relevant to his profession. This is free market capitalism: a seemingly chaotic bricolage of entrepreneurial decisions, price reconfigurations, and capital flows coming together in a unified orchestration that harmonizes individual and collective self-interests.

For instance, let's consider the case of Larry the lemon farmer. Being a farmer, Larry is primarily conscious of the cost of fertilizer, soil, and water; and keenly aware of his total cost structure relative to the expected market value of his lemon crop, as maintaining total revenues above total costs is necessary for entrepreneurial survival. Should a drought strike and drive up the scarcity of water, Larry will become aware of this economic reality through the increased price of water which will, in turn, cause him to increase the selling price of his lemons or cut costs elsewhere to maintain his profit margin. Critically, Larry can respond effectively to this drought based purely on the increased price of water without any direct knowledge of the drought itself or its causes. As entrepreneurs choose to buy and sell the various productive factors related to their occupations, the knowledge in their minds becomes encapsulated in and distributed by the prices of these factors to everyone else in the world who interacts with them in the marketplace.

As new experiences provide feedback that change the state of knowledge, entrepreneurs must be left free to rationalize their own economic affairs, take risks in accordance with their rationalities, and operate in an environment free of coercion or violence that would otherwise disrupt their business dealings. Government in intended to be this protective force, which uses its monopoly on violence to prevent violence within society, thus preserving the rule of law and people's rights to private property. Unhampered, free market competition among entrepreneurs ensures that only those adding value to society can survive and thrive. This principle of non-interference and mutual respect form the essence of true free market capitalism. An excerpt from the masterful essay I, Pencil poetically explains the magic of free markets:

"I, Pencil, am a complex combination of miracles: a tree, zinc, copper, graphite, and so on. But to these miracles that manifest themselves in nature an even-more-extraordinary miracle has been added: the configuration of creative human energies — millions of tiny know-hows configurating naturally and spontaneously in response to human necessity and desire and in the absence of any human masterminding! Since only God can make a tree, I insist that only God could make me. Man can no more direct these millions of know-hows to bring me into being than he can put molecules together to create a tree…The above is what I meant when writing, "If you can become aware of the miraculousness that I symbolize, you can help save the freedom mankind is so unhappily losing." For, if one is aware that these know-hows will naturally, yes, automatically, arrange themselves into creative and productive patterns in response to human necessity and demand — that is, in the absence of governmental or any other coercive masterminding — then one will possess an absolutely essential ingredient for freedom: a faith in free

people. Freedom is impossible without this faith…The lesson I have to teach is this: Leave all creative energies uninhibited. Merely organize society to act in harmony with this lesson. Let society's legal apparatus remove all obstacles the best it can. Permit these creative know-hows freely to flow. Have faith that free men and women will respond to the Invisible Hand. This faith will be confirmed. I, Pencil, seemingly simple though I am, offer the miracle of my creation as testimony that this is a practical faith, as practical as the sun, the rain, a cedar tree, the good earth."

Standing in stark contrast to the economic system of free market capitalism is central planning (socialism). Central planning, as the name implies, means directing an entire economy in accordance with a single unified plan in a top-down, authoritarian, and unnatural way. In a socialistic economic system, a central entity owns and operates all the productive factors (capital, land, and, ultimately, its people) within a society. As such, this centralized body (usually old, stale, and pale white guys) is arrogantly assumed to possess all the knowledge and feedback loops necessary to form a completely (and continuously) accurate representation of the ever-changing economic realities navigated by its society. Whereas the free market is a form of ideological competition (akin to the idea meritocracy) intended to guide entrepreneurial actions consistent with economic reality, central planning is more akin to the ideological totalitarianism (akin to bureaucratism) associated with a traditional organizational hierarchy, where the merits of ideas are given short shrift and underlings unquestionably carry out the orders of their "superiors".

Being completely misaligned with reality, socialism failed because it is a poor information system: with all productive factors singularly owned and controlled, the price signals necessary for adapting to changing market realities are inhibited from developing. This inevitably leads to the shortages, mass starvation, and societal disintegration commonly associated with socialism. For an acute visualization of the differences in societal vibrancy between capitalism and socialism, take a look at this shot:

This image of North and South Korea at night vividly illuminates the stark differences between opaque central planning in the north, and vibrant free market capitalism in the south.

If we learned nothing else in the 20th century, it is that free markets are better than centrally planned ones in across almost every conceivable dimension. Left to function freely in their natural state, markets consistently generate innovation that increases productivity, lowers costs, and improves quality of life for everyone in society. Just consider for a moment how much innovations such as the automobile, smart phone, and internet services have increased our personal freedoms and enriched our lives. Now consider how un-innovative and un-adaptive government-run functions like the DMV, Post Office, and central banks are. So the elephant in the room, then, is why, in light of overwhelming evidence favoring a free market economic system, do we still tolerate central planning of the largest market of all — the market for money. Again, money is simply a technology for moving value across spacetime. Although it is an ancient (and somewhat, thanks largely to propagandists, enigmatic) social technology, it is hardly different than any of the other things we produce and distribute via free market mechanisms all over the world today.

Coming back to the congruence between the free market and the idea meritocracy, we arrive at two useful formulas. First, the idea meritocracy is comprised of three key elements: In Ray's words, (p.309):

"Idea Meritocracy = Radical Truth + Radical Transparency + Believability-Weighted Decision Making"

Now, let's translate this equation into its comparable free market format:

Free Markets = Truthful Price Signals + Transparent and Reliable Rule of Law, Private Property Rights, and Hard Money + "Skin in the Game"-Weighted Decision Making

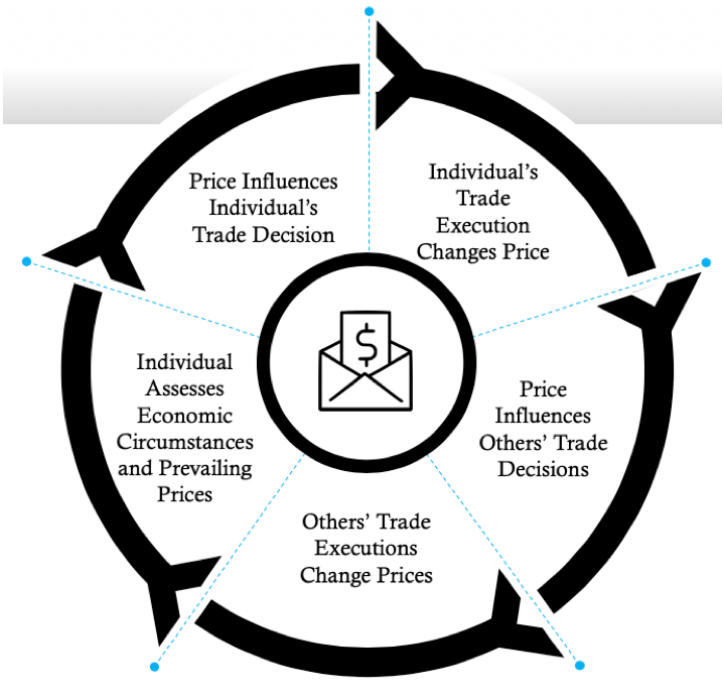
With these equations in mind, let's now dive into each of their elements to gain a clear understanding of Ray's idea meritocracy and its relationship to free markets. Once we fully unpack these concepts, we will go deeper into the other principles underpinning Ray's approach to life and work, using them as filters to more fully observe the potential impact of Bitcoin on all aspects of life.

We begin our journey from the greatest force of freedom in the universe — the truth.

Radical Truth

(p.135) "Truth — or, more precisely, an accurate understanding of reality — is the essential foundation for any good outcome."

The first element of Ray's idea meritocracy is Radical Truth, the idea that gaining a clear perception of reality is paramount to facing it head on and dealing with it. In markets, its commonly said that "price is truth"; meaning that all known market realities are expressed in, and evaluated by, any particular asset's price at any given moment. You may remember from Economics 101 that the market price is the intersection of supply (an objective quality) and demand (an intersubjective or opinion-based quality). Put another way, prices are data packets that convey information about scarcity (which is objective) and value (which is intersubjective). Each entrepreneur's decision to buy or sell is influenced by prevailing prices and, in turn, communicates back into the market the state of economic conditions relevant to him which, in turn, influences the same decision-making of all other entrepreneurs within his market; this is intersubjective value. These decisions are based on actual availability of time, resources, and know-how; this is objective scarcity. This feedback loop is the means by which free markets dynamically adapt to express prices that accurately portray economic realities:



Price signals are the economic nervous signals of an economy. To remain healthy and honest, they must be expressed in an uncompromisable monetary medium.

Let's return to Larry the lemon farmer: say a storm wipes out a large crop of lemons in California; reduced supply levels of lemons intersecting with an unchanged level of consumer demand necessarily means an increase in lemon prices. Increased prices incentivize lemon growers like Larry to produce more as they now fetch higher prices in the marketplace. On the other side of the lemon market, higher prices disincentivize consumers from buying as many of the sour yellow citrus fruit. As people respond to these ever-shifting incentives, which are a reflection of the endlessly

shifting economic realities of supply and demand, free markets adapt to maximize output and minimize costs. In this way, price signals serve as a dynamic incentive system for equalizing supply and demand discrepancies in free markets. However, to maintain their truthfulness, these price signals must be freely expressed in a money that is undistorted by government interventionism.

A price signal converts countless economic complexities into simplicity; it compresses myriad market realities down into a single, actionable variable — the market price.

Accurate price signals only prevail if the market is freely competitive and not subject to government interventions such as price fixing, trade restriction, or legal monopoly insulation. In true free market capitalism, most markets are relatively unobstructed by such artifices and the price signals are, accordingly, mostly reliable conveyors of truth. Lemon prices, for instance, tend to reflect the actual underlying supply and demand (or scarcity and value) realities at any given point in time. The market for money, however, is quite different in the modern economy, and its differences have cascading effects across all other markets.

Money is economic water; in the same way water intermixes and intersperses organic chemicals throughout the circle of life, money mediates the interchange of goods, services, and knowledge within markets.

Money, as one half of virtually every economic exchange, is the largest market in the world. This market is monopolized by central banks in every major economy worldwide; meaning that all forms of money competitive to fiat currency are prohibited (see eGold). As Ray aptly points out, (p.533) "Fiefdoms are counterproductive and contrary to the values of an idea meritocracy." Yet, for some reason, the economic fiefdoms called nation-states, which are antithetical to the free market paradigm (and, therefore, the idea-meritocratic paradigm), are commonplace. Even in the US, where we pride ourselves on being free market capitalists, we maintain this socialistic market structure for money. In this market, the following elements impact price expression of money:

· Supply — the amount of money available to be loaned out (aka loanable funds)

· Demand — the amount of loanable funds desired for borrowing

· Interest Rate — the price paid for funds borrowed

Central banks "manage" the market for money by controlling the supply of loanable funds and setting the interest rate (the price) at which these funds can be lent out. These central bank privileges are preserved by state-enforced monopoly rights, which insulate their mass-produced fiat currencies from competition and eliminate their "skin in the game". Skin in the game, a crucial Talebian concept, is a property based on symmetry, a balance of incentives and disincentives: in addition to upside exposure, people must also be penalized if something for which they are responsible for goes wrong or hurts others. Skin in the game is a central pillar for properly functioning systems, of both the organic and inorganic variety, and is at the heart of hard money. For gold, its mining costs and risks form the disincentives which are balanced against the incentives of its market price. Central banks, through various schemes and machinations, eventually coopted the market for gold and developed an economic system that could create money without skin in the game; allowing them to privatize seigniorage profits and socialize any losses they

incurred through inflation. Unless consequential decisions are made by people who are exposed to the results of their decisions, the system is vulnerable to total collapse; the frequent faltering of fiat currencies attests to the unfavorable asymmetry of this model for citizens.

Most commonly, as they have a direct financial incentive to do so, and with no downside to consider, central banks increase the supply of loanable funds and decrease the interest rate below its natural levels, thereby inducing an expansion of the money supply. Importantly, money supply expansion does not create any new wealth, as "printing money" does not infuse an economy with any new productive factors such as tools, factories, equipment, or human time. Instead, expansionary monetary policy only redistributes claims on productive assets from their rightful owners to those who receive the newly printed money first — usually bankers, politicians, and the other politically-favored-few closest to the spigot of liquidity (due to the Cantillon Effect). As Charles Holt Carroll said:

"Inflation is the surest way to fertilize the rich man's field with the sweat of the poor man's brow."

Inflation of the money supply is a violation of private property rights, as it reallocates wealth away from its original owners (the many) into the hands of those closest to the governors of the monetary system (the few). But confiscation of wealth, via the shadow tax of inflation, is not the only collateral damage inflicted by money supply expansion. Entrepreneurs operating in these soft money economies are easily misled by the distorted price signals that centrally planned fiat currency markets inevitably cause.

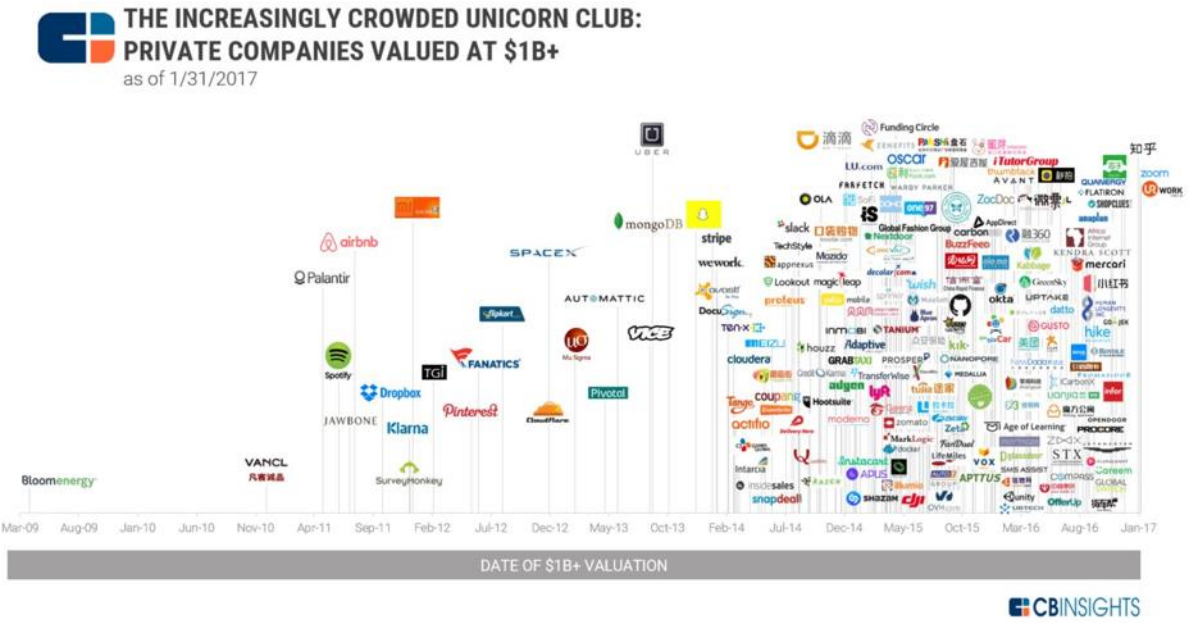
To understand this, let's look at the world through the lens of Larry the lemon farmer: emboldened by the "cheap" loans proffered by his local banker, Larry decides to borrow money to expand his lemon farm. He figures that borrowing enough money at 3% will allow him to expand and increase output of his farm by 2.5X, while only increasing his cost structure (including the 3% loan interest payable to his banker each year) by 2.3X. This economy of scale (the positive 0.2X margin between revenue growth of 2.5X and cost increase of 2.3X), Larry calculates, will drop straight to his bottom-line profit. So, Larry visits his local banker to sign the loan documents and sets out to expand his operation. At first, everything seems to be going smoothly as Larry gradually begins buying the additional land, fertilizer, and equipment necessary to grow and sell more lemons. However, things get sideways when other lemon farmers, lured by similar prospects of economic gain, also borrow from their local bank to expand their farms. As more lemon producers borrow and bid for the same lemon-farming assets, inflation sets in and prices begin to rise, thus increasing the cost structure of lemon production. Shortly after investing all his loan capital into his farm expansion, Larry finds that his cost structure has actually increased 2.8X due to more dollars chasing the same amount of productive factors for lemon farming. Gradually, then suddenly, the money Larry borrowed to expand his profit margin begins to work against him, as his increased capacity has eaten up his original profits and is now generating a loss (the negative 0.3X margin between revenue growth of 2.5X and cost increase of 2.8X, net of any prior profit margin). At this point, Larry has no choice except to increase his prices, cut costs, refinance, sell the farm, or declare bankruptcy. Under the same circumstances, other projects in other industries, misled into overborrowing by artificially cheap money, begin suffering losses as well.

An economy-wide simultaneous failure of overleveraged projects like Larry's is called a recession. The boom and bust business cycle we have all grown accustomed to in the modern economy is an inevitable

consequence of this centrally planned manipulation in the market for money. It is substantively no different than the shortages that would result if the price of bread was fixed at an artificially low level (which caused the starvation of millions in Soviet Russia). Artificially low interest rates don't provide any benefit to the real economy, rather they simply disseminate distorted price signals that encourage entrepreneurs to embark on projects that cannot be profitably executed due to the (hard to foresee) impact of inflation on their cost structures. As with all well-functioning markets, the price of money must emerge through, and constantly reorient itself against, the natural interactions of supply and demand. Attempts to centrally plan this market only distort truth (price signals) and trigger overborrowing, recessions, and cause (or, at least, exacerbate) the boom-and-bust business cycle.

As money supplies become more opaque, so too do the critical price signals they carry back and forth between the minds of entrepreneurs.

The more opaque the present and future supplies of money, the more entrepreneurs suffer from this myopia, and the more stifled the economization of human action becomes. Price signal distortions like those faced by Larry result entirely from the opacity of central bank "managed" (read: manipulated) money supplies. Central banks are only able to perpetrate this scheme due to the legal monopolies (artificial barriers against free market competition) which shield their inferior monetary technologies (fiat currencies) from facing off with superior technologies (like gold) in the marketplace. Legal monopoly protections inhibit price discovery in the market for money (the natural interest rate). There is also ample evidence that central banks actively suppress the price of gold to preserve fiat currencies (see Gata.org). Further, if monetary technologies were freely selected and priced in the marketplace, as was the case when gold ascended to dominance, then everyone could more reliably use money as a store of value instead of being forced further out along the risk curve into stocks, real estate, and other scarce assets to protect their wealth from the ravages of inflation, which further distorts prices; the increasingly crowded unicorn club reflects just how distorted prices have become:



Money that cannot reliably hold its value across time forces people to make ever-riskier investments.

Simply put, price is truth; distorted money supplies distort the truthfulness of price signals and throw entrepreneurial action into disarray. At the heart of the cyclic booms and busts in the economy, then, is this distortion of the fundamental signaling which, in its current distorted state, misguides entrepreneurial action. Under these conditions of monetary socialism, trying to build a business is like trying to build a house in a jurisdiction that constantly changes the spatial values of its metric system; as Taleb puts it:

According to Wittgenstein's ruler: Unless you have confidence in the ruler's reliability, if you use a ruler to measure a table you may also be using the table to measure the ruler. The less you trust the ruler's reliability, the more information you are getting about the ruler and the less about the table.

With an absolutely fixed supply, Bitcoin will restore the clarity of these economic nerve signals that are so critical to proper capital allocation, risk assessment, and entrepreneurial planning. Universal units of measurement are critical in economics and industry — the seconds, meters, kilograms, and other units of measurement we use throughout the world are all immutable in value. Upon these foundations of standardized measurement, the machinery of global commerce is constructed: builders of skyscrapers, electronics, and myriad other goods rely on the constancy of these measurement units when sourcing components and materials from around the globe. Money, too, is most communicative when its supply is immutable. As a purely objective monetary medium, once it accretes enough value to incentivize its users to spend it, Bitcoin denominated price signals will carry more truth than any other money in history.

Bitcoin is a monetary channel free from the noise of unexpected supply fluctuations, which necessarily means it carries the clearest signals. In this way, Bitcoin is the perfect conveyor of the data packets on value and scarcity known as price signals.

In terms of the idea meritocracy equation, we see that fiat currency is antithetical to radical truth and, its free market corollary, truthful price signals. On the other hand, Bitcoin is the most honest money imaginable, as every component of it, including its money supply, is viewable by everyone. In a world filled with fake news, click bait, and data breaches — Bitcoin is one of the rare instances of honesty in modernity. Central banking is the reverse; it is shrouded in complexities intended to hide its truth. Bitcoin is both radically truthful and transparent.

If money is economic water, then fiat currency is inscrutably murky, and Bitcoin is crystal clear.

Bitcoin's transparency has already shed much light on the umbral industry of central banking and its shadowy tactics by sparking a renewed interest in Austrian economics and making an entire generation ask the question: "What is Money?". We stand to gain even more clarity around Bitcoin's impact on the world by diving into the second element of Ray's idea meritocracy — radical transparency.

Radical Transparency

(p.308)"By radical transparency, I mean giving most everyone the ability to see most everything."

Originally, capitalism was founded on the cornerstones of reliably consistent rule of law, private property rights, and hard money. Respectively, these cornerstones provided people non-violent dispute resolution,

confiscation resistant assets, and a sound medium of exchange. With strong and reliable rules, entrepreneurs are then free to "play the game", accumulating capital for themselves and diffusing any innovations gleaned in the process into the whole of society. For entrepreneurs to execute effectively, they must know the rules of the game, and must be able to trust that they are not subject to change. Imagine a poker player sitting at a table where the hand-rankings changed at the whims of the casino every few hands; without sound rules on which build a strategy, no player would remain engaged for long, and would quickly exit the game. Stability in these areas is among the primary reasons why the United States is such an attractive environment for investing; for the most part, its courts function well and contract law is enforced without bias. The exception, of course, is the violation of private property rights which results from centrally manipulated money supplies — in other words, the softness of the US dollar.

According to you Ray, "The most painful lesson that was repeatedly hammered home is that you can never be sure of anything: There are always risks out there that can hurt you badly, even in the seemingly safest bets, so it's always best to assume you're missing something". Considered by many to be among the safest bets in the world today is the US Dollar — it is issued by the largest economy in the world, is "backed" by the world's most militant taxing authority, and is accepted almost everywhere as a medium of exchange. Further, by unilateral decree (and a veiled threat of force), the US Dollar exclusively denominates the lifeblood commodity of the modern industrial economy, oil. The problem with the perceived safety of the US Dollar is the opacity of the rules which govern its existence: How many are there in existence? How many will be issued in years to come? Who gets to decide? Who stands to profit from its production? Even though the US Dollar today is just an SQL database maintained by The Fed that could choose to open its records to audit, it refuses.

https://twitter.com/_justinmoon_/status/1159598647815917568?s=21

Instead, The Fed sets monetary policy in closed door meetings and (only vaguely) communicates its intentions using ambivalent speech. To counterbalance this opacity, an army of macroeconomists, analyst, and market commentators pour over every detail of the statements issued by central bankers including not only their words, but their tone, delivery, and even wardrobes.

Imagine a semi-governmental agency being put in charge of setting the price of, say, automobiles based on undisclosed criteria and decided in closed-door meetings. Ask any "free market capitalist" if this seems like a good idea and he will spew vitriol at you for even suggesting such a socialistic method of managing the production of automobiles. Then ask him whether it's a good idea for this same agency to control the price of communications technologies like laptops and smart phones. You'll be met with the same answer and (perhaps) a loud American battle cry in support of free market capitalism. Finally, very smoothly point out to him that The Fed sets the pricing of the US Dollar (the interest rate), which is the United States' most valuable export market, and does so based on undisclosed criteria and closed-door discussions. Although Keynesians have done a great job convincing many of the enigmatic nature of money, it is quite simply just a tool for moving value across spacetime, and as such should be priced and technologically selected on the free market (just like everything else in a truly capitalist society).

Sunlight is the best disinfectant; when everyone can see the criteria and process behind a decision they are more likely to deem in trustworthy. With Bitcoin, the algorithm which sets its monetary policy is totally

transparent, meaning people can universally agree that the system is fair and unbiased. As an open-source monetary protocol, Bitcoin is essentially the principle of radical transparency in perpetual action. Similar to some of the management tools you've created Ray — such as the baseball cards, Dot Collector, Pain Button, etc. — Bitcoin can be thought of as a global monetary policy management tool. As a machine componentized by open-source software and entrepreneurial self-interest, it does the work facilitated by central banks today — maintaining monetary policy, reaching consensus as to account balances, and facilitating international value flows — without relying on the whims of bureaucrats who control state-backed monopolies on money. Bitcoin is the purely transparent alternative to the opacity of central banking; it is a beacon of light outcompeting an industry purposefully shrouded in darkness. Once properly understood, Bitcoin's superior visibility inescapably enhances its believability. And once you see it, it cannot be unseen.

Bitcoin's monetary policy (its new supply flow schedule) is becoming the most trusted in the world as it is fully transparent and unchangeable. Bitcoin runs countervailing to government monetary policy which is uncertain, opaque, and subject to change based on bureaucratic whim.

In terms of the idea meritocracy equation, Bitcoin restores the confiscation-resistance of money, which provides its users stronger property rights when compared to fiat currency. Importantly, Bitcoin also reestablishes the sorely lacking 3rd cornerstone of capitalism in an otherwise free world — hard money. As an economic good undergoing monetization on the free market, with a supply inelasticity destined to surpass that of gold, Bitcoin is resurrecting the free market capitalist triad. As it bears repeating: Bitcoin is both radically truthful and transparent.

As you've said Ray: (p.327) "Having nothing to hide relieves stress and builds trust." Transparency and reliability is the essence of Bitcoin's monetary policy. It is truly unique in that its supply is absolutely predictable and absolutely scarce. Bitcoin is the most credible monetary policy in history outcompeting the least trustworthy monetary policies in history; it is rapidly gaining a track-record superior to central banks across all dimensions — reliability, predictability, auditability, cost-effectiveness, and resistance to censorship or manipulation — thereby further eroding the believability of central bankers, which is in shorter supply with every dollar printed.

Believability-Weighted Decision Making

(p.284) "When you're responsible for a decision, compare the believability-weighted decision making of the crowd to what you believe."

When it comes to money, track records matter. People's trust tends to coalesce slowly around the most stable from an exchange ratio perspective — in other words, what best maintains or gains purchasing power across time. In this respect, gold is undoubtedly the king, as it sports a more than 5,000 year history of remaining reliably scarce and, therefore, valuable. An ounce of gold has roughly equaled the price of a fine man's suit for the past century, whereas the same suit's price in dollars has skyrocketed. The best performing central bank fiat currency in history in the British pound, which has only lost 99.5% of its value in its 317 year existence. When it comes to value storage, gold has a believable track record, whereas fiat currencies could only barely be less believable. The hardness or soundness of money, as one of the

three cornerstones of free market capitalism, has been almost completely compromised as a result of state-enforced monopolization.

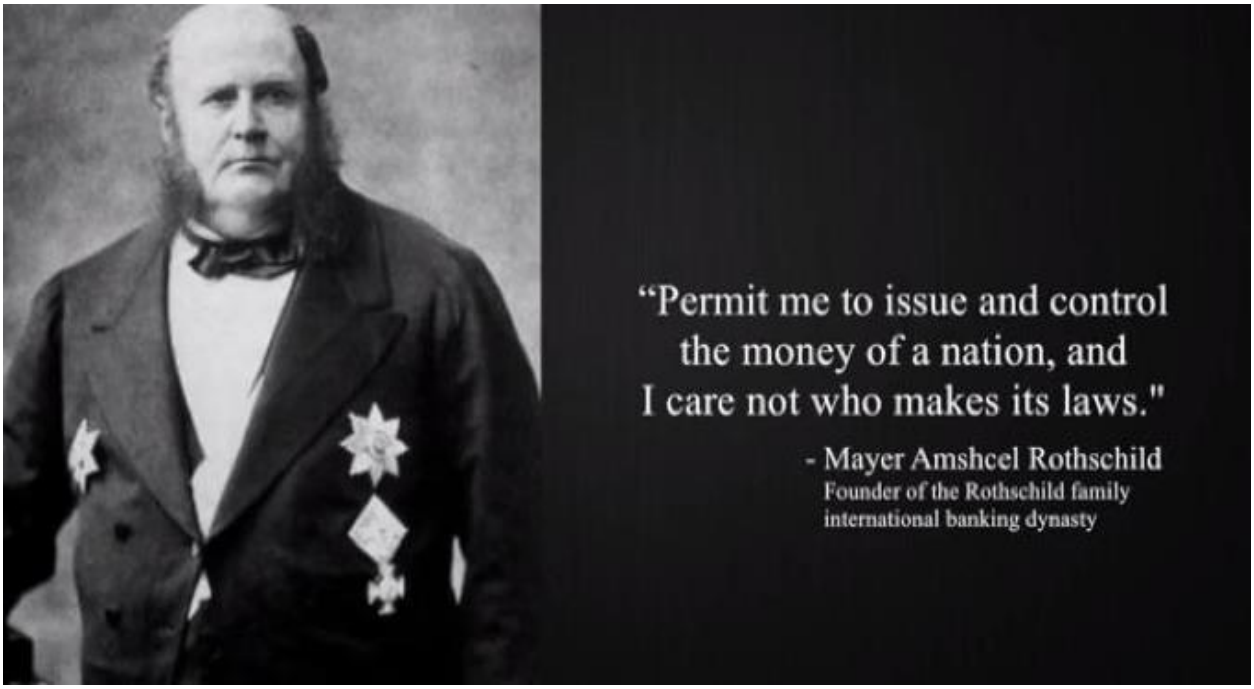
For free markets to function optimally, its three cornerstones — rule of law, private property rights, and hard money — must be consistently applied across all market participants. While the rule of law and property rights are (mostly) sound in western society, centrally planned money supplies are quite the opposite. Without any reliable insight into the primary governance aspects of money (see Radical Transparency above), entrepreneurs are forced to rely on other means of protecting their wealth from theft or debasement. Simply, the implementation of fiat currency offers limited to no assurances to its users that their wealth will be protected from confiscation, censorship, inflation, or counterfeit.

Fiat currencies, when stored in banks, are subject to confiscation or payment censorship by authorities. When stored physically (say, under your mattress), fiat currencies are still subject to value dilution via inflation (the legalized version of counterfeiting). Although fiat currencies offer some physical security measures against counterfeiting (the criminalized version of inflation), this has proven to be a cat and mouse game in which counterfeiters and authorities are constantly trying to outsmart one another in the domain of currency verification technologies.

Bitcoin, on the other hand, is a purely sound money and offers robust assurances to its users. It is resistant to confiscation, as only the possessor of a private key (an alphanumeric string of data) can produce the digital signature necessary to spend it. Bitcoin transactions cannot be censored due to the peer-to-peer and open-source nature of its software architecture. Complete immunity to unforeseen changes in its money supply is guaranteed by unbreakable cryptography and the economic self-interest of miners which secure its network. Finally, since the rules which govern Bitcoin can be verified by anyone, anywhere, and at any time — it is completely counterfeit resistant. Indeed, it is its radically transparent nature that makes Bitcoin the most believable monetary technology in history. Monetary opacity always leads to moral hazard on the part of policymakers.

With decades of experience seeing these hazards explode up close, Ray has said, (p.107) “The job of a policymaker is challenging under the best of circumstances, and it’s almost impossible during a crisis. The politics are horrendous and distortions and outright misinformation from the media make things worse.” So this begs the question: why should we permit policymakers to dictate monetary policy? As “free market capitalists”, we make no such concessions in any other market in the world. We don’t trust a board of governors to tell us how many automobiles to manufacture or at what price to sell laptops each year, so why should we trust central banks to set price and production targets the largest market in the world? As with all production decisions, the free market — representing the collective interests, intelligence, and wisdom of all economic actors — is always the best generator of (low) believable prices, new innovations, and consumer satisfaction.

Controlling monetary policy is like being crowned king of the world. As a fat-cat banker once said:



Money is an instrument of freedom; controlling its supply grants control over its users.

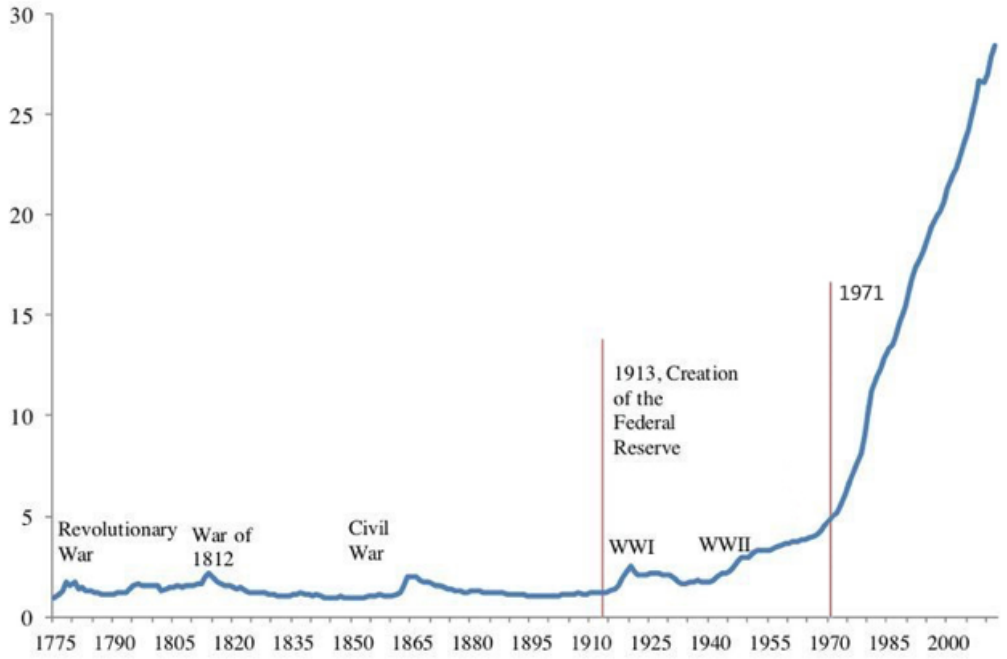
For this reason, most of the world's wars have been waged in an attempt gain control over this contentious crown. And to control monetary policy, it is necessary to dominate the original monetary sovereignty layer of planet Earth — gold. For instance, during World War II, North America became a geographically-strategic safe haven for European gold hoards to protect them from Nazi plundering. At the conclusion of World War II, into which the United States ultimately intervened to destroy its war-wearied opponents and declare itself victorious, the Brettonwoods Conference was convened in which the rules of the global economic were rewritten by the newly self-proclaimed king — the United States. This conference cemented The Fed as the effective central bank of the world and the US dollar as the world reserve currency.

Even if you are a believer in monetary socialism, you would be hard pressed to defend the believability of central bankers. As you said Ray, "Think about people's believability, which is a function of their capabilities and their willingness to say what they think. Keep their track records in mind." In terms of capabilities, central banks have arrogated themselves virtually unlimited latitude to manipulate the supply and price of fiat currency. However, they have exercised these privileges based on (largely) undisclosed criteria and are notorious for their veiled communication styles. In other words, central bankers seem quite unwilling to say what they think (which violates the first thing necessary for an idea meritocracy) and their decision-making criteria is shrouded in falsehood. As Michel de Montaigne once wrote:

"If falsehood had, like truth, but one face only, we should be upon better terms; for we should then take for certain the contrary to what the liar says: but the reverse of truth has a hundred thousand forms, and a field indefinite, without bound or limit."

In regards to track records, central bankers likely hold the world record for the most abysmal performance history. Since reputation cannot be printed, and must be earned through a lifetime of honesty, it is unsurprising that central banks have struggled in this respect. Historically, every fiat currency has trended towards worthlessness, which has only dragged the believability of this monetary model ever-downward. Mandated with price stabilization and employment maximization, The Fed has failed miserably at both, especially since severing the peg to gold in 1971; here, we show the US dollar's loss of purchasing power since 1775:

Figure 1. Consumer Price Index, United States, 1775-2012
(level, 1775=1)



Sources: Bureau of Labor Statistics, Historical Statistics of the United States, and Reinhart and Rogoff (2009).

The softer money becomes, the more it trends towards absolute worthlessness.

Central banker opinion-driven money supplies are proportionately reliable to the value storage functionalities of the ever-softening fiat currencies they mass produce. Bitcoin's fact-driven money supply is as reliable as the mathematics and thermodynamics which sanctify its inviolable ledger. Opinions are like soft money, in that they can easily be diluted and distorted. Facts are like hard money, in that they are rooted in scientific realities. Said simply: do we believe the largest market in the world is best governed by opinion or fact? Buying Bitcoin is buying a put option on central banker malfeasance. As Travis Kling says:

https://twitter.com/Travis_Kling/status/1181647574861832193

More fundamentally: how can we possibly believe that central bankers will perform well when they completely lack skin in the game? As Taleb puts it:

"Systems don't learn because people learn individually -that's the myth of modernity. Systems learn at the collective level by the mechanism of selection: by eliminating those elements that reduce the fitness of the whole, provided these have skin in the game. Food in New York improves from bankruptcy to bankruptcy, rather than the chefs individual learning curves -compare the food quality in mortal restaurants to that in an immortal governmental cafeteria. And in the absence of the filtering of skin in the game, the mechanisms of evolution fail: if someone else dies in your stead, the build up of asymmetric risks and misfitness will cause the system to eventually blow-up."

Totally disconnected from the consequences of their policy actions, which are instead born by citizens, central bankers are incentivized to maintain the status quo to preserve their jobs and "prestige". Money, the largest and most critical market in the world, simply cannot evolve without practitioners who are subjected to real world consequences and tradeoffs, in real time. Simply, if you lack skin in the game then you lack believability. This explains why ancient Roman architects were required by law to stand beneath their monolithic arches when the scaffolding was removed. This (deadly) disincentive to malperformance worked wonders, as some of the oldest arches constructed in this way are still standing at over 2,000 years of age. If only central bankers were subjected to the devastation they inflict on centrally planned economies should their decision-making not work out, then perhaps the world would still be on a gold standard and the dire need for Bitcoin would be lessened.

Parading themselves as the healers of economic crises, central bankers are actually the creators of these calamities. QE, TARP, NIRP, and other interventions inflict a heavy iatrogenic cost on society; and the harm done is further compounded by the agency problem (central bankers have no skin in the game, and therefore have conflicted interests when it comes to managing money supplies).

So, in terms of the idea meritocracy formula, it is clear that central banking fails to satisfy its third element of Believability-Weighted Decision Making, instead, the prevailing economic order seems to promote the least believable people into the driver's seat of the world economy. Translated into the free market formula terms, this is an expectant result as these policymakers suffer from the agency problem and are rendered impotent without "Skin in the Game"-Weighted Decision Making. In this sense, Bitcoin is the reverse; its node operators and miners govern the system, all of whom have skin in the game and, therefore, possess more believable decision-making capabilities — just like the ancient architects who stood beneath their newly un-scaffolded arches.

To put it all together in terms of our original equations; we began with:

"Idea Meritocracy = Radical Truth + Radical Transparency + Believability-Weighted Decision Making"

Which translates to this free market format:

Free Markets = Truthful Price Signals + Transparent and Reliable Rule of Law, Private Property Rights, and Hard Money + 'Skin in the Game'-Weighted Decision Making

Based on what we've learned so far, we can translate these equations once again into central banking and Bitcoin versions:

Central Banking = Untruthful Price Signals + Transparent and Reliable Rule of Law, Marginalized Private Property Rights (due to violations via inflation), and Soft Money + "Agency Problem"-Weighted Decision Making

Bitcoin = (Absolutely) Truthful Price Signals + Transparent and Reliable Rule of Law, Private Property Rights, and (Absolutely) Hard Money + "Skin in the Game"-Weighted Decision Making

Clearly, only Bitcoin is 100% consistent with the equation for free markets; whereas fiat currency is almost entirely inconsistent. Since this free market equation is equivalent to the idea-meritocratic equation, we may deduce: Bitcoin is completely consistent with Ray's formulation of the idea meritocracy, and fiat currency is not.

Therefore, because math, Bitcoin is both a free market and an idea meritocracy.

So, Ray, assuming your Principles are stated forthrightly, how can you possibly be a non-believer in Bitcoin? As you said Ray, (p.379) "When someone says 'I believe X,' ask them: What data are you looking at? What reasoning are you using to draw your conclusion?" So let me ask you Ray: after Bitcoin's impeccable performance for over a decade (over 99.98% uptime, never been hacked, evolution into the most secure computing network in the world, roughly $200B in market capitalization, and over $1T of transactions cleared in total), what data and reasoning are you using to draw your conclusion about Bitcoin?

My guess is that like many smart people, you may have disregarded Bitcoin at the outset. In accordance with one of your favorite principles, I implore you to keep an open mind about Bitcoin and, perhaps, you will come to see it as an embodiment of open-mindedness itself. In that spirit, let's dive deeper.

Open-Mindedness

(p. 187) "If you can recognize that you have blind spots and open-mindedly consider the possibility that others might see something better than you — and that the threats and opportunities they are trying to point out really exist — you are more likely to make good decisions."

Open-mindedness is a key aspect of both an idea meritocracy and evolution. It is a concept closely related with filtering and optionality: a form of non-cognitive intelligence intrinsic to natural systems in which exposure to multiple potentialities is employed, allowing the system to "learn" by adopting what works and discarding what doesn't. An interesting paradox is discovered in that this openness is the source of Mother Nature's opaque logic — as Taleb puts it:

"Evolution proceeds by undirected, convex bricolage or tinkering, inherently robust, i.e., with the achievement of potential stochastic gains thanks to continuous, repetitive, small, localized mistakes. What men have done with top-down, command-and-control science has been exactly the reverse: interventions with negative convexity effects, i.e., the achievement of small certain gains through exposure to massive potential mistakes...Simply, humans should not be given explosive toys (like atomic bombs, financial derivatives, or tools to create life)"

Close-mindedness, on the other hand, represents a rigid fixity on an existing knowledge framework that excludes the possibility of learning, innovation, and evolution. Without a culture of open-mindedness, organizations fail to learn and adapt well, and begin to suffer losses at the hands of more fit competitors. Sheltered from market discipline by their legally fortified monopoly positions, central bankers become feeble minded while, at the same time, their monetary technologies become brittle and maladapted to shifts in user demand.

Open-mindedness is an ever-present state of mind, a keen awareness of optionality and the freedom to filter; to change one's mental or organizational model, to reform one's prior assessment of conditions based on new information or a new vantage on old information (Bayesian inference).

Here, we see another perspective on the ineffectiveness of central planning — by moving in accordance with a single, rigid plan of action, the economy gets locked into a non-opportunistic course of action; it becomes blind to optionality and, thus, close-minded. For institutions, innovations, and individuals, close-mindedness is fatal. As legendary physicist Richard Feynman said, "we can never be sure we're right, we can only be sure we're wrong" — this is why open-mindedness matters across all spheres of human action.

Open-mindedness in the technological realm is manifests in the form of open-source technologies; tools sporting schematics that anyone can inspect, modify, or enhance. Ray incorporates this principle into his culture at Bridgewater and in the "management tools" his team uses to make organizational and investment decisions. Bridgewater's management tools are open-source by design so that they can consistently adapt to offer the highest utility to its workforce. As Ray says, (p.527) "Because the thinking behind the algorithms is available to everyone, anyone can assess the quality of the logic and its fairness, and have a hand in shaping it." By applying the principle of radical transparency to his management toolset, Ray encourages a culture of open-mindedness by making their tools open to critique and change, in the same way ideas are assessed openly based on their merits alone within his cultural paradigm. This approach ensures that everyone maintains a perspective of "why are we doing it this way" and "is the tool helping us achieve our objectives as an organization".

Essentially, by practicing open-mindedness, the team at Bridgewater supports their effort to operate as an idea meritocracy. In effect, Bridgewater has structured itself as an open-source organization in which its team learns and grows by, (p. 67) "Wrestling with the markets, thinking independently and creatively about how to make our bets, making mistakes, bringing those mistakes to the surface, diagnosing them to get at their root causes, designing new and better ways of doing things, systematically implementing the changes, making new mistakes, and so on." Whether you realize it or not Ray, you have been cultivating a culture based on the ethos of open-source technology.

Open-source technology is readily inspectable and, therefore, trust-minimized. Openness lets it absorb feedback from many sources to adapt in response changing market conditions and user demand. These technologies are absolutely transparent and auditable, which minimizes the need to trust other people when using these tools to interact. Trust-minimization is one of the primary benefits of that ancient open-source monetary technology — gold. Since trading partners couldn't necessarily trust each other,

they could instead rely on the natural laws restricting the supply of gold and use time-honored techniques for assaying its authenticity (until coinage fulfilled, then repeatedly violated, this trust function), thus minimizing the need to trust counterparties to a transaction.

Closed-source technology is the reverse and thus requires users to trust in its purveyor; it is unauditable and, therefore, maladapted to market conditions and user demand. In the case of fiat currency, this purveyor is a monopolist and, as many of us learned in Economics 101, profit maximization for a monopolist comes at great expense to everyone else. Fiat currency is closed-source technology that is legally protected from audits and competing monetary technologies. Such opacity and market insulation not only slows the rate of monetary technology innovation, it also erodes the trustworthiness of fiat currency, and fattens its monopolists:

Agustin Carstens, head of the Bank of International Settlements, the central bank of central banks. Just a soft guy, slinging soft money.

As you've said, "Adaptation through rapid trial and error is invaluable" — this is the ethos of open-source. Bitcoin, being open-source, is like a language, as its source code and transaction history are universally transparent and can even be printed onto paper (interestingly, this makes it protected under the First Amendment in the United States). Further, Bitcoin is supported by a global network of volunteer programmers. These programmers are self-interested in the sense that they are almost always Bitcoin owners as they are aligned with its purpose philosophically, and therefore stand to gain financially from its improved functionality and network growth. The work of these open-source programmers closely mirrors Ray's approach to organization building, in which he creates systems that encourage others to

(p.64) "Put honest thoughts on the table, have thoughtful disagreements in which people are willing to shift their opinions as they learn, and have agreed-upon ways of deciding if disagreements remains so that we can move beyond them without resentments". Again Ray, your approach to culture and management style mirrors the philosophy of open-source technology.

Ray, is there any reason you believe Bridgewater should benefit from open-source tools while society should suffer under closed-source fiat currency? Shouldn't citizens everywhere have access to the most open and highest quality feature-set for the most important technology in their lives — money?

Bitcoin's openness is key to its competitive superiority as money. Over the past decade, its global army of volunteer programmers has greatly enhanced the utility of the Bitcoin network. However, and this is critical, these programmers are unable to change the rules of Bitcoin due to its ingenious social contract implementation. Further, since everyone (every node) is "in charge" of the Bitcoin network, it adheres well to Ray's advice to, "Make sure that those in charge are open-minded about the questions and comments of others." This constant scrutiny and feedback from users, each of whom has skin in the game and is "in charge", ensures that Bitcoin is always functioning at or near its optimum. Contrarily, fiat currency has undergone essentially no innovation since its inception.

Due to its open-source nature, Bitcoin is sometimes referred to as "the internet of value". In the same way the internet is a set of open-source protocols for exchanging data (called the internet protocol suite), Bitcoin is an open-source protocol for exchanging value. Such openness ensures that Bitcoin's code cannot be manipulated to benefit anyone at the expense of anyone else. Fiat currency is the opposite; its central planners are, at their own discretion and at near-zero cost, able to siphon value from its monetary network by inflating its supply (such "technology backdoors" are only possible with fiat currency). In regards to how to kill Bitcoin, the "internet of value" analogy also gives us the useful comparative question: How would one turn off the entire internet worldwide, permanently? Governments have proven adept at eliminating centralized entities, however the decentralized nature of the internet and Bitcoin in many ways transcend the coercive and compulsory powers of governments (which is why America can't regulate Bitcoin).

The openness of Bitcoin also makes it antifragile, meaning it becomes hardened by hostility. As you've said, "The key to success lies in knowing how to both strive for a lot and fail well." Open-source, decentralized, digital tools like Bitcoin are uniquely capable of organizing human efforts without a central coordinator at unprecedented scales (strive for a lot) and also become enhanced in the face of technical failings (fail well). Stressors to Bitcoin may come in the form of an external attack on its network or an attempt to fork its blockchain. After 11 years of nearly flawless operation within a relentlessly adversarial environment, Bitcoin has earned its fair share of battle scars (Bitcoin cash, Segwit, etc). Each time Bitcoin withstands an attack, its reputation for network security, reliability, and immutability is strengthened.

Bitcoin is a technology that has accrued value on the free market based on its credibility as money. Unlike fiat currency which persists only because of a government-enforced refugium from competing technologies, Bitcoin persists based on its own merits. Indeed, Bitcoin is a free market for converting electricity into digital gold — it is outcompeting (literal) monopoly monies worldwide and, by doing so,

making the market for money free once again (as we saw in the Gilded Age). Similar to the internet outcompeting intranets, Bitcoin is outcompeting fiat currencies because of its superior openness and monetary traits:

Money is a social technology used to solve a problem which has persisted for all of humanity's existence: how to move economic value across time and space. Competition is at all times alive between different forms of money, subject to market-driven natural selection.

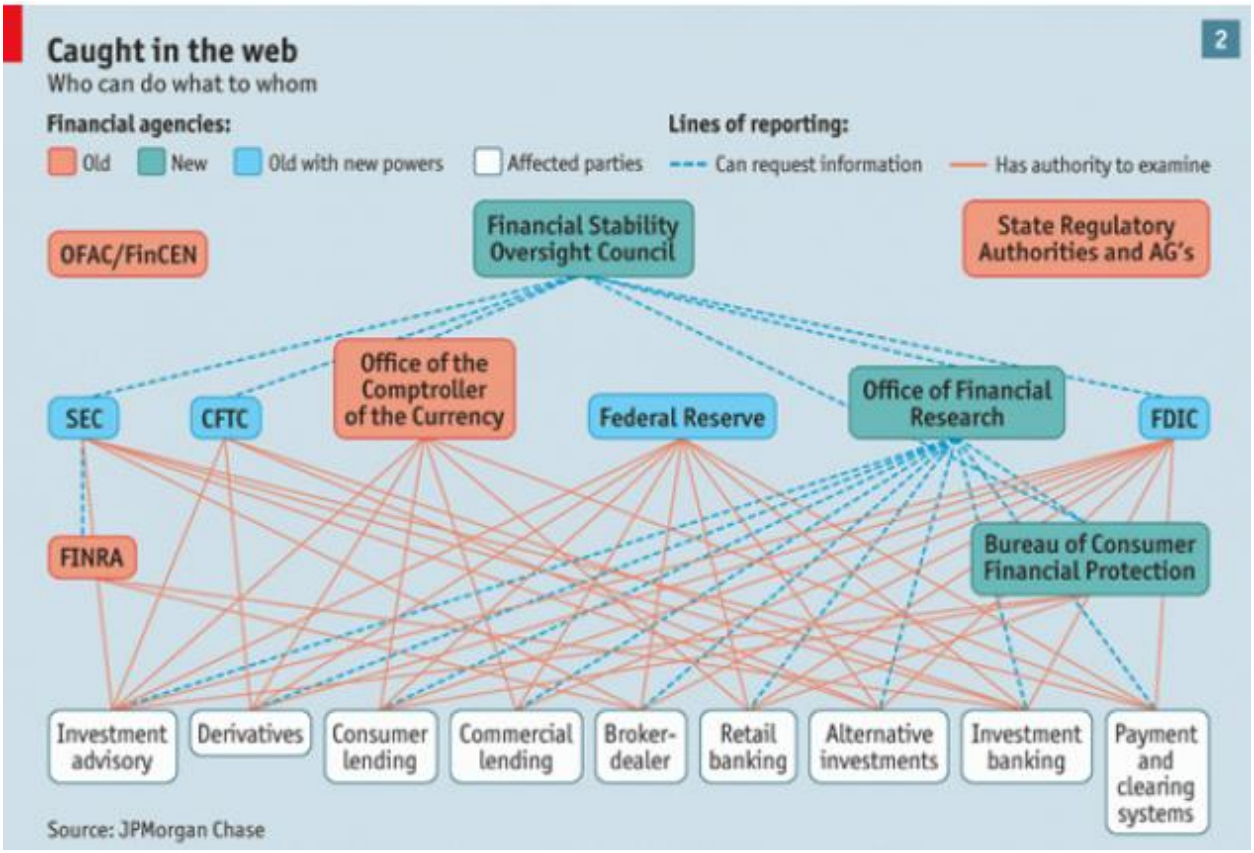
Traits of Money	Gold	Government Money	Bitcoin
Fungibility (interchangeable units)	High	Medium	High
Hardness (stock-to-flow ratio)	Medium	Low	High
Portability	Medium	High	High
Durability	High	Medium	High
Divisibility	Low	Medium	High
Security (cannot be counterfeited)	Medium	Medium	High
Easily Transactable	Low	High	High
Scarcity (predictable supply)	Medium	Low	High
Self-Sovereign (permissionless)	High	Low	High
Government Issued	Low	High	Low
Decentralized (censorship resistant)	Low	Low	High
Smart (adaptive & programmable)	Low	Low	High

In the monetary ocean, Bitcoin is a blue whale feasting on large swarms of soft money plankton.

As you've said Ray, (p.189) "To be radically open-minded, you need to be so open to the possibility that you could be wrong that you encourage others to tell you so." Unhampered competition incentivizes others to prove you wrong in the marketplace by discovering better or cheaper ways of producing or doing things — this is the very essence of free market capitalism. In truly free markets individuals are maximally sovereign and ruthlessly pursue satisfaction of their wants, which keeps entrepreneurs ever-vigilant in their quest to deliver high quality at a fair price. This unabated pursuit makes free markets generators of quality, innovation, and cost-effectiveness. The reverse is true in monopolized markets — which maximize profits for monopolists at the expense of customers in the form of lower quality (low innovation) and higher prices (market distortions, egregious fees, and value confiscation via inflation).

As you've said in regard to open-source technology Ray, (p.528) "Though the system won't be perfect, it is much less arbitrary — and can much more easily be examined for bias — than the much less specified and much less open decision making of individuals with authority." Here you are describing the value of Bitcoin's immutable monetary policy, which is totally free of arbitrariness, and its incentive-oriented design (people are incentivized to use Bitcoin, see feedback loop in Primer on Bitcoin) over central bank's arbitrary monetary policy and disincentive-oriented design (people who attempt to compete with or refuse to use fiat currencies are punished). Further, the institutional web surrounding central bank

interests is so complicated and holistically unfathomable, it is more prone to arbitrages by insiders, accumulation of systemic risks, and blow ups:



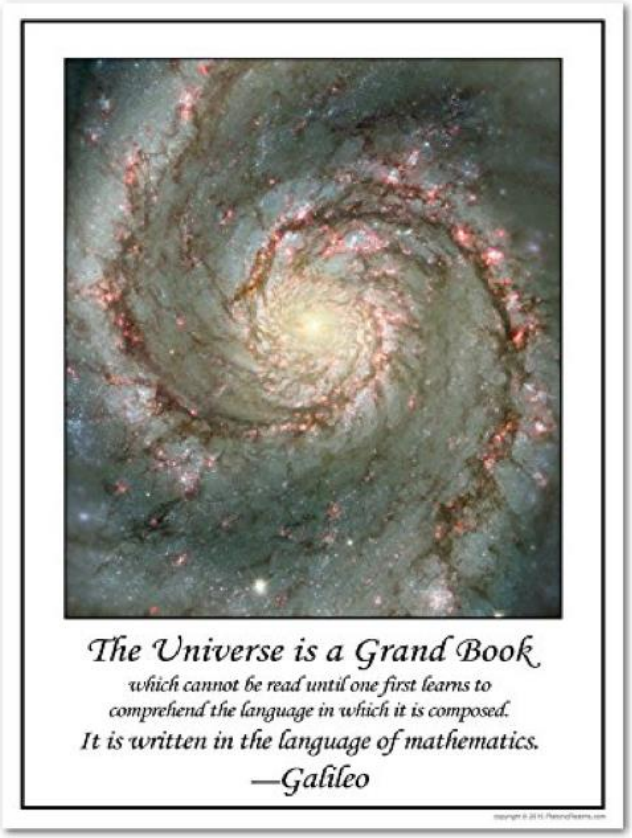
Clear as mud, and twice as dirty.

This messy, closed-source system is bureaucratic, inefficient, and fragile. The main point: open-mindedness is the key to the adaptivity and, thus, the longevity of natural systems. As open-source money, Bitcoin excels in this respect. And money, a long time before government, arose as a natural market phenomenon.

Faith in Nature

(p.140): "Whenever I observe something in nature that I (or mankind) think is wrong, I assume that I'm wrong and try to figure out why what nature is doing makes sense."

Ray's introductory observation here is consistent with the wisdom of Taleb, who said, "what Mother Nature does is rigorous until proven otherwise; what human and science do is flawed until proven otherwise." Clearly, this is a damning indictment of fiat currencies, which are unnatural monies born of unnatural laws. Gold and silver, on the other hand, rose to become natural monies precisely because of natural laws, which are beyond the reach of mankind's prying hands, and which bestowed them with the traits of good money. Similar to the (mostly) uncompromising rules governing gold, the rules governing Bitcoin are founded in the (absolutely) uncompromising laws of mathematics — nature's fundamental language:



Bitcoin is the fusion of two universal languages: money and mathematics.

As you've said Ray, (p.141) "nature optimizes for the whole, not for the individual, but most people judge good and bad based only on how it affects them." This is what's wrong with putting individuals in charge of money supplies — they are directly incentivized to produce ever-more money and use it to acquire hard assets (like land, gold, and businesses) and pass on the costs of production (monetary value dilution via supply inflation) to all other market participants, who are legally coerced into using increasingly value-compromised fiat currencies.

As a social technology so fundamental to human cooperation, like spoken language itself, money, to offer the highest utility to the most people, must be governed by rules that cannot be manipulated to benefit one person over another. Somewhat counterintuitively, for money to benefit the most people, governance over its supply must be beyond the reach of everyone. This is why gold ascended to become money on the free market and why it remains the sole instrument for final settlement among central banks today. As the hardest natural money in the world, gold remains the prime monetary sovereignty layer on Earth. From an accounting perspective, where Assets = Equity + Liabilities, gold is purely equity-based, as physically possessing a gold asset is 100% equity and 0% liability; whereas fiat currency is debt-based, as it requires trust in the issuer, its taxing authority, and any payment intermediary associated with its use at any given time.

Simply, gold is the king of natural money; it arose to the role of money as a result of free market processes which, themselves, are operations of nature. Fiat currencies, on the other hand, are artificial; they can only exist in economies where people are coerced into using them via artifices like legal tender laws, capital controls, confiscatory actions, and other anticompetitive restrictions on the market for money. The impetus for fiat currencies existence arises from egoic desires of man like greed, control, and protectionism.

Whereas central banking converts human greed into a race to debase fiat currencies, which inevitably destabilizes economies over time, Bitcoin converts greed into network resiliency and reliability. Bitcoin ingeniously combines the self-interestedness inherent to human nature with electricity and converts them into indisputable records and expansion of its monetary network. The Bitcoin network is itself an embodiment of a free market, where any entrepreneur with access to sufficiently cheap electricity and the

necessary hardware can freely enter the market as a miner, that is disrupting the monopolization over the market for money worldwide.

In this sense, Bitcoin is a fractalized free market; its network of miners compete freely to forge an absolutely scarce money that exists outside the scope of monopoly-preserving artifice, thus impressing its free market characteristics onto the world market for money and giving people an alternative to monetary socialism.

Free markets represent a natural organizing principle for humanity that converts the pursuit of individual self-interests into improvement of its collective interests (in Talebian lingo: anti-iatrogenics). This spontaneous order generated by free markets has persisted, to a greater or lesser extent, ever since mankind started trading. Free markets, as an organizing principle, are among the most important in the world as they transmute greed into higher productivity, lower prices, and a stream of new, innovative ideas. What excuse is there, then, to tolerate an unfree market for money? As you've said Ray, (p.281) "Remember that most people will pretend to operate in your interest while operating in their own." This is exactly what the private owners of central banks have been doing for over a century — operating in their own self-interest, under the aegis of government-enforced monopolies, at the expense of everyone else. In this sense, central banking could be the most successful con artistry at scale ever perpetrated.

In nature, energy expenditure is required prior to eating. Plants harvest sunlight into sugar, herbivores spend much of their lives standing and eating plants, and carnivores push themselves to full exertion episodically to hunt. As the 1st Law of Thermodynamics teaches, there is no free lunch in this universe. If there appears to be, you can be sure that hidden risks are accumulating as nature inevitably optimizes for the whole and will eventually restore balance — suddenly and violently if a state of sufficient disequilibrium is reached. Central banks, via the printing press, have spent over a century enjoying a perpetual "free lunch" where control over assets is continuously reallocated from the many to the few; Bitcoin is a (relatively) sudden monetary phenomenon and an economically violent force against banking cartels that is restoring equilibrium to the global economic order.

Bitcoin mining, although often demonized for being tremendously wasteful, may actually have a profoundly positive impact on the world environment. Although this has not been conclusively proven yet, there is research which supports this claim and deductive reasoning suggests it to be true. Consider the following excerpts from a report on this matter:

"Because bitcoin mining is highly mobile compared to overall power demand, it might actually be a boon for global stranded renewables...Whereas traditional industrial and residential power demand is largely geographically captive — be it by proximity to cities, resources, transport links or whatever other factors determine the location of such entities — bitcoin mining can be undertaken pretty much anywhere...This means that some of our most promising sources of renewable energy remain untapped due to their remote locations...Bitcoin mining is a relentless race to the lowest electricity costs and therefore — as explored by Dan Held and Nic Carter — acts as an electricity buyer of last resort...In this manner, bitcoin mining — which offers the possibility of immediate electricity monetization independent of grid connection — can play a vital part in the renewables development cycle."

What is an energy buyer of last resort? Nic Carter gives us a useful visualization:

Nic Carter is really smart.

> *"The Bitcoin network is a global energy net that liberates stranded assets and makes new ones viable. Imagine a 3D topographic map of the world with cheap energy hotspots being lower and expensive energy being higher. I imagine Bitcoin mining being akin to a glass of water poured over the surface, settling in the nooks and crannies, and smoothing it out."*

In this sense, Bitcoin mining is as natural as the free market processes of which it is composed. Instead of boiling the oceans, Bitcoin mining may actually help us to clean them up. Ray, as a thalassophile, I am sure this prospect must excite you, maybe you just haven't looked deeply enough at the nature of this new money to understand its potential environmental impact yet? After all, Bitcoin mining is among the most efficient uses of energy in the world, and increasing mankind's collective energy efficiency (aka productivity) is the entire purpose of the world economy in the first place:

	Annual Cost ($USD)	Energy Consumption (GJ)	$USD per GJ
Gold Mining	$ 105,000,000,000	475,000,000	$ 221
Gold Recycling	$ 40,000,000,000	25,000,000	$ 1,600
Government Fiat Money Production	$ 28,000,000,000	39,000,000	$ 718
Banking System	$ 1,870,000,000,000	2,340,000,000	$ 799
Governments	$ 27,600,000,000,000	5,861,000,000	$ 4,709
Bitcoin Mining	$ 4,500,000,000	183,000,000	$ 25

Life is all about energy efficiency; it's why we tinker, trade, and enjoy laying down.

In a profound sense, as Friar Hass says, Bitcoin is nature; a new form of life — a digital organism. Ralph Merkle, famous cryptographer and inventor of the Merkle tree data structure, has a remarkable way of describing Bitcoin:

"Bitcoin is the first example of a new form of life. It lives and breathes on the internet. It lives because it can pay people to keep it alive. It lives because it performs a useful service that people will pay it to perform. It lives because anyone, anywhere, can run a copy of its code. It lives because all the running copies are constantly talking to each other. It lives because if any one copy is corrupted it is discarded, quickly and without any fuss or muss. It lives because it is radically transparent: anyone can see its code and see exactly what it does.

It can't be changed. It can't be argued with. It can't be tampered with. It can't be corrupted. It can't be stopped. It can't even be interrupted.

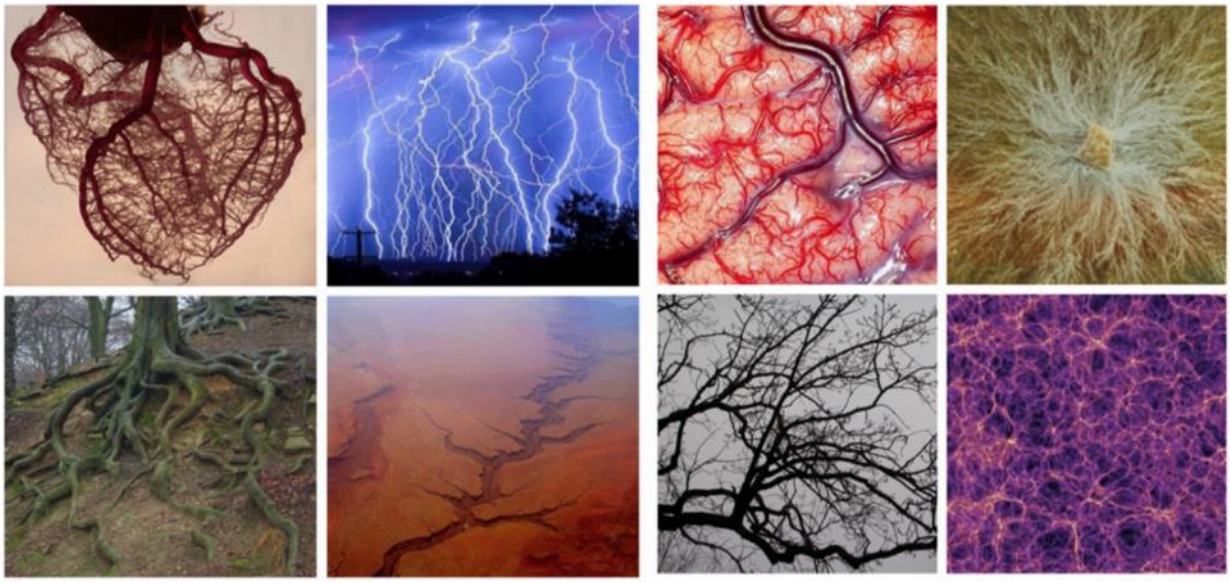
If nuclear war destroyed half of our planet, it would continue to live, uncorrupted. It would continue to offer its services. It would continue to pay people to keep it alive.

The only way to shut it down is to kill every server that hosts it. Which is hard, because a lot of servers host it, in a lot of countries, and a lot of people want to use it.

Realistically, the only way to kill it is to make the service it offers so useless and obsolete that no one wants to use it. So obsolete that no one wants to pay for it, no one wants to host it. Then it will have no money to pay anyone. Then it will starve to death.

But as long as there are people who want to use it, it's very hard to kill, or corrupt, or stop, or interrupt."

Bitcoin is a technology, like the hammer or the wheel, that survives for the same reason any other technology survives: it provides benefits to those who use it. It can be understood as a spontaneously emergent protocol that serves as a new form of uninflatable money and an unstoppable payments channel. Structurally, the Bitcoin network reflects a quintessential manifestation commonly found in nature — the decentralized network archetype:



Clockwise from the top left: the human heart, lightning, the human brain, a fungal mycelium network, roots from a tree, an aerial view of the Grand Canyon, branches from a tree, and a cosmic web of galactic superclusters in the deep universe (the largest observable structure known at over 1 billion lightyears across).

The decentralized network archetype found in nature is the antecedent to paradigm shifting innovations throughout history such as the railroad system, the telegraph, the telephone, the power distribution grid, the internet, social media and now Bitcoin.

Although fiat currency is commonly held as the "natural order of things" in modernity (a fallacious form of monetary uniformitarianism), it is precisely the opposite. As you've said Ray, (p.280) "to be great, one can't compromise the uncompromisable." What excuse was there to compromise the redeemability of dollars for natural money or to so heavily dilute the value of fiat currencies over time? These machinations were solely designed to enhance the expropriative abilities of bankers, bureaucrats, and politicians throughout history; letting them effectively default on their debts and pass on the real costs to citizenries. Far from being a natural form of money, fiat currency became dominant in the world at the end of a long chain of causality — a chain rooted in a flawed system that incentivizes people to operate with smaller time horizons and a zero-sum mentality.

Chains of Cause and Effect

(p.127) "I believe that everything that happens comes about because of cause-effect relationships that repeat and evolve over time."

Different institutional structures and incentive systems produce different human behaviors. Fiat currency is the most recent, and most extreme, act of money supply manipulation — a practice engaged in by all those who gained the ability to do so throughout history. Interestingly, it was a drawback of monetary metals, the difficulty of assaying their value and authenticity, which gave rise to coinage. The "public stamp" emblazed on the face of coins (usually with a smug emperor's face) served as the veracity that entrepreneurs of old relied upon, thus converting the need to verify (or assay) money used in each transaction into the need to trust a state-stamped corroboration of monetary value. Almost every time coinage arose, it was not long before rulers engaged in the act of "coin clipping" in which they would periodically gather the coins from the citizenry, melt them down and mint them into newer versions with the same face value but less precious metal content, keeping the residual content to enrich themselves. People, of course, were outraged, as the expression of their preference for hard money was stifled; but this is an unsurprising effect of central planning.

When it comes to economic systems, free markets make customer preferences irrefutable; central planning causes them to become irrelevant.

Similar to modern day inflation, coin clipping was a way of surreptitiously taxing the population by debasing its currency. Nero, the infamous emperor of the Roman Republic, was the first to engage in this deceptive practice. In doing so, he set a malicious precedent that would be emulated by many successive emperors (and later, central bankers) across many different eras and empires. Each time the value-storage integrity of money was compromised by coin clipping or supply inflation, it was only a matter of time before the society which it bound together started to unravel. Centralizing control over a money supply always has, and always will, lead to expanded wealth disparity as those few (rulers, politicians, central bankers) who can extract value from the many (citizens) have always given in to this temptation. Eventually, this parasitism leads to social unrest and, ultimately, revolt.

Interestingly, as the problem of assaying monetary metals shifted the monetary trust function unto the state-backed coinage, this gave demagogues the means to violate the trust placed in their "public stamps" to enrich themselves. Had a monetary technology existed historically that was sufficiently counterfeit and confiscation resistant (like Bitcoin), government may have never grown to become such a significant institution in human affairs. Hard to believe perhaps, but true. Lack of trustworthy money caused the state to flourish; over time, the invention of perfectly credible money may, as a side effect, render the nation-state model anachronistic.

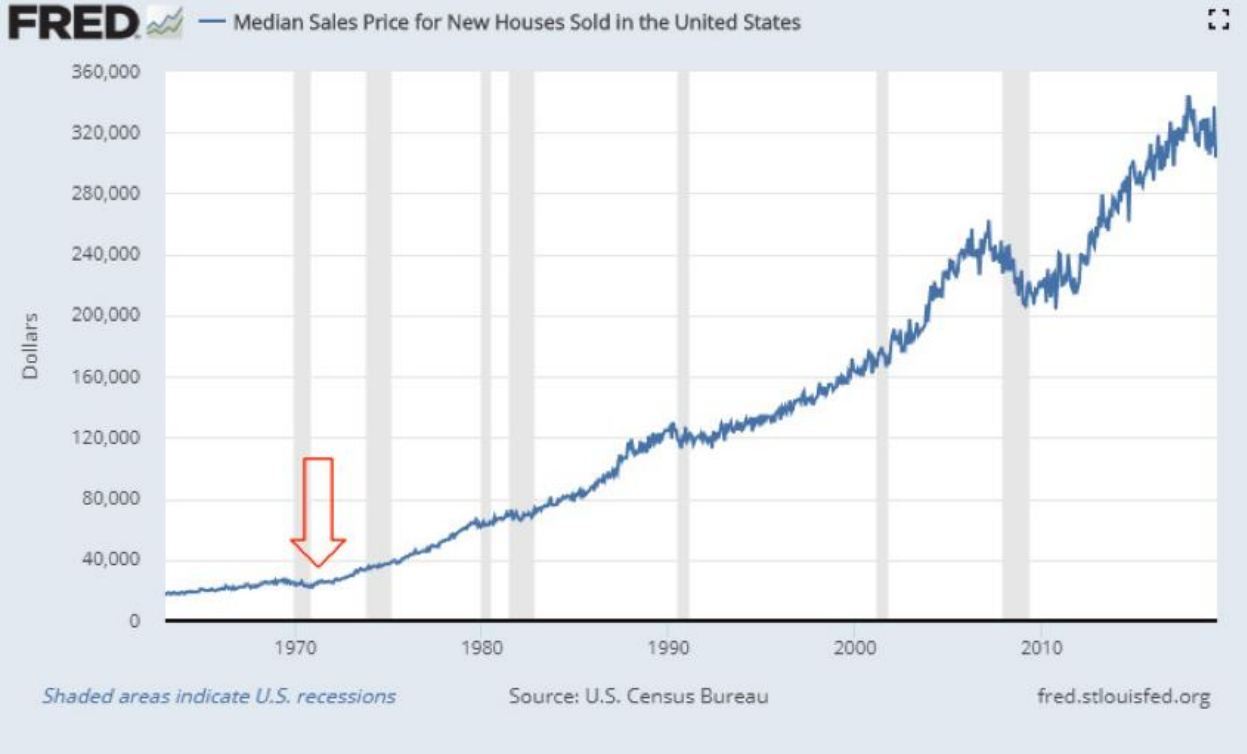
Money is the mechanism through which people market-price and exchange their time; it is the trust fabric through which people weigh opportunity costs and decide where to invest their finite energies and capital. When this cooperative mechanism is manipulated by rulers, the societies which run on the softening money begin to disintegrate as trust in the currency deteriorates, thus inhibiting trade and reversing the division of labor. This causes prices to rise and economic crisis to take hold. Unproperly channeled into a centrally planned economic system instead of a free market, greed becomes inherently self-annihilating.

Greed destroys fiat currencies, but greed secures the Bitcoin network.

Instead of learning these lessons of history, central banks pushed this monetary parasitism to unprecedented extremes. According to you Ray, "From 1950 until 1980, debt, inflation, and growth

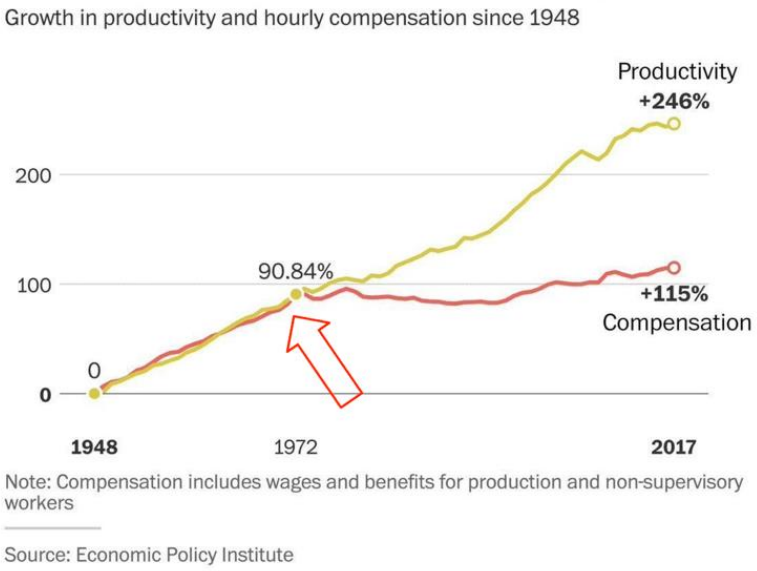
moved up and down together in steadily larger waves, with each bigger than the one before, especially after the dollar's link to gold was broken in 1971." The unitary motion of these economic forces was no coincidence. By breaking the peg to gold in 1971, Nixon set the world on an irreversible course that would be marked by successively larger recessions and (attempted) compensatory rounds of quantitative easing. This death-stroke to the gold standard moved the world into uncharted monetary territory, and became the cause of myriad economic and social problems. Here, we will highlight a few of them (for more on this, check out www.wtfhappenedin1971.com)

With the store of value functionality of money broken, people began using their homes as savings vehicles, which inflated a housing bubble that bursts in 2008 with disastrous consequences:

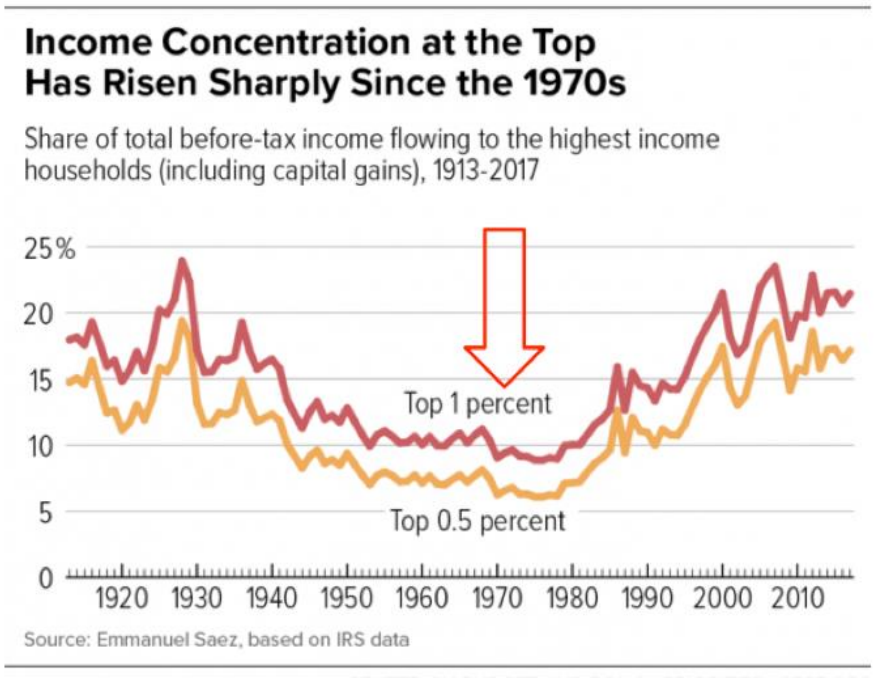


The above housing bubble tells another tale of fiat disease: when people use residential real estate as a store of value, whether it's their residence or not, they needlessly drive up the price of shelter, a basic human need. In this way, central banking generates homelessness.

By breaking money's anchor to reality, control over productive assets was steadily shifted into fewer hands with each economic recession and round of money printing (via the Cantillon effect). This caused an unprecedented decoupling of productivity and wage growth:



This divergence between productivity and compensation meant that more value was being captured by the most wealthy at the expense of the poorest:



Such distortions and wealth redistributions are the inescapable effects of monetary central planning. By manipulating the price of money (the interest rate) central banks spur over-borrowing, capital misallocation, and market distortions. By holding the interest rate below its naturally determined value (at the intersection of the supply and demand curves for loanable funds), central banks interrupt the natural chains of cause and effect which maintain dynamic market equilibria. This, in turn, causes market price movements to become more a function of monetary policy than of actual supply and demand curves. Ray observed this firsthand: “In 1978–80 (as in 1970–1971 and in 1974–75) different markets began to

move in unison because they were more influenced by swings in money and credit growth than by changes in their individual supply-demand balances." This causality still holds and becomes abundantly clear when seen from the right perspective:

A correlation as spurious as umbrella ownership in Seattle.

These market distortions would not exist in a world with a free market for money. Free markets are ruthlessly efficient and trimming excesses and encouraging optimal allocation of resources; which is why they are so ruthlessly effective at promulgating hard money, because people will naturally select the most liquid asset that best holds its value across time as money first and foremost. Hard money eliminates market distortions because its supply remains rooted in economic reality and beyond the reach of self-interested central planners. Simply, by transitioning to a free market money like Bitcoin, we can eliminate the prime driver of wealth disparity — money supply inflation.

To better understand the root cause of wealth disparity, we use an approach advocated by you Ray: as you've said, (p.489) "Root causes are described in adjectives, not verbs, so keep asking 'why' to get at them." Let's begin our analysis:

Root cause discovery process:

A primary cause of social unrest and societal disintegration is wealth disparity. Alarmingly, this has been on the rise in advanced economies all over the world.

Why is wealth disparity growing?

Disparity in wealth holdings is rooted deep in the monarchical history of mankind. Although some economic inequality is natural, as people are born with unequal skills and predispositions, the (growing) levels seen in modernity are anomalous. Today, few people own most of the productive assets. Under a

system of monetary central planning, these few have privileged access to newly printed fiat currency, which represents a redistribution of productive assets to those who receive the newly printed money first at the expense of those who receive it later (via the Cantillon effect).

Why do few people have privileged access to newly printed money?

Those with the most control over productive assets have leveraged their position to monopolize the market for money. These positions are reinforced via the lobbying mechanism, a system of institutionalized bribery, that heavily influences public policy in favor of its financiers' private interests. Once a monopoly position is firmly established, they employ monetary policy as a means for implicitly taxing entire populations to further enrich themselves (again, via the Cantillon effect).

Why is there a legal monopoly on money?

Again, the few who own the most productive assets within a society are able to (heavily) influence the legal frameworks they operate under. Naturally, these few favor laws which benefit their interests. Primary among these interests is the ability to confiscate wealth via inflation. This privileged position is protected via the government monopoly on violence. Inflation allows early accessors of new liquidity to perpetually extract wealth from all the market participants coerced into using the fiat currency — those who resist face incarceration or violent retaliation.

Why is violence used to insulate the legal monopoly on money?

The root cause of violent coercion such as this is the fearfulness inherent to egoic human behavior. People naturally seek to secure themselves against the uncertainties inherent to the future. To this end money, a tool of pure optionality in the marketplace, is the ultimate hedge against the future. Using the government monopoly on violence, private interests gradually were able to monopolize the market for money, thus obstructing its natural course. Simply, central banks have acquired absolute power, which as we all know, corrupts absolutely. Fiat currency is the ultimate expression of unfree market dynamics.

Per this root cause analysis: the "why" of a growing wealth disparity is causally rooted in the adjective "unfree". The root cause of a growing wealth disparity, then, is an unfree market for money. Fiat currency is a tool for restricting freedom and confiscating wealth. Bitcoin, like its predecessor gold, is a purely free market money — a tool for maximizing freedom and preserving wealth.

Monetary inflation, a property unique to centrally planned money, is purely a means of wealth confiscation — it does not offer a single equitable benefit to the people. Not one. The virtually limitless power control over the fiat currency printing press affords is the very cause for its existence and monopolization; it is both the means and the ends of monetary socialism. Fiat currency is a governmental tool for taxing, controlling, and manipulating people. As Thomas Jefferson once warned:

"If the American people ever allow private banks to control the issue of their currency, first by inflation, then by deflation, the banks and corporations that will grow up around them will deprive the people of all property until their children wake up homeless on the continent their Fathers conquered…. I believe that banking institutions are more dangerous

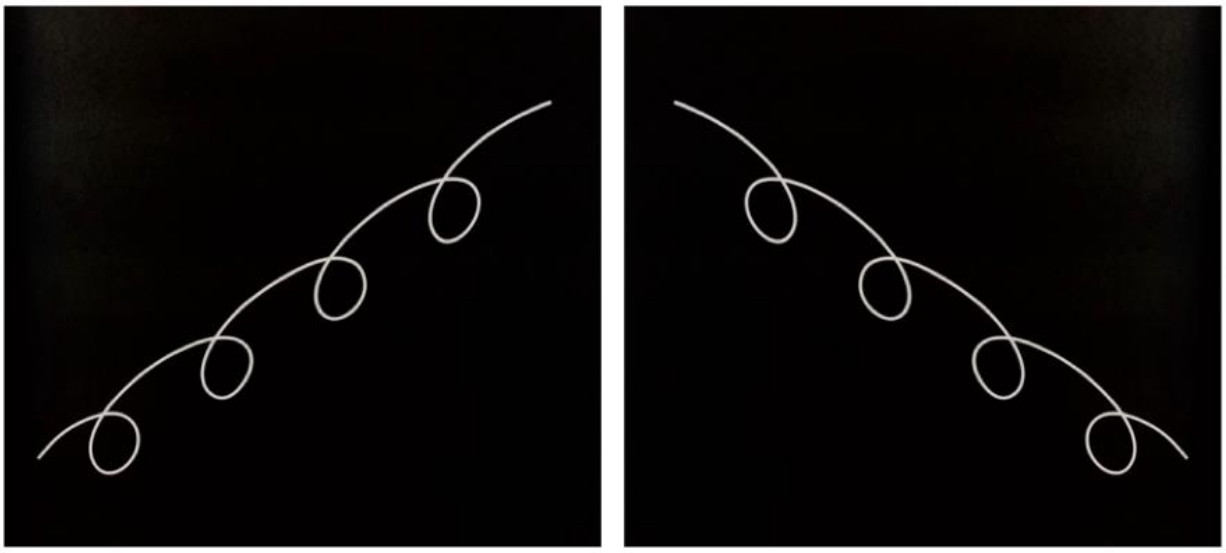
to our liberties than standing armies…. The issuing power should be taken from the banks and restored to the people, to whom it properly belongs."

By attempting to centrally plan money, mankind marginalizes his own potential. Although Bitcoin has demonstrated its disregard for the legal restrictions which insulate fiat currencies, it's impossible to know what monetary technology the market would naturally select absent government interventionism. Monopolization increases costs and stifles innovation, the exact opposite of the effects generated by free markets. Devolution is the inevitable and disastrous effect of monopolization, whereas free markets cause the reverse — evolution.

Evolution

(p.142) "Evolution is the single greatest force in the universe; it is the only thing that is permanent and it drives everything."

Change is the only thing that never changes. And when something is finished changing, it is finished. As such, all things exist in either a state of evolution or devolution:



For better or worse, change never changes.

Whether improving or declining, all things exist in flux. As you've said Ray, (p.142) "As I thought about evolution, I realized that it exists in other forms than life and is carried out through other transmission mechanism than DNA. Technologies, languages, and everything else evolves." Money, like a spoken language, is an informational protocol. Unlike language, money has evolved to inhabit many different forms. Seashells, salt, cattle, beads, stones, precious metals and government paper have all functioned as money at one or more points in history. Even today, forms of money still spontaneously emerge with things like prepaid mobile phone minutes in Africa or cigarettes in prisons being used as localized currencies. Different monetary technologies are in constant competition, like animals competing within an ecosystem. Although instead of competing for food and mates like animals, monetary goods compete for the belief and trust of people.

Historically, the hardest monetary technology to produce which exhibits otherwise comparable monetary traits (durability, divisibility, portability, recognizability) outcompetes more easily produced forms to become dominant on the free market — an asset that succeeds in this way is called hard money; a technology that is discovered through market-driven natural selection.

As we have learned, the rise of fiat currency was the result of governments coopting gold — which had risen to global dominance on the free market because of its superior scarcity relative to other monetary metals, which themselves exhibited superior monetary characteristics compared to other monetary technologies (like seashells, salt, cattle, etc.). By issuing paper money redeemable in gold, governments were able to resolve its one drawback — suboptimal divisibility. However, governments eventually eliminated redeemability of paper money for gold, thus ushering in the age of fiat currency. Lack of scarcity would have resulted in the extinction of fiat currency long ago if it weren't for the anticompetitive efforts of governments in the gold markets (if you haven't yet, check out Gata.org). In this sense, gold is the last freely chosen money in the marketplace and fiat currency is but an apparition of this multi-millennia-old monetary metal; a deception that has been haunting human progress since its inception in 1971. As Taleb describes it:

"...institutions block evolution with bailouts and statism. Note that, in the long term, social and economic evolution nastily takes place by surprises, discontinuities, and jumps."

In free markets, competition generates the information that vitalizes innovation — the man-made type of evolution. Completely isolated from the discipline of the market by legal monopoly, central bank issued fiat currencies have softened tremendously, in both value and functionality. This is unsurprising: any complex system — whether it be a technology, an economy, or an organism — that is isolated from the shaping of competitive forces will naturally devolve over time. As you've observed Ray, (p. 147) "One of the great marvels of nature is how the whole system, which is full of individual organisms acting in their own self-interest and without understanding of guiding what's going on, can create a beautifully operating and evolving whole. While I'm not an expert at this, it seems that it's because evolution has produced a) incentives and interactions that lead to individuals pursuing their own interest and resulting in the advancement of the whole, b) the natural selection process, and c) rapid experimentation and adaptation." This marvelous dynamic is at the heart of free market competition, open-source adaptation, and Bitcoin which, as we have seen, is both a free market in and unto itself and an open-source instance of digital hard money.

Bitcoin is an evolutionary leap forward for money: it combines the divisibility, durability, portability, and recognizability of pure information with the absolute scarcity of time to form the most impeccable monetary technology the world has ever known.

As you've said in regards to evolution, (p. 124) "I realized that passing on knowledge is like passing on DNA — it is more important than the individual, because it lives way beyond the individual's life." Ray, isn't it time for humanity to transition to a form of money that exists beyond the schemes, machinations, and manipulations of those who are able to wrest control of its controlling mechanisms? By centering an evolved monetary social contract on an immutable ruleset, we can eliminate the incentives to fight over

gold or international reserve currency status and therefore enhance mankind's cooperative capacity, which in turn will accentuate the division of labor, enhance productivity, and increase aggregate wealth creation worldwide. It's time for money to be governed by rules instead of rulers, and Bitcoin gives us the opportunity to make this transition once and for all. Imagine how much human ingenuity could be freed up worldwide if we eliminated the need for monetary policymakers, the army of analysts who watch them under a microscope, and the heavily distorted price signals caused by soft money.

Each of us are nodes of information — biological machines expressing our genetics, experiences, and ideas — that are collectively best served by successfully minimizing impediments to expression like policies, hierarchies, and illegitimate institutions. As Noam Chomsky said:

"*Institutional structures are legitimate insofar as they enhance the opportunity to freely inquire and create, out of inner need; otherwise, they are not.*"

Modes of organization which favor merit-based competition and rely on natural selection to determine which ideas flourish help us flourish. This is the free market (and idea meritocratic) paradigm: unobstructed exchange is always superior to that which is centrally intermediated, regulated, or manipulated. Dissimilar to cognitive learning, evolution does not distinguish between the observer and the observed, enabling it to "learn at the edges" by absorbing the successes and failures of its constituents (cells, individuals, exchanges, or businesses) through a filter of natural selection and incorporating them into its own form (a body, society, market, or economy).

Global free markets, coordinated via truthful price signals, can be thought of as a human hive-mind constituted of innumerable interpersonal exchanges; an organic, bottom-up system in which resources, risks, and human time are priced and allocated according to the prevailing economic realities faced by society. This collective mind is the macrocosm of our individual mind microcosms, which have naturally evolved in a bottom-up way. Existing as illegitimate, closed-source economic fiefdoms, central bank money monopolies inhibit natural selection and diminish the evolutionary potential of our global collective mind.

https://twitter.com/Breedlove22/status/1155304556164571137?s=20

As you've observed Ray, (p.213) "This universal brain has evolved from the bottom up, meaning that its lower parts are evolutionarily the oldest and top parts are the newest." Why should we expect the amalgamation of human economic actions to evolve any differently? Free markets enable price and technology discovery from the bottom up, as they completely lack any centralized governing body. Hard money has always evolved on the free market and is the norm of human history; only over the past century has it been so explicitly coopted by a few at the expense of everyone else. Using a Darwinian analogy: what natural selection is to gold, artificial selection is to fiat currency. In the same way mankind created designer dogs from wolves, or Monsanto self-terminating seeds from naturally-occurring seeds, so did he create fiat currency from gold. Bitcoin, as an unstoppable free market money being naturally selected for favorably in the marketplace, may in this sense be considered the reemergence of hard money in the modern world; a natural reversion to the free market foundations of money through an evolved (and evolving) monetary technology.

As a hard money that is monetizing in real time, Bitcoin outcompetes other forms of money in market-driven natural selection, whereas fiat currencies exist exclusively due to monopoly-driven artificial selection. As Bitcoin transcends the artifices that preserve the monopolistic position of fiat currencies, it forces these monetary technologies to compete based on their own (inferior) merits, and promises to push them into extinction.

https://twitter.com/Breedlove22/status/1179117506696376320?s=20

One would be hard pressed to find a worse technology from both a functional and societal value-add standpoint. As you've said Ray, (p.272) "To be good, something must operate consistently with the laws of reality and contribute to the evolution of the whole; that is what is most rewarded." In this sense, fiat currencies are bad — really bad. Not only do they give politicians a lever by which to control people, they also erode societal cohesion as their primary function — the storage of value across time — is repeatedly compromised in favor of multifarious political agendas all over the world. As Taleb says:

"...it is downright irrational if one holds onto an old technology that is not naturalistic at all yet visibly harmful, or when the switch to a new technology... is obviously free of possible side effects that did not exist with the previous one. And resisting removal is downright incompetent and criminal (as I keep saying, the removal of something non-natural does not carry long-term side effects; it is typically iatrogenics free)."

Viewed on a grander scale, Bitcoin seems to be a natural evolutionary step towards freer society:

Gutenberg's Printing Press gave us decentralized analog knowledge (which separated Church and State)

Democracy gave us decentralized government

The internet gave us decentralized digital knowledge

Bitcoin gave us decentralized digital money (which may one day separate Money and State)

Indeed, it is amazing that a lone, anonymous programmer released an open-source protocol that is now a viable contender for the world reserve currency whereas Facebook, one of the most flush corporations in the world, has been unable to move forward with its currency project due to regulatory roadblocks. Digital technology reshapes reality, and decentralization enables us to create leaderless organizational structures based more so on rules than rulers. Bitcoin is the latest and greatest expression of this overarching trend away from centrality and towards a more natural ordering of things.

https://twitter.com/perbylund/status/1177589207491063812?s=21

Like you Ray, I consider myself a shaper who experiences "the gap between what is and what could be as both a tragedy and a source of unending motivation." I see a world shackled in financial slavery, with central bankers and their inner circles as the great parasites of wealth created by working people all over the world. Centrally planned money is straight out of the socialist playbook and, aside from a brief period in the late 19th century when the world was mostly on a gold standard, we have never seen a truly free market for money. An economy is like life itself; in life, we do not expect to understand events as they occur, at least with total causality and clarity in mind, but looking back on them we gain a better

understanding. Bitcoin is alive; while it is impossible to say where it is heading with certainty, it is monetizing and evolving in real time, and its proponents all have skin in the game.

Evolution can only happen if the risk of extinction is present. Only systems with skin in the game are capable of evolution; absent this, devolution becomes inevitable. Systems learn and evolve through the death of their components; the biological manifestation of this via negativa process is called apoptosis. Any institution that cannot glean lessons from its undying components loses touch with reality as it grows until nature ultimately overrules its energetic imbalance in a mighty swing of the universal pendulum — whether by way of renaissance or revolution.

Therefore, we evolve best by sharpening our organizing principles against the palpable feedback gathered from falsifiable entrepreneurial experiments conducted at the front lines of our understanding, where each failure edifies the economic ensemble as to what does not work so that its next individual efforts will be emboldened by the greater experience gained. In this way, we are better served by the free market, with its bricolage of tactile sensory inputs from its entrepreneur-led, optionality-rich explorations of economic realities instead of the unwavering unidirectionality of a centralized plan. The choice of the technology we use as money is best arrived at in an uninhibited marketplace in the same way other technologies are invented, shaped by competitive forces, and tinkered with over time; in accordance with the timeless principle behind both innovation and evolution.

Timelessness

(p.121) "With time and experience, I came to see each encounter as "another one of those" that I could approach more calmly and analytically, like a biologist might approach an encounter with a threatening creature in the jungle: first identifying its species and then, drawing on his prior knowledge about its expected behaviors, reacting appropriately."

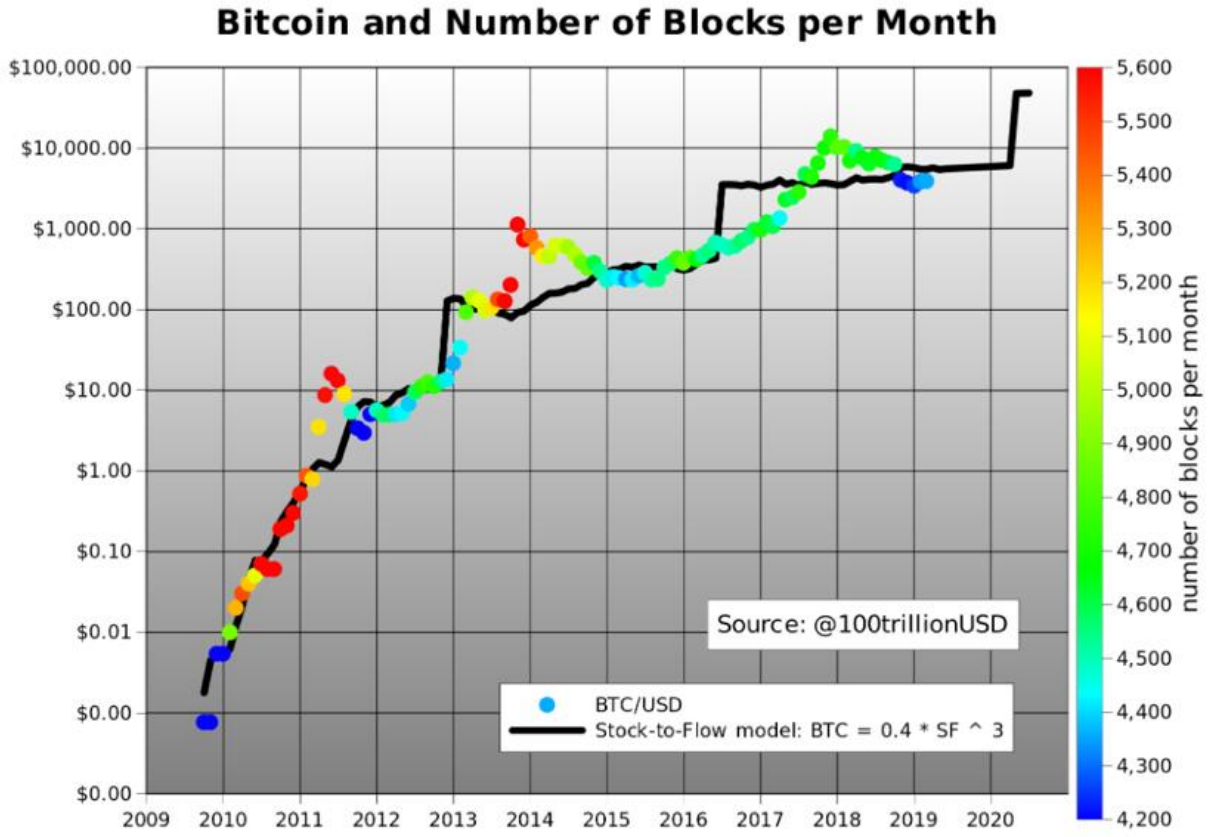
History doesn't repeat, but it does rhyme. Every moment and person are unique, but they tend to conform to some prior pattern or archetype. Personality types can be characterized and filtered by a variety of metrics including Meyers-Briggs and management tools like the Baseball Cards Bridgewater uses. Modern-day events are often foreshadowed by historical happenings. By thoughtfully studying these archetypal forms of characters and events, we are better equipped to deal with the uncertainties inherent to life and work. As the axiom says, "Those who do not learn history are doomed to repeat it."

Bitcoin is often called digital gold for a good reason; the best analogy for its emergence is the monetization of gold. Money is a market pricing and coordination mechanism for human time; it reflects the present value of the (liquid) time savings generated by subdivided labor and denominates prices. The relative inelasticity of gold's supply to other monetary metals is the reason it outcompeted them to become dominant in the free market before central banking commandeered it (seriously, check out Gata.org). Its ascent as money is based on timeless economic principles from the Austrian school. Despite the justifications for schemes like fiat currency in 1971 (revoking dollar redeemability for gold was said to be a "temporary" measure) and MMT today, the minds of prominent historical figures agreed universally that only monetary metals were actual money:

- JP Morgan said in his 1912 testimony to congress: "Money is gold, and nothing else."

- Thomas Jefferson is quoted as saying: "Paper is poverty, it is only the ghost of money, and not the money itself."

Even you Ray once said: "If you don't own gold, you know neither history nor economics." In the free market, fiat currency has never existed. Only through state intervention has money come under the monopoly control; the state had no more of a hand in the development of money than it did language. So, to understand the ascent of Bitcoin from a quantitative perspective, we must first understand how gold came to dominate the market for money. In his masterful work The Bitcoin Standard, Saifedean Ammous sheds light on how Bitcoin can be perceived as "another one of those" in the sense that it is following a similar monetization path as that followed by gold. In short, throughout history societies have naturally coalesced around the monetary technology exhibiting the highest "stock-to-flow" ratio. When we look at the stock-to-flow quantitative model put together by PlanB, we see that the Bitcoin price has an extremely high correlation to this key valuation metric:



Ignoring the lessons of history is a great strategy for being naturally selected out of the gene pool.

Said simply, the attribute of money that causes it to retain its value is its scarcity. As a former commodities trader Ray, I am sure you will understand the value of this model. In free market monetary competition, the scarcest money wins, as it is superior at protecting wealth across time. Bitcoin is on an inevitable path to become the highest stock-to-flow asset in human history, overtaking gold by a factor of two in the year 2024. Bitcoin's ever-constricting new supply flow as a percentage of existing stock is encouraging its adoption first as a store of value before it begins fulfilling the other functions of money

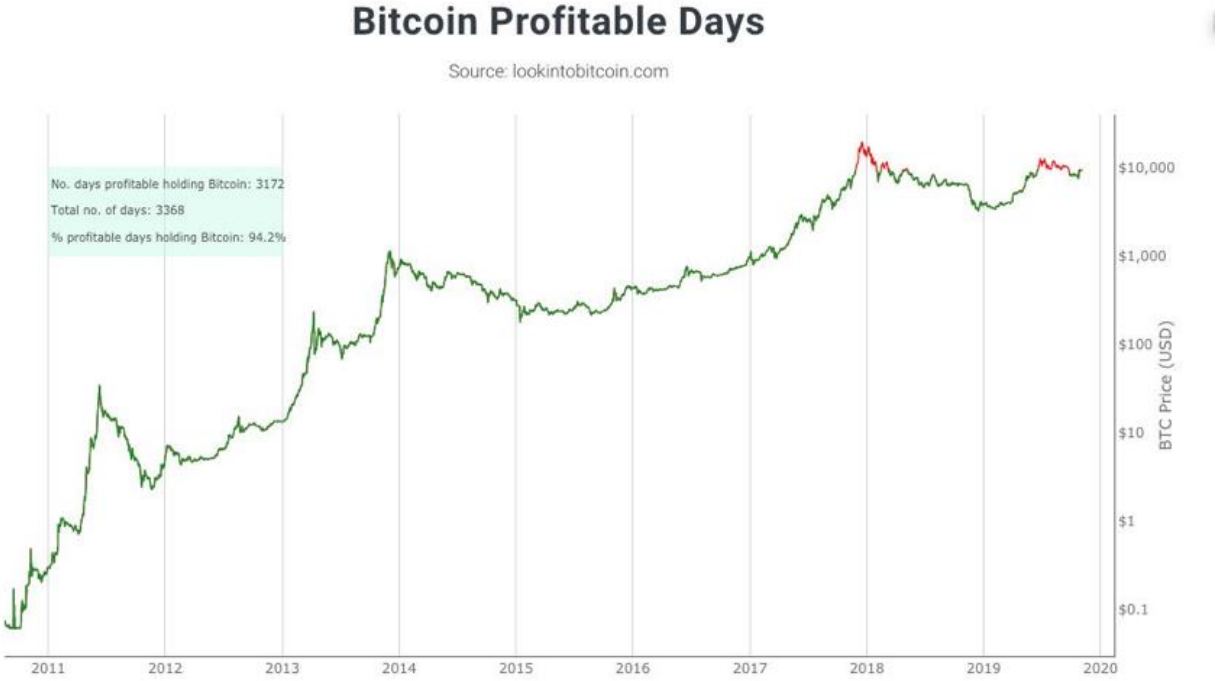
more adequately. This is consistent with the monetization path taken by gold — as the classical economist William Stanley Jevons remarked:

Historically speaking, gold seems to have served, firstly, as a commodity valuable for ornamental purposes; secondly, as stored wealth; thirdly, as a medium of exchange; and, lastly, as a measure of value.

So, in terms of monetization, Bitcoin is "another gold" following a similar evolutionary path — collectible, store of value, medium of exchange, and finally a unit of account. In an even deeper sense, Bitcoin can be considered "another one of those" as a part of the resurgence of ancient wisdom in the modern world. Yoga, meditation, Ayurvedic medicine, mindfulness, paleo diets, Ayahuasca, acupuncture — citizens of the digital age are rediscovering the deep roots of humanity. As the collective learnings of mankind are now accessible to everyone with an internet connection, this is likely a key driver of this worldwide phenomenon. Bitcoin, as a pure expression of Austrian economic thought, is yet another case of ancient wisdom's resurgence into modernity. By releasing the economic juggernaut that is Bitcoin into a world dominated by monopoly money, Satoshi put Keynesian economics and its "highly mathematized" theories (central bank circumlocutory propaganda) to the test and, thus far, has succeeded wildly in disproving their validity.

https://twitter.com/murraysuggests/status/1181515143240409089?s=21

Bitcoin is the best performing asset in human history, even when its sharp drawdowns are taken into account. It has offered the highest risk-adjusted rate of return of any asset class over the past decade (as quantified by the Sharpe ratio), and outperforms even further when only the negative volatility is taken into account (most of Bitcoin's price volatility has been positive). Indeed, it has been difficult to invest in Bitcoin unsuccessfully:



These are the days.

As you've said Ray, "the greatest success you can have as the person in charge is to orchestrate others to do things well without you." This is exactly what Bitcoin does for all current and future generations; it takes monetary policy out of the sphere of political influence and protects it with timeless, immutable, and mathematically-enforced rules beyond the machinations of mankind. These rules are fixed and fully transparent — resistance to confiscation, censorship, inflation, and counterfeiting — for all to see and rely upon across time. In this sense, Bitcoin is a timeless monetary system into which people can escape the walled-garden economies of a central bank dominated world; an man-made antidote to the poisoned society of man — as Henry Miller described it:

"Society had so complicated the relations between men, had so enmeshed the individual with laws and creeds, with totems and taboos, that man had become something unnatural, something apart from nature, a phenomenon which nature herself had created, but which she no longer controlled."

By providing a more sound substrate for economic planning and coordination, Bitcoin promises to reduce the toxic bureaucracies that have festered around the central banking model. Outfitted with a sound store of value, people will no longer be forced out further along the risk curve to protect their wealth, making real estate more affordable and unicorn companies more rare. As state revenues naturally decline as a result, government-sponsored "zombie" companies and monolithic "too big to fail" institutions will gradually slip into irrelevance. Finally able to protect their wealth from confiscation via inflation, people will be better equipped to capitalize their own businesses and pursue their dreams. And a world in which people are doing what they love is better for everyone. The majority of most people's lives is spent working to earn money, and Bitcoin stands to change the very nature of both work and money. In this sense, Bitcoin is bound to change mankind more than he will ever change Bitcoin.

Meaningful Work

(p.538) "We work with others to get three things: 1) Leverage to accomplish our chosen missions in bigger and better ways than we could alone 2) Quality relationships that together make for a great community 3) Money that allows us to buy what we need and want for ourselves and others... (p.216) man is perpetually suspended between the two extreme forces that create us: 'Individual selection which prompted sin and group selection which promoted virtue.'"

Since time immemorial, man has been driven to take both selfish and selfless actions. The principles which guide people's actions are a composite of family values, social experience, incentive structures, and natural predilection. Many of us inherit the political and religious leaning of our parents or family, which influence our value systems. However, our experience in the world also shapes (and continually reshapes) our values as well. These external influences are both, of course, undergirded by our natural inclinations and preferences. In short, we are all born unique, but are also products of our environments. Money, as the most interconnective social phenomenon in the world, is one of the most significant external forces shaping our thinking, planning, preferences, relationships, and actions. Think about it: how many times have you thought or talked about money in the past 24 hours? For most of us, many, many times. The nature of the money we use is a powerful determinant of whether we act viciously or virtuously.

In this respect, Bitcoin has an interesting impact on personal character. As Jimmy Song laid out (here, here, and here), Bitcoin (and hard money more generally) encourages people to develop virtues such as

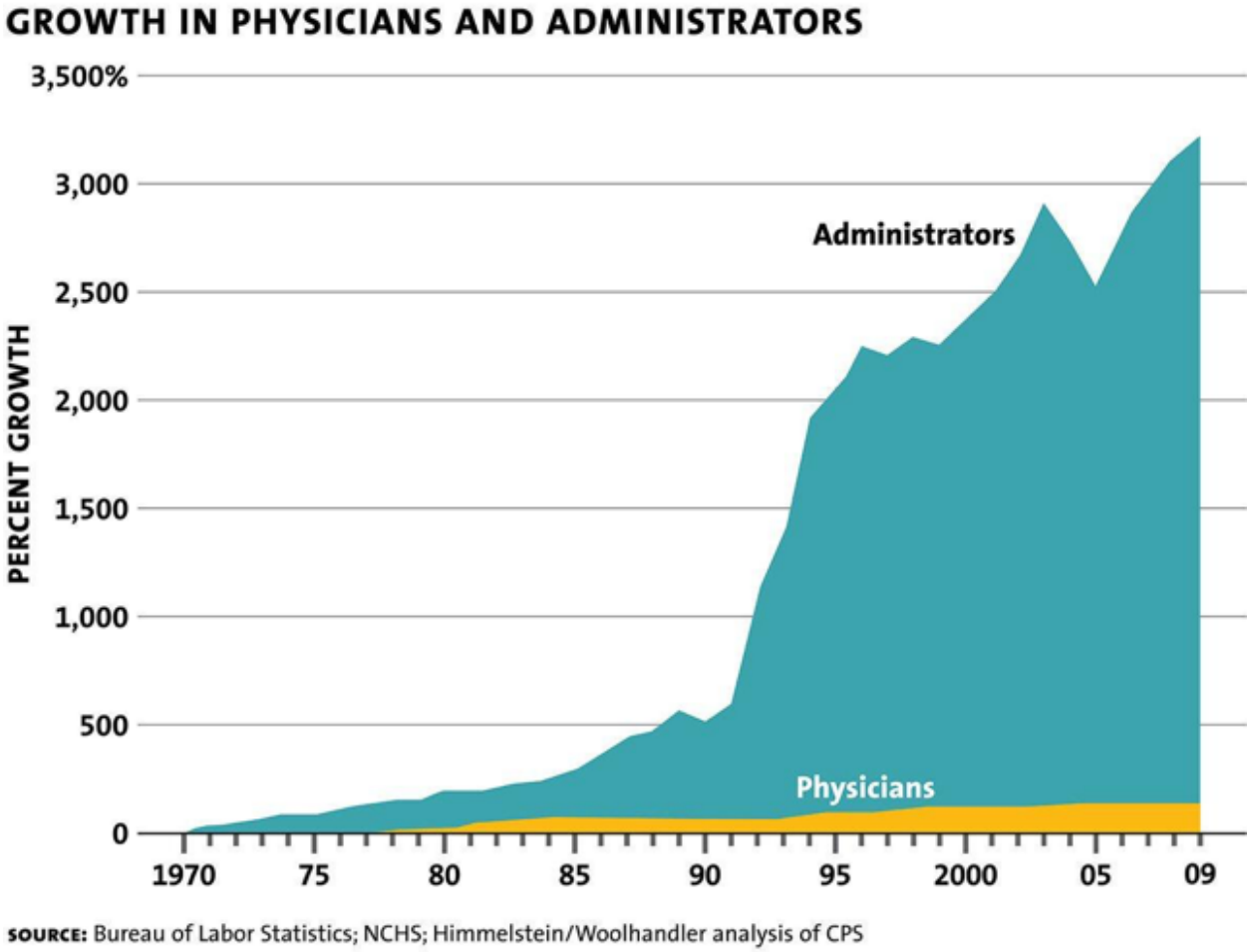
prudence, temperance, and justice. Since fiat currency suffers from perpetual dilutions of value, its users are incentivized to spend and borrow; in other words, to be less prudent with their money. Bitcoin is the reverse; its fixed supply and diminishing inflation rate ensures that it appreciates as global economic output grows and incentivizes people to save and invest. As more people adopt Bitcoin, their time preferences are shifted to become more future-oriented. In this way, Bitcoin encourages people to treat the future as something to be invested for instead of borrowed against.

Since its supply is unmanipulable, Bitcoin is gradually eroding the financial capability of governments to provide guarantees in the form of welfare or bailouts. It's easy to see how this softens temperance: if you knew your job were guaranteed no matter your performance, how hard would you try? Similarly, a long history of tax-payer funded bailouts for failed banks without skin in the game have encouraged them to take on steadily more risk, as any gains realized from their efforts accrue to their shareholders whereas any catastrophic losses that are incurred are paid for by taxpayers (against their will). This contradicts the tradition in ancient Catalonia, in which failed bankers were beheaded in front of their banks (talk about skin in the game). By providing a means of privatizing gains and socializing losses, governments cause the market to misprice risk and erode the value of temperance: the skill of rightsizing one's exposures in life on the risk and reward spectrum. With the risk of failure removed, beneficiaries of government guarantees no longer have skin in the game, and therefore take on risks intemperately. Repeated blow ups and taxpayer anger, as savings are eroded to bail out "too big to fail" institutions, fragilizes the delicate bonds that hold society together.

Justice is embodied in fair treatment; it encompasses integrity, honesty, and respect. When an action is taken that benefits one group disproportionally at the expense of another, we can say that it is unjust. Inflating money supplies is an unjust action, as it does not offer a single equitable benefit, and instead enriches the politically-favored few closest to the monetary spigot at the expense of the many farther away from it. Using inflation as a means of funding welfare and warfare, new government programs are continually implemented while old ones are kept functional despite their inefficiency or uselessness. As Milton Friedman once said, "Nothing is so permanent as a temporary government program". Again, government intervention severs skin in the game and decouples the intention of these programs from their results. The impact of this is a swelling class of government dependents, workers, and contractors that function inefficiently and only exist because of the government's ability to create new money. Interventionism of this kind distorts the information provided by market pricing and, therefore, makes fair dealings much more difficult. In a free market run on hard money, only industrious people who add value and deal fairly in an economy are rewarded. Paradoxically, as governments strive to ensure equality of outcomes, they incentivize unjust treatment. At the core of this rottenness is monetary inflation: a legally enforced injustice.

In an economy run on soft money, intermediary business models and professional roles designed to extract value from the money that originates at the center (the central bank) and flows outward into an economy (through successively lower tier banks and eventually to businesses and consumers) start popping up everywhere. These intermediary functions add little value to an economy yet capture a disproportionate share of the value of economic output; a dynamic commonly called "rent-seeking" that is unsurprisingly pervasive in industries that suffer from extensive government meddling like healthcare,

education, and banking. After the last vestiges of hard money were abandoned in 1971, rent-seeking has exploded; consider the case of healthcare:



Physicians are productive, administrators are extractive: the cartelization of healthcare is a fiat disease.

Meaningful work is being compromised by central banking. There has been a demographic shift from value-additive to value-subtractive positions — as evidenced by the training of more bankers than engineers, or the academic credentialing transition from medicine to finance. In a free market, compensation is reflective of a role's usefulness to society. But with monetary socialism, there are greater financial incentives to work closer to the spigot of fiat currency in roles that are mostly non-productive and extractive. Hayek summed this up nicely:

"*It is not merely that if we want people to give their best we must make it worthwhile for them. What is more important is that if we want to leave them the choice, if they are to be able to judge what they ought to do, they must be given some readily intelligible yardstick by which to measure the social importance of the different occupations. Even with the best will in the world it would be impossible for anyone intelligently to choose between various alternatives if the advantages they offered him stood in no relation to their usefulness to society.*"

One more thing: most rent-seeking jobs suck! How many accountants, bankers, or administrators do you know that "love" their job? Many of these jobs are a direct result of the lacking social scalability inherent to monetary socialism. The more we can globally standardize onto a hard money, the more productivity we generate collectively, the lower the cost of living becomes, and the less we have to work individually.

Money is just a means to an end: as you've said Ray, (p. 417) "Remember that the only purpose of money is to get you what you want, so think hard about what you value and put it above money." I think it's safe to say that most people want to live a fun and productive life full of fulfilling relationships. To this end, the type of money society runs on is of paramount importance. The utility, supply, and value of fiat currency cannot be trusted; since money is the trust network through which all of our commercial relationships are carried out, this lack of trust in the money infects the trust relationships amongst its users. Again, to get what we want, we need reliable protocols for commercial interaction like private property rights, rule of law, and manipulation-proof money. As central banks confiscate and redistribute wealth created by the work of others, they cut these cornerstones of capitalism and weaken the foundations of civilization.

Money and speech are media of expression; any inhibition or censorship of these societal building tools, which together are responsible for nearly all human coordination and communication, contradicts the most basic liberties (1st Amendment in the US) intrinsic to Western Civilization. There is zero justification for a system that suppresses verbal or financial expression. By organizing ourselves within a truly free market capitalist system that incentivizes basic morality (don't steal, don't kill), we can advance our civilization to new levels and dramatically improve the quality of human relations.

Meaningful Relationships

(p.216) "The rewards of working together to make the pie bigger are greater than the rewards of self-interest, not only in terms of how much pie one gets but also in the psychic rewards wired into our brains that make us happier and healthier."

The history of mankind has been marred by episodic violence — skirmishes between individuals, tribes, and, later, nation-states have been a consistent thread in the story of humanity. Like other animals, man seeks to maximize the odds his genes will be passed on to successive generations and will fight tooth and nail for his chance. Counterbalancing this self-seeking behavior are the benefits offered by a peaceful and cooperative society — the division of labor, rising standards of living, and more free time to spend as one sees fit. Between the 16th and 19th centuries, conflict-related deaths as a share of world population averaged less than 1%. In the 20th century, this figure more than quadrupled to over 4%:

Table 5.1 Conflicts steadily cost more in human lives

Period	Conflict-related deaths (millions)	World population, mid-century (millions)	Conflict-related deaths as share of world population (%)
Sixteenth century	1.6	493.3	0.32
Seventeenth century	6.1	579.1	1.05
Eighteenth century	7.0	757.4	0.92
Nineteenth century	19.4	1,172.9	1.65
Twentieth century	109.7	2,519.5	4.35

This is no coincidence. Inflating fiat currency supplies gives governments a much cheaper and more surreptitious way to finance military operations as opposed to direct taxation or selling of war-time bonds. As Ron Paul said:

"*It is no coincidence that the century of total war coincided with the century of central banking... If every American taxpayer had to submit an extra five or ten thousand dollars to the IRS this April to pay for the war, I'm quite certain it would end very quickly. The problem is that government finances war by borrowing and printing money, rather than presenting a bill directly in the form of higher taxes. When the costs are obscured, the question of whether any war is worth it becomes distorted.*"

As the enablers of inflation, this institutionalized system of time theft and financial subjugation, central banking is the mechanism through which government confiscates the resources necessary to fund its belligerent efforts. As Mises remarked in 1919:

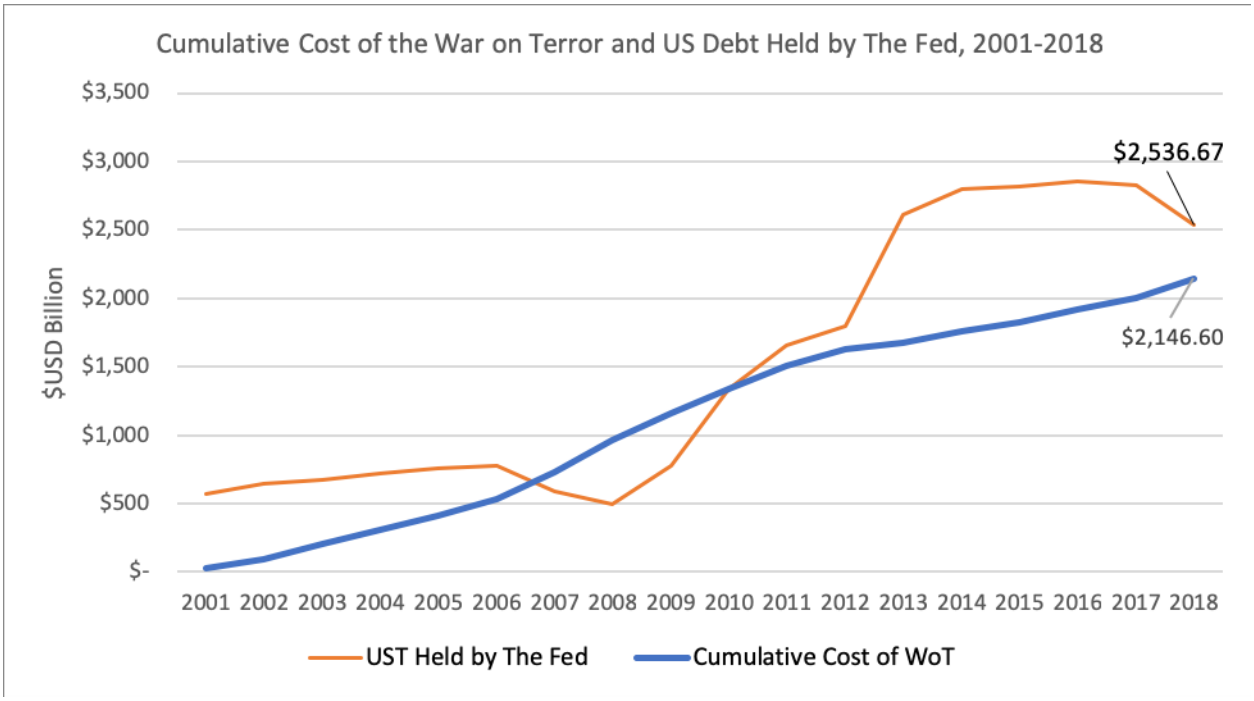
"One can say without exaggeration that inflation is an indispensable means of militarism. Without it, the repercussions of war on welfare become obvious much more quickly and penetratingly; war weariness would set in much earlier."

Before the fiat currency experiment, it was a common refrain among warring nations that "the gold standard must be abandoned". Clearly, it was in the best interest of these nations to severe the monetary anchor to time since debt-based money unlocked much more potential for borrowing against the future (via inflation) to finance current war efforts. Of the three ways governments can generate revenue — taxation, borrowing, and inflation — the latter is clearly more preferable for governments as its negative consequences are spread out over long periods of currency debasement and the shadowy, implicit tax imposed by inflation in the form of rising prices is less well understood by citizens (and rising asset prices helps paper over the perceived damage, although this is largely illusory).

Expansionary monetary policy was the key to financing the US military operations during the Vietnam War. Although the war-time economy seemed strong during the 1960s, US citizens would suffer economically in the echo of this economic intervention as the 1970s became mired in stagflation (low growth, high unemployment, and high inflation). Besides the death and destruction wrought during the war, there was economic devastation in the US and abroad. Between 1965 and 1984, the Dow index

suffered a drawdown of 80% from its peak value on an inflation-adjusted basis in the wake of this soft-money-fueled-military-spending-spree. Unfortunately, this pattern of warfare funded through inflation would persist well into the new millennium.

After its great successes with its War on Poverty and War on Drugs, early in the 21st century, the US would launch its "War on Terror". Over the course of the following 17 years, with the cumulative cost of the "war" (more accurately, an imperialistic military campaign) reaching over $2.1T in direct governmental expenses, we witnessed The Fed print money and purchase US government debt (US Treasuries or UST) almost exactly equal to the cost of the war:



Clearly, it is no exaggeration to say that the US central bank money machine and the US war machine are intimately connected. Central bank enabling of government war machines is a perpetual bane to humanity. Neither central banks nor military regimes are accountable to anything other than their own self-interests. In reckless pursuit of their own politicized ends, these institutions siphon away vast swathes of societal wealth to fund destructive military campaigns; this "twin demon" problem of wealth confiscation and capital destruction is the most anti-economic force in the world today. In the face of this diabolic menace, the world has but one hope: the separation of money and state.

As with all other critical commodities and industries, the free market is the best mechanism for allocating capital, promulgating innovation, and properly pricing risk. The singular purpose for the monopolization of the market for money by government is its unquenchable thirst for power; it imposes itself on citizens with hortatory messages from central banks and relies on the submissiveness of citizens. Fiat currency facilitates an exploitative relationship between governments and their citizens in which the former harvest the fruits of the latter's labor in exchange for "protection".

Wars do not protect the public, they tax it. Wars do not promote the public good, they destabilize it. Wars do not stimulate economies, they devastate them.

Throughout history, money has been both the means and ends of all war. People have always fought to control more resources or territory, and have wreaked havoc on each other in the process. Warfare is antithetical to meaningful relationships. If we want to build a world with more meaningful relationships, we must mitigate mankind's ability to wage war against himself. An unmanipulable, uninflatable, and confiscation-resistant free market monetary alternative like Bitcoin is a good start: it holds within it the promise of starving the state of the virtually unlimited resources the fiat currency printing press feeds into it. When people have a choice to opt out of the inflationary economic order, governments lose the ability to tax them (both explicitly and implicitly through inflation) which mitigates state revenue and its ability to wage war.

Warfare, its attendant loss of life, and the destruction of capital it causes are mitigatable outcomes of money market monopolies. As with the other negative consequences of monopolization — like food shortages, unemployment, price signal distortion, and exacerbated business cycles — war can be curtailed by open and free markets, which create incentives for cooperation and long-term relationship building. As an unstoppably free market, Bitcoin is rendering irrelevant the artifices which preserve monetary monopolies and returning the market for money to its naturally free state. It accomplishes this by virtue of its intrinsic truthfulness and transparency which are, interestingly, two of the key ingredients to Ray's free market for ideas — the idea meritocracy. As you said Ray, "In my case, I wanted meaningful work and meaningful relationships, and I believed that being radically truthful and radically transparent were required to get those". A money that embodies these free market qualities is likely to influence its users to behave accordingly; this would create cultural effects diametrically opposed to those spawned by fiat currencies today. Simply, hard money like Bitcoin lowers societal time preferences; it encourages people to invest in themselves, seek meaningful work aligned with their skills, forge meaningful relationships, and to collaborate over longer time horizons. Critically, in a world run on Bitcoin, funding perpetual warfare via inflation would be a relic of mankind's barbaric past — making Bitcoin the ultimate boon to the meaningfulness of relationships. But to get there, we must face reality head on and deal with it as it is, which brings to the here and now.

Facing Reality

(p.138) "Man's most distinctive quality is our singular ability to look down on reality from a higher perspective and synthesize an understanding of it."

Since 2008, central banks across the world have injected an unprecedented flow of fiat currency liquidity into the economic system. Expectantly, this has furthered wealth disparity and sewn new seeds of systemic risks. Although we remain in a historically long economic bull run, these hidden risks appear to be rousing from their dormancy. No matter what form the next crisis takes, central banks have only three options to try and mitigate its consequences: 1) cutting entitlement benefits, 2) raising taxes, and 3) printing money. All three of these options will hit those living on fixed-income — retirees, pensioners, and the working poor — the hardest. Of the three, printing money is historically most favored by central bankers as it can be done (and is being done) with little political fuss or muss.

These systemic risks are compounded by negatively yielding government bonds, which most retirees, who typically have lower risk appetites because of their age, depend on for fixed-income in their twilight years. Since these many of these instruments now suffer from negative yields, this forces investors with low risk appetites, including retirees and pension funds, to keep their nest-eggs "at risk" in equities markets, lower quality bonds, or even riskier assets. This contradicts the standard American dream in which you spend your younger years earning and investing in higher risk assets, like equities, so that as you neared retirement you could gradually transition your exposure to lower risk investments that generate a relatively predictably, consistent return — like bonds. This approach gives you exposure to higher upside when you are young and reduces downside exposure as you age, so that your nest-egg doesn't get crushed in a stock market crash.

Bitcoin can help those living on fixed-income protect themselves from the accumulation of hidden risks created by the optionality-theft central banks impose on citizens. A small allocation of less than 5% gives those vulnerable to economic contractions a kind of insurance policy — a put option on the idiocy inherent to a politically-charged, debt-based monetary system. Once again we find the wisdom of Taleb, as this is an expression of the barbell strategy: an approach to investing and other aspects of life in which assumes a large exposure to a low-risk, low-reward element and small exposure to a high-risk, high-reward element. In fact, a portfolio with 95% cash and 5% Bitcoin outperformed the S&P500 on risk and return every year over the past 6 years:

https://twitter.com/100trillionUSD/status/1136969637588021250?ref_src=twsrc%5Etfw%7Ctwcamp%5Etweetembed%7Ctwterm%5E1136969637588021250&ref_url=https%3A%2F%2Fjameso.be%2F2019%2F08%2F24%2Fbitcoin-is-for-this.html

After decades of flooding the market with cheap money, central banks have distorted free market incentive systems and made economies dependent on this artificial liquidity to stay afloat. Even the indication of quantitative tightening sent markets tumbling in 2018, which was quickly reversed by The Fed's now infamous "dovish pivot" back to a more accommodative monetary policy. As this soft money is continually injected into the economy, it is flowing to hard assets so that investors can protect their wealth against the inevitable inflation quantitative easing creates, thus further distorting soft-money-denominated prices and setting the stage for new bubbles in markets like real estate and equities. At the core of this perpetual monetary easing is the (perhaps well-intentioned but certainly misguided) attempts of central banks to "create price stability" and "smooth out the business cycle" — which, intentionality aside, is equivalent to an arsonist racing to extinguish the fire he started. To state the argument again succinctly: printing money does not create stability of any kind, it distorts price signals and exacerbates the severity of economic cycles.

Further, it is printing of money that has created the deeply negative bond rates we are seeing in Europe. As the European central bank (ECB) keeps printing money, it must buy bonds to inject this cash into the economy, which drives up the price of bonds and depresses their yields. So, we get into this (familiar) fiat currency trap in which the attempts to keep the economy healthy by injecting artificial liquidity hurt the most vulnerable among us, those living on fixed-income, the most. Bitcoin fixes this: by taking monetary policy out of the hands of people, who are as incapable of "managing" a complex system like the economy as much as they are the weather, it eliminates the vector by which policymakers create these economic

distortions that they then try to fight off using the same policy tools that created the problems in the first place. Since Bitcoin's supply is absolutely scarce, whatever portion you own of the total supply, you can be 100% certain that you will always have at least that fraction; this is the crucial discovery of absolute scarcity that Bitcoin represents, a one-time event that can never be recreated.

Another way soft money is distorting markets is through "share buybacks", in which corporations take out cheap loans and use the proceeds to buy back their own shares. This action is an expression of the belief that the company's stock will outperform the cost of capital net of inflation over the loan term. Also, the agency problem rears its head again here, as the reduction of shares outstanding helps corporate executives hit their "earnings per share" targets on which their bonus packages are based. This "financialization" of the real economy is a product of the flawed incentives inherent to fiat currency. Unsurprisingly, in the wake of the past 10 years of reckless money printing, corporate share buybacks have become the dominant source of demand for equities:

Corporate buybacks are dominant source of equity demand

	Net US equity demand ($ billions)			
Category	2016	2017	2018	2019E
Corporations	**$ 697**	**$ 296**	**$ 509**	**$ 600**
Foreign Investors	(188)	125	(94)	25
Pension Funds	(217)	(162)	(243)	(100)
Mutual Funds	(112)	(134)	(124)	(175)
Households	(151)	226	191	50
Life Insurance	98	(45)	(18)	-
Other	(12)	(17)	9	-
less				
Foreign equities by US	22	167	128	350
Credit ETFs	96	123	100	50
Included among holders above are:				
Equity ETF purchases	$ 188	$ 347	$ 210	$ 300

A perverse configuration of dependencies arises as a result: low risk appetite investors have been driven out of "safe" investments like bonds because of their negative yields, thus pushing them further out along the risk curve into equities or worse. However, due to the soft money fueled share buybacks outlined above, the dominant source of demand for these equities are the corporations buying their own stock with artificially cheap money, making their share prices perversely dependent on the continued central bank provisioning of low interest rate loans. So now, in a twisted turn of fiat disease, entire retirement portfolios and pension funds have been forced into dependency on the continued accommodative monetary policy of central banks, which can only maintain their confiscation via inflation so long as the underlying society remains sufficiently productive and submissive to its authority.

Facing reality, we see that the fiat currency experiment is in the endgame now. It interest rates aren't held down or if central banks stop injecting liquidity in steadily larger doses, the economy will crash cataclysmically. Even if they do, it is only a matter of time before society begins to come unglued, as it always does when its trust fabric, money, is sufficiently debased. So, the time is now to accept our reality, learn the lessons of history, and plan for a better future. Although it's probably clear by now, fiat currency is not a viable monetary system. In any case, let's "look down on the reality" of different monetary systems to glean some comparative insight as to their fundamental nature and what would best suit us from an organizing principle perspective. In a sense, each particular kind of money represents a liquid equity stake in its respective monetary system. Let's compare:

Fiat Currency: Liquid equity in a central bank, a privately owned and operated monetary monopoly

- Only Class B Shares available, All Class A Shares owned by Central Bank Shareholders
- No voting rights
- Board observation rights limited to public central banker appearances
- Converts greed into monetary dilution, confiscation via inflation, and trade wars
- Liquid equity subject to unlimited dilution
- Liquid equity subject to deauthorization
- Liquid equity subject to censorship
- Liquid equity subject to confiscation
- Liquid equity has no claim on underlying assets of monetary network (gold)

Gold: Semi-liquid equity in the world's original, physical, and free market money

- Class A Shares = Physical Gold, Class B Shares = Gold Certificates
- No voting
- Governed by nature, no board to observe (only for Class A)
- Converts greed into monetary value and unforgeable costliness
- Liquid equity subject to unlimited dilution, although historically this is low and predictable
- Liquid equity immune to deauthorization (only for Class A)
- Liquid equity immune to censorship (only for Class A)
- Liquid equity subject to confiscation
- Liquid equity is the underlying asset (gold, only for Class A)

Bitcoin: Liquid equity in the world's only global, digital, final settlement monetary network

- Class A Shares = Private Key, Class B Shares = Bitcoin Exchange IOUs
- Pro-rata voting rights, option to fork network to new ruleset
- 100% transparent ruleset, no board to observe
- Converts greed into monetary value, unforgeable costliness, and network security
- Liquid equity immune to dilution
- Liquid equity immune to censorship (only for Class A)

- Liquid equity resistant to confiscation (only for Class A)

- Liquid equity is the underlying asset (Bitcoin, only for Class A)

Ultimately, none of our individual opinions matter about this; it is up to the free market to decide. Fortunately, Bitcoin exists as a free market alternative upon which society can stand and clean up the mess central banks and governments have created for the world. Only time will tell how this all plays out. Remember: the escalating stock-to-flow ratio of Bitcoin is relentless. At this point, it is fiduciarily irresponsible to ignore this asset completely, and the pain of having no exposure to it will likely only worsen with time.

https://twitter.com/Breedlove22/status/1155265716834062336?s=20

With that, let me briefly summarize my arguments before closing:

Distorted price signals are the "nerve damage" inevitably suffered by an economic order based on central banking. As is true with all industrial monopolies, the profits for few are subsidized at the expense of many. Bitcoin fixes this by disintermediating the market for money and restoring its natural supply and demand dynamics. As Ray says, "An idea meritocracy requires people to do three things: 1) Put their honest thoughts on the table for everyone to see, 2) Have thoughtful disagreements where there are quality back-and-forths in which people evolve their thinking to come up with the best collective answers possible, and 3) Abide by idea-meritocratic ways of getting past the remaining disagreements." These three requirements of the idea meritocracy, closely reflected in free markets, can be summarized as honesty, quality competition, and conflict-resolution. Bitcoin satisfies all three: it is completely transparent (honesty), secured by a free market for mining (quality competition), and governed by a community-determined ruleset that is algorithmically enforced (conflict-resolution protocol). Bitcoin embodies idea-meritocratic elements, and is one of the only sources of truth in modernity. As Einstein said: "The significant problems of our time cannot be solved by the same level of thinking that created them." In the same way that we needed the breakthrough of double-entry bookkeeping to catalyze capitalism, as it enabled us to synchronize our economic efforts further across spacetime, we now need the triple-entry accounting system intrinsic to Bitcoin to break the central bank monopoly and more greatly amplify the synchrony of mankind's economic efforts into futurity.

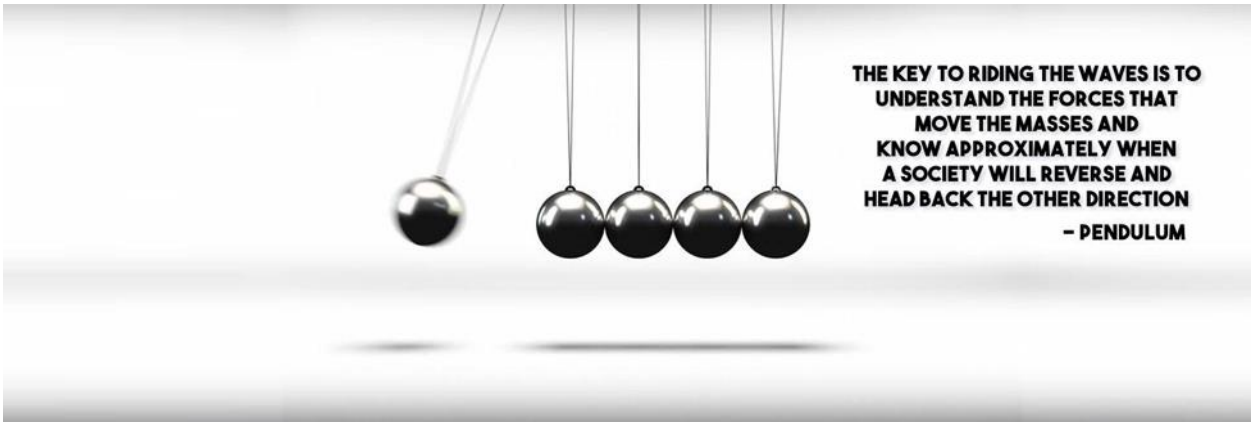
Bitcoin is an open-source protocol for exchanging value. Such openness ensures that Bitcoin's code cannot be manipulated to benefit anyone at the expense of anyone else. The rules governing Bitcoin are founded in the (absolutely) uncompromising laws of mathematics — nature's fundamental language. Bitcoin is the zero-marginal-cost-marketplace into which all available energy maybe sold; this means that every joule of energy which cannot find a more profitable employment flows into the "alchemization of digital gold" (the ultimate energy unemployment relief program, if you will). This realigns the race to the bottom associated with fiat currency, in which all monopolists are incentivized to devalue their currencies and secretly tax their people, to become a race to the bottom for the cheapest energy sources, thus spurring innovation in the realm of energy efficiency worldwide, forever. This perpetual bounty program for cheap energy becomes increasingly economically compelling as more monetary value accretes to Bitcoin, as more stranded joules become savable.

With central planning, any defectors from the single unitary plan become enemies of the state. This concentrates power in the hands of a progressively smaller few, which makes the intoxication of power more potent and attracts the most unscrupulous among us to seek its reigns. Bitcoin is the exit option, the plan B, for those enslaved by the prevailing monetary monopolies; it allows defectors a way out of the panopticon constructed by politicians and bankers by simply exercising their freedom of speech. It is a peaceful revolt against the institutionalized system of time-theft we call central banking. In the same way that Galileo's new perspectives on the heavenly bodies shattered the political influence of the church over time, Bitcoin obliterates political control over money because it is the one-time discovery of absolute scarcity — a quintessential property of time that lives beyond the reach of man-made legal frameworks.

The idea meritocracy is the depoliticization of decision-making; Bitcoin is the depoliticization of money.

Bitcoin is an idea meritocracy and unstoppable free market for money, it is naturally outcompeting all monopoly-insulated monies by transcending the laws which protect them and forcing them into the competitive sphere in which only their merits matter. Bitcoin is a free-market-chosen-hard-money emancipating the monopoly-warrened economic fiefdoms all over the world. Bitcoin is an idea meritocracy consisting of: radical truth (true consensus, immutable records, carrier of truthful price signals) + radical transparency (open-source, inflation-immune, transparent and reliable money supply) + believability weighted decision making (one hash equals one vote, skin in the game governance). In this way, it is a free market money that is subsuming all economies facilitated with fiat currencies (centrally planned monies) into itself. Bitcoin is unregulatable, unstoppable, perfectly transparent implementation of energy-based, absolutely scarce, hard money devouring all softer forms and infusing the value stored therein into itself, once and for all. Bitcoin is hard money bending monetary history back towards its free market point of origin.

In the grand arc of human history, Bitcoin represents a reversion to a free-market-chosen hard money system. Ray, Bitcoin is the paradigm shift you've seen coming; once again, nature's pendulum is changing directions:



As Alexander the Great once said:

"Through every generation of the human race there has been a constant war, a war with fear. Those who have the courage to conquer it are made free and those who are conquered by it are made to suffer until they have the courage to defeat it, or death takes them."

Courage can only exist in the face of fear. If you listen closely, you may hear the devil whispering "You can't withstand the storm." And if you listen closely to your heart, to the warrior within, you will hear him respond, "I am the storm."

The Coming Storm

In the 19th century essay by Georgi V. Plekhanov titled The Role of the Individual in History, a strong case is made for the inevitability of the path which charts itself as an expression of the unpredictably free action of people. As a process, human history expresses laws (principles) by which to orient its constituents. As an actualization, human history is made by those who set and solve the problems of progress in accordance with the conditions of their respective epoch, regardless of its laws. In this sense, a great man is great because "he possesses qualities which make him most capable of serving the great social needs of his time", and will carry out his sacred duties lawlessly whenever necessary.

Restoration of individual sovereignty is the chief aim of separating money and state. Free markets are idea meritocracies; minimized barriers to the interplay, recombination, and reproduction of knowledge are the defining characteristics of both. And knowledge growth is the key driver of innovation, evolution, and economic growth. Bitcoin is both a free market money and a free market in and unto itself, with entrepreneurs freely entering and exiting its mining network. Consistent with Ray's definition of an idea meritocracy, Bitcoin is radical truth and radical transparency in action, governed with skin in the game. As the central pillar of every economy, it is critical that the market for money remain free and unobstructed by monopolists, else we witness the continued cartelization of those industries closest to its economic influence. Bitcoin is free market money born out of societal necessity; the absolutely inelastic fabric of trust necessary to save mankind from his own self-destructive greed.

Paradoxically, it is only when people are free to act on their own accord that they become conscious of economic necessity by virtue of having their own skin in the game. Those who are coerced by regulations or insulated from the consequences of their actions by government monopolies, guarantees, or other obstructions suffer from a disconnect with reality and atrophy over time. In this sense, freedom is the conscious awareness of necessity; acceptance of the opportunity costs to be incurred in action, awareness of the obstructions to be overcome, and understanding of natural laws. Value is the bridge between the conscious awareness of life's necessities and the freedom to choose; it is expressed in price: the intersection of (objective) supply with (intersubjective) demand. Without an objective touchstone for the value of things (hard money), market signals are distorted and capital allocations are manipulated, causing societies to trend towards centralized power concentrations (bigger government), nationalization of assets (less free enterprise), and marginalization of citizenries (inflation, taxation, and conscription). Entrepreneurs are elemental to free markets and antithetical to state control. Leaving each person free to pursue profits by whatever (nonviolent) means necessary ensures that markets generate the lowest prices, highest satisfactions of wants, and continuous streams of innovations for all to enjoy.

Freedom allows people to self-actualize the actions they themselves deem necessary as they face the inherent scarcities of existence. Freedom, in a profound sense, is necessity transformed into action. A profound definition like this is fractal, in that it does not refute its superficial form, but is instead inclusive of it. Once an individual overcomes the restrictions imposed both within and without himself, he is born again; his "free actions become the conscious and free expression of necessity." By transcending the government coercion of money production, Bitcoin facilitates a reversion to man's natural, sovereign state of being; an existence with more freedom of expression and less oppression. By incinerating the opacity of central banking with the light of pure transparency, drowning the lies inherent to fiat currency in a ceaseless flow of indisputable truth (a new block roughly every 10 minutes), and like the free people whose sovereignty it is reinvigorating, Bitcoin is swelling into a great social force that is:

"Bursting on cunning falsehood

Like a storm of wrath divine…"

Bitcoin is the first social institution in history with the potential to subvert the greatest man-made scourge humanity has ever faced — the infamous wealth-extracting, disparity-driving, and warfare-financing duopoly of monopolists: governments and central banks.

Thank you for reading "An Open Letter to Ray Dalio re: Bitcoin"

Follow me on Twitter: Robert Breedlove

My sincerest gratitude to these amazing minds:

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And anyone else I forgot :)

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Bitcoin and the Tyranny of Time Scarcity

By Robert Breedlove

Posted December 19, 2019

The tyranny of time scarcity is ubiquitous in life; here we will explore how mankind cooperates to resist this immortal tyrant using one of our most ancient social technologies, money, and why Bitcoin is bound to achieve global monetary dominance.

A Tyrant of Time Immemorial

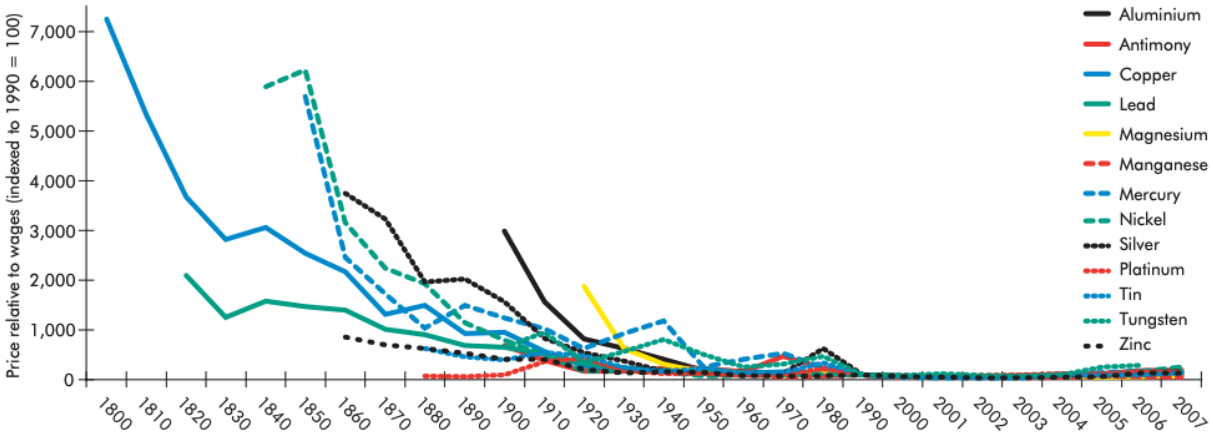
All human action inescapably occurs within the bounds of time. As the universally shared element of experience, time is the grand paradox of nature; it heals all wounds, yet ultimately ravages all things. Each of us feels a current of time that is totally impersonal; in a ruthlessly egalitarian manner, time flows equally for rich and poor, sick and healthy, young and old alike. The temporal flows we experience cannot be reproduced, reversed, or stopped. At an intrapersonal level, our allotment of time is as scarce as our lifespan is limited. Interpersonally, time scarcity manifests as the total time we can collectively allocate towards serving one another; whether we are making goods, providing services, or gaining knowledge — we have but a finite quantity of hours to commit towards our efforts. In this sense, time scarcity is the immortal tyrant subjugating all of us mortals. Only through cooperative action can we break free of the restraints time scarcity clasps upon us.

Society is the sum total of cooperative actions taken, a social order that is, paradoxically, shaped by competition among its constituents — free people. Actions intent on improving our relationship with nature, which enhance our quality of life by saving us time, necessarily involve the use of natural resources. If one seeks to dig ditches faster, he will first need to construct a shovel — a tool that requires wood from a felled tree, refined metal ore, and expertly shaped screws to hold the (earth-shattering) device together. Since the Earth we share is physically finite its natural resources are inherently scarce, and we must each compete to earn our own fair share. In a world that is as physically abundant as our ingenuity will allow, it is ultimately only our finite time that constrains us from producing more of anything we want.

Existing under the ubiquitous tyranny of time scarcity, it's natural for animals to adopt more energy efficient means of satisfying their wants. The "Law of Conservation of Energy-Mass" is the 1st Law of Thermodynamics; an inviolable principle of the universe that organisms (lazily and cleverly) follow to the letter. Predators in the wild frequently make expected-value calculations when deciding whether or not the anticipated energy expenditure in pursuit of a particular prey is worth the caloric value of the meal, should the hunt be successful (most hunts have low chances of success). Even herbivores like koala bears economize their physical movements to maximize their consumption of eucalyptus leaves per exertion. Of course, these decisions are not (likely) based on any mathematical knowledge, but rather on instinct.

Similarly, driven by an instinct to overcome the oppression of time scarcity, us humans have always found ways to uncover and extract ever-more natural resources as we "hunt" for satisfactions to our wants. We have literally "just scratched the surface," as our efforts haven't even taken us halfway into the Earth's crust, its thinnest and outermost layer. Through generations of trial and error, with our collective learnings accumulated in heuristics, written knowledge, and methodologies, mankind has steadily economized his productive efforts, gradually making more and more use of his time. The fruits of our labor are evident: the price of all natural resources, in terms of time necessary to produce them, has steadily decreased over the long-run as technological advancements continually increase our productivity — our capacity to produce the greatest results with the least effort. Metal prices over the past two centuries are a testament to this:

Figure 5 **Metal prices relative to wages, U.S., 1800–2007**



Sources: (1) Data for 1800–1990 are from Moore (1995). (2) Price data from 1990–2007 are from various issues of USGS, *Mineral Commodities Summaries and Minerals Year Books*, available at http://minerals.usgs.gov/minerals/pubs/commodity/, visited on July 7, 2008. (3) Wage data for 1990–2007 are from Bureau of Labor Statistics, *Establishment Data: Historical Hours and Earnings*, available at, ftp://ftp.bls.gov/pub/suppl/empsit.ceseeb2.txt, visited June 27, 2008

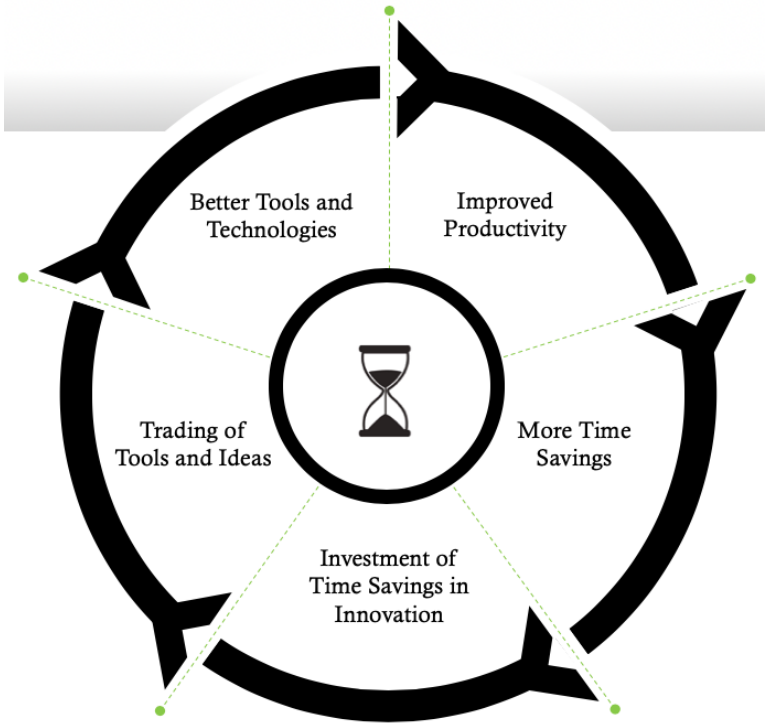
Evincing the simple truth of mankind's ever-rising productivity is gold: as the annual new supply flow of this extremely rare metal remains steady, it makes no sense to consider other natural resources (which are less rare than gold) as scarce in any practical sense[1] . Indeed, only time scarcity truly constrains our creative output. In this sense, time — both individually and collectively — is our most precious and scarce resource. Each of us seek to extend and savor our time on Earth. As a population, we strive to economize our actions and increase our productivity to attain the greatest results possible with minimal use of time and effort. Indeed, the purpose of the world economy is to accelerate our collective productivity gains through innovation and trade; in a term, to gain energy efficiency — our sole emancipator from the hardships imposed by time scarcity.

Trade Interconnects Us

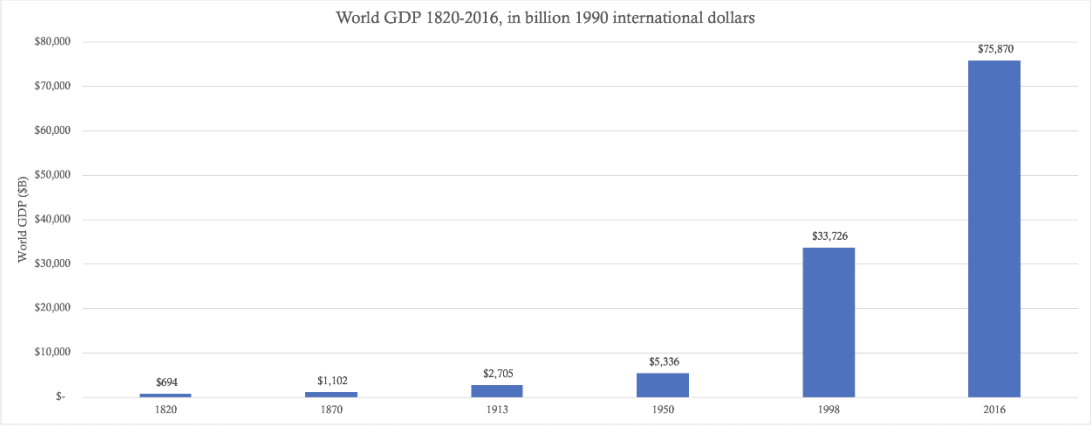
Acts of trade (or interpersonal exchange) interconnect us into economic networks which increase our productivity by virtue of our inherent comparative advantages: a diversity of skills, experience, and know-how that arises naturally among us. Trade allows us to focus on our comparative advantages and become ever-more specialized in our skills over time. This positive-sum game undergirds all economic activity; by working as a cooperative ensemble we become more productive than we would be working as isolated individuals. Our economic interdependence makes us collectively more productive and prosperous. This cooperative dynamic is commonly called the "division of labor" and the general purpose of society is to foster an environment which favors its proliferation.

The division of labor enables each of us to concentrate on what we do best and increases our collective productivity: meaning it lets us produce the same amount in less time or a greater amount in the same time. Alternatively, we can choose to use these newfound time savings to innovate. Innovation involves the creation of tools and technologies to help us do even more in less time (i.e. digging with a shovel

instead of by hand). As innovative new tools and ideas become diffused into society through trade, more time savings are generated, and this process becomes recursive into a self-reinforcing, virtuous cycle with no known natural limit:



By specializing, trading, and innovating societies create a (literal) wealth of time savings that can be spent productively or leisurely. By spending time savings productively, societies create wealth — the accumulation of time saved in the form of capital. Anything that economizes human action — tools, knowledge, or even relationships — is considered capital, as it provides a way for us to more quickly satisfy our wants. Said simply, as we become more productive, we accumulate more capital — a form of frozen time savings. In this respect, we have come a long way over the past two centuries:



sources: https://theunbrokenwindow.com/Development/MADDISON%20The%20World%20Economy--A%20Millennial.pdf, https://www.multpl.com/world-gdp/table/by-year

Money: Mankind's Masterwork

Money is the most marketable (or readily exchangeable) capital in an economy; it is the most liquid measure of time savings — a social chronometer of sorts. Money is the technology we use to measure and move the value of our time savings across time and space. The primary function of money is to store value, meaning that it must (at a minimum) retain its own exchange value across time. Naturally, as our collective productivity increases, the value of money rises in tandem, and prices expressed in it decline. The secondary function of money is to mediate exchange, meaning that it can be exchanged for anything in the marketplace — goods, services, or knowledge. Money is sought by all seeking to trade their way into satisfying personal wants[3] (this includes everyone that isn't entirely self-sufficient). The tertiary function of money is to quantify exchange ratios, meaning it is used to denominate prices across the minds of market participants. Consider how we think in dollars, or in our local currency, when deciding whether and how much to buy or sell of anything in the marketplace. Interestingly, this "unit of account" function of money is so deeply etched into our mental machinery that it actually changes how we think and perceive the world.

Besides these three functions, monetary technologies generally exhibit the following traits:

Scarcity: resistance to money supply manipulations and, thus, dilutions to its monetary unit value (difficult to produce)

Divisibility: ease of accounting and transacting at various scales (separable and combinable units)

Portability: ease of moving value across space (high value to weight ratio)

Durability: ease of moving value across time (resilient to deterioration)

Recognizability: ease of identifying and verifying the monetary value by other parties in a transaction (universally identifiable and verifiable)

Whatever good is most impervious to the depredations of time, transference, and greed is naturally selected as "money". The monetary technology selected freely in a marketplace is referred to as "hard money"; a haven for liquid value (exchangeable time savings) that resists the ravages of time, damages related to transference across space, and intentional misappropriations by those vicious two-legged apes (people). In these respects, monetary metals have been historically superior due to their durability and portability, making them ideal for storing value across time and space, respectively. With the advent of coinage, which standardized each monetary unit, the divisibility and recognizability traits of these metals were greatly enhanced. Critically, the scarcity of monetary metals is governed by natural laws that are beyond the control of man, making their supplies (mostly) resistant to greedy manipulations. Gold became, and remains, the prime monetary metal of the world precisely because of its superior relative scarcity — historically, it has been the best reflector of absolutely scarce time.

Gold is the hardest monetary metal to produce and nearly every ounce ever mined remains part of its extant supply today, as it is chemically an ultra-stable element. Taken in combination, these properties made gold the best medium for storing value across time, as its supply is the most resistant to change, and therefore the most inflation-resistant. By providing sufficient monetary characteristics (divisibility, portability, durability, recognizability) coupled with superior physical scarcity, gold was naturally selected as money on the free market (hard money). With a (low) reproducibility and physical scarcity most closely aligned with the absolute irreproducibility and scarcity of time, gold has been the most credible store of value historically — which explains why freely acting individuals have hoarded it for centuries. More technically, gold's superior stock-to-flow ratio makes it more resistant to supply inflation (and, its corollary, monetary value dilution) than all other monetary technologies (prior to the invention of Bitcoin).

Game Time

To understand gold's ascent, we must realize the actions of people in free markets are driven by game theory. In game-theoretic terms, a "game" is any situation in which people can win or lose — as is the case in markets. A "strategy" is just process for making decisions. Game theory is applicable in any domain where people must decide whether to cooperate or compete. For instance, if you and I are being chased by a bear, my decision to run or fight is not based on how fast I am, but rather how fast I think you are. Game-theoretically, I only need to be faster than you, not the bear, to ensure my survival. Such assessments of interpersonal dynamics are also closely related to economics and monetary evolution.

In the context of monetary evolution's relationship with time: free market participants choose hard money over all other monetary technologies because its resistance to supply increases most closely reflects the immutable flow of time. No matter how much time was allocated to gold production, its supply resisted inflation more than any other monetary metal, causing people to coalesce around its use as a superiorly sound store of value. In game theory terms, gold production became the "Nash Equilibrium", a game state in which everyone follows the same strategy because there is no advantage to be gained by switching to any other strategy. So long as people sought to maximize their freedom from time scarcity by accumulating capital, collectively produced more than they consumed, and accomplished these goals through trade, gold remained the best proxy for the scarcest economic resource — time.

Unicity of Time and Money

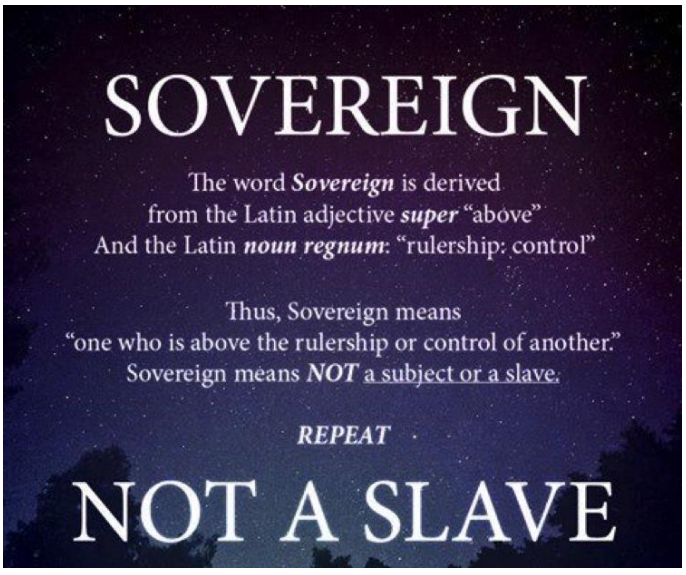
Time is the only irreversible element in existence. Its directionality is imparted by the ever-growing entropy of the universe — as defined by the 2nd Law of Thermodynamics. This "Thermodynamic Arrow of Time" which points us into an increasingly chaotic universe is, in fact, the only irreversible aspect of reality; every other natural process is symmetrical, making it impossible to discern whether an event is unfolding forward or backward in time. As such, this universally objective and unidirectional flow of time provides our purest reference point for all values (of the seven key metrics maintained by the Systeme Internationale of Units and Measures, six are rooted in the time it takes light to move through a vacuum). Gold, then, as the most difficult commodity to produce no matter how much time was allocated towards its extraction, served as the best market proxy for the objective purity of ever-flowing time. It is commonly said that time is money, but few realize that the reciprocal is also true — money is time.

Beyond relative irreproducibility, hard money exhibits other properties akin to the natural flow of time. Markets naturally optimize for a hard money that is as impersonal, irreversible, and unstoppable as the flow of time to which it is anchored, and which it is intended to epitomize in the marketplace. As hard money arises naturally as the result of countless market interactions in which individuals seek to trade their goods for steadily more exchangeable goods, it is inherently beyond the control of any single individual, nation, or central bank. This makes hard money apolitical and impersonal; it cannot be used to benefit any one group over another. In other words, hard money tends to be politically neutral, like time.

Hard money is also equity-based, meaning that physically possessing gold as an asset, for instance, is 100% equity and 0% debt (a bearer asset). This makes payments in gold immune to reversal, unlike those made with monopolistically imposed debt-based monies, called fiat currencies, which are liable to the whims of bureaucrats, who can choose to confiscate, censor, or deauthorize fiat currencies at any time, for any reason. Finally, hard money is unstoppable, in the sense that if I flip you a gold coin, there is no single authority on Earth that can block or devalue that transaction. Hard money, like gold, derives its value from freely acting individuals choosing the best monetary technology available to them.

Sacred Sovereignty

Bearer assets, like gold, offer another significant advantage — each individual unit is self-sovereign. Sovereignty refers to the freedom to take action as one sees fit. As Rosseau said: "Man is born free and everywhere he is in chains." The struggle of history has been the need for flexible coordination of human action on a large scale against the usurpation of individual sovereignty that the institutions built for this purpose typically impose. Paradoxically, as mankind pursued large scale mobilization of his efforts to overcome the natural tyranny of time scarcity, he gave birth to an artificial tyrant that engorges itself by consuming our individual sovereignty — the government and, its apparatus of thievery, central banking. True sovereignty originates at the individual level; it naturally reigns when our individual expressions, whether verbal or financial, are unmanipulable by others. When a government censors your speech or a central bank devalues your dollar, it is a violation of your individual sovereignty. Let no one prevent you from speaking your mind or spending your time and money as you see fit. We are each our own supreme ruler:



Gold is a self-sovereign bearer asset whose credibility and value as money is derived from the combined sovereignty of countless self-interested individuals exercising free choice in the marketplace. When a good gains value on the free market, it is a result of market participants finding it useful, making sacrifices for it, and, thereby, imbuing it with part of their individual sovereignty. Since gold achieved

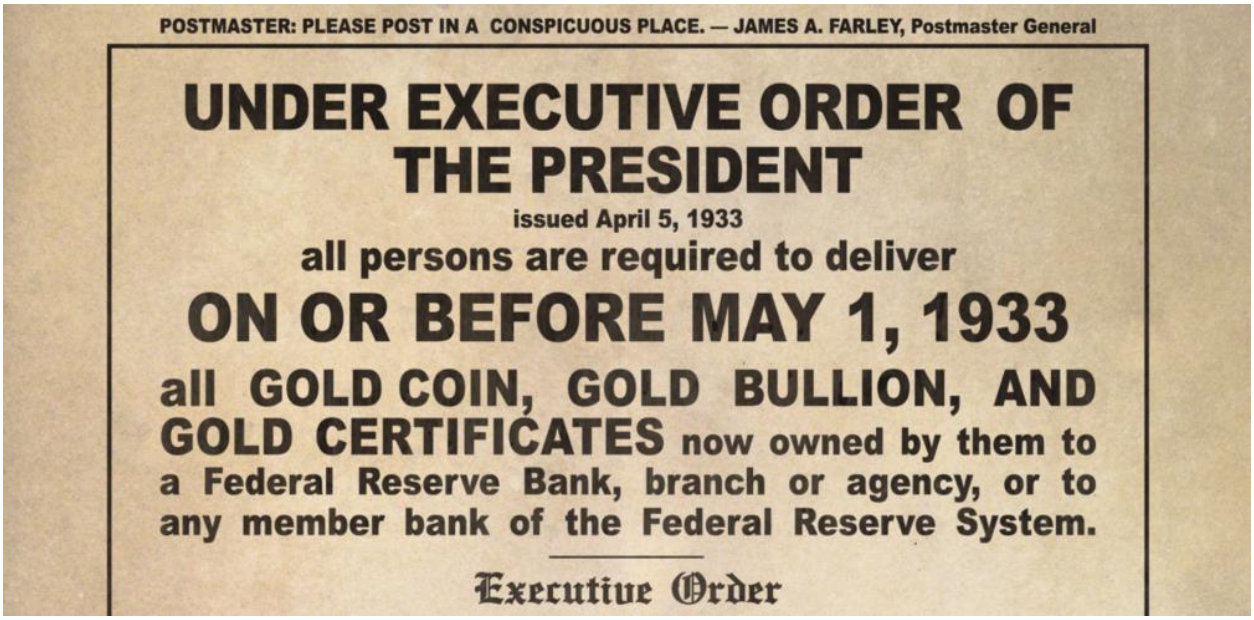
dominance on the free market as a result of countless "votes" in the form of self-interested trade decisions by a faceless multitude across history, it can be considered the monetary materialization of popular sovereignty — the founding principle of Western Civilization:

Although it's an ancient monetary technology, gold still forms the prime monetary sovereignty layer of Earth, as it underpins all governmental sovereignty. In turn, governments use this power to monopolize the market for money (via their central bank henchmen) and insulate fiat currencies from direct monetary competition. Such insulation is the only way debt-based monies can survive alongside hard money. Gold and other bearer assets are final extinguishers of debt, as payments in them carry no associated liability. Modern central banks still perform final settlement exclusively in gold and actively engage in market machinations to suppress its price (see Gata.org); a testament to the primacy of this ancient monetary metal.

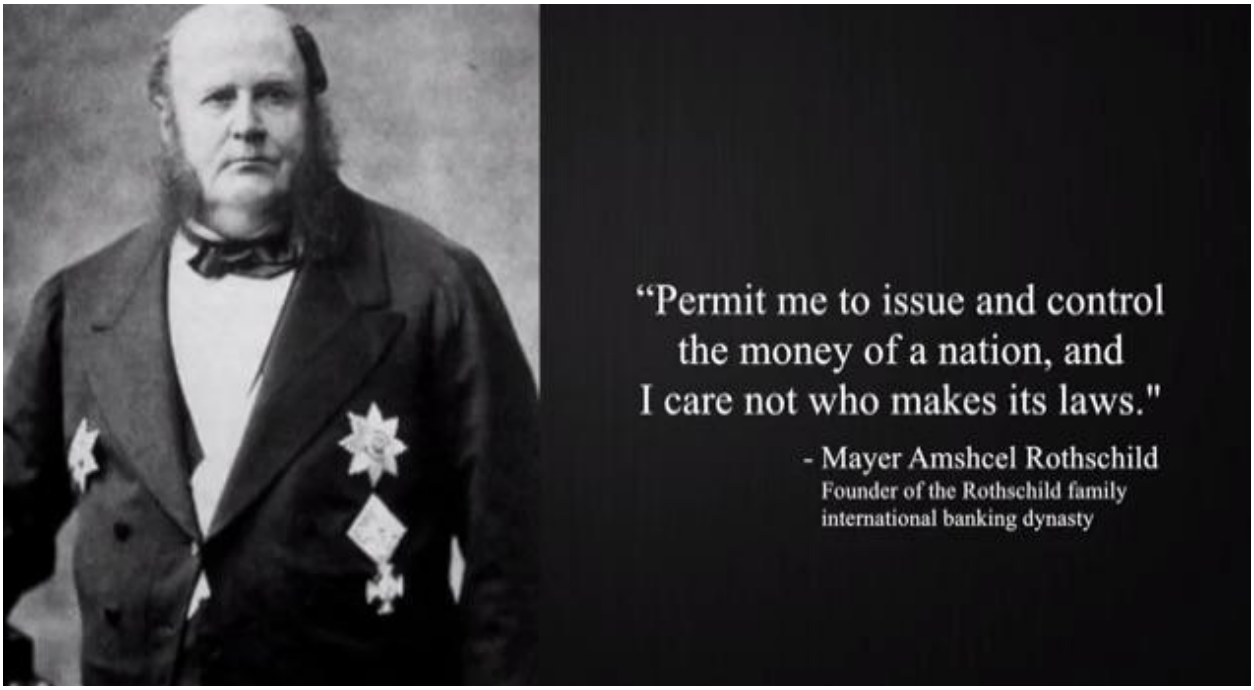
Den of Thieves

Despite this misappropriation of gold's sovereignty by government for its own self-seeking purposes, fiat currency is no longer anchored to gold, making it highly reproducible at near-zero cost. Indeed, fiat currency is the softest form of money in history; it can (and in virtually all cases does) suffer from counterparty risks such as censorship, deauthorization, or hyperinflation. Hard money is anchored in the reality of time to secure the time savings of its holders; fiat currency is a political tool that facilitates the institutionalized system of time-theft known as "expansionary monetary policy" perpetrated by central banks globally.

Although governments legally compel us to use fiat currencies today, these rules are only enforceable due to their vampirism — the sucking of sovereignty out of gold holdings. Ironically, this stolen power is used to monopolize violence and silence dissent. Government sovereignty, then, is derived from the agglomerated self-sovereignty of its gold hoards; which, in combination with the anticompetitive artifices it erects (legal tender laws, capital controls, capital gains taxes, etc.) in the sphere of money, explains why gold has been confiscated and its private ownership outlawed repeatedly throughout history:



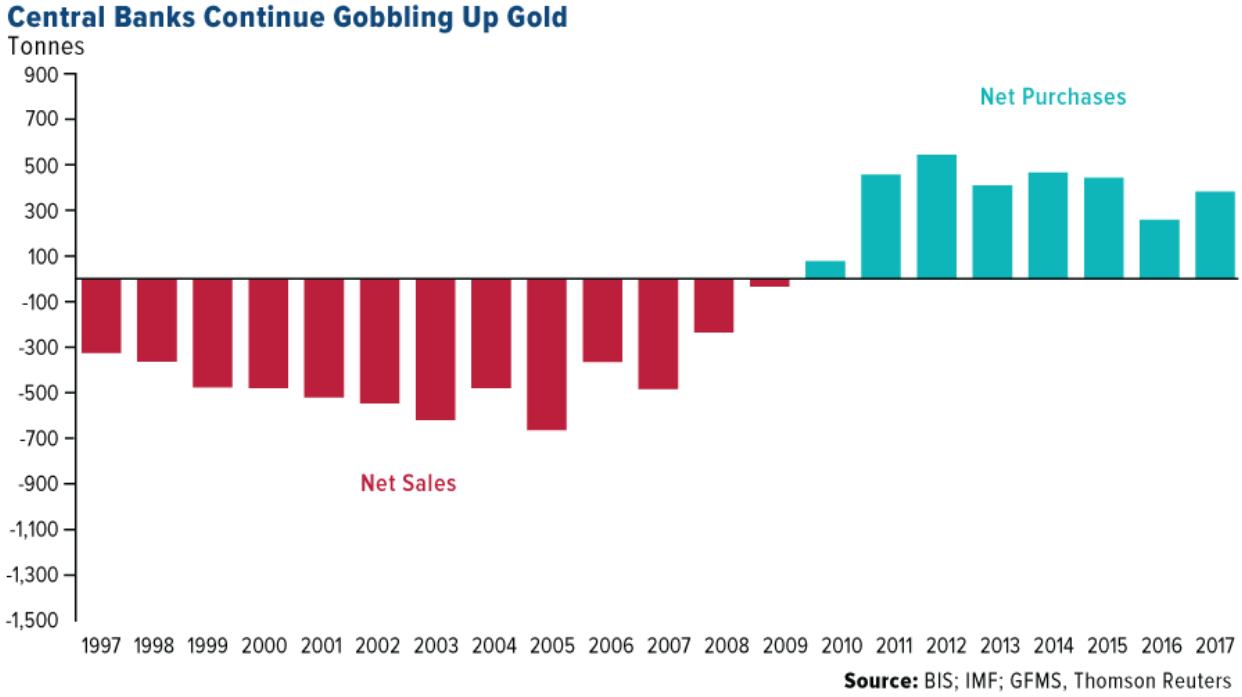
There is only one reason for such confiscatory acts: governments grasping for more power; a means to usurp gold's self-sovereignty, an embezzlement of power which itself originates in the actions of free people selecting a monetary technology in the marketplace; a tragedy at the heart of all modern economies. As the axiom says: "Whoever has the gold, makes the rules.":



Prime Money

In this sense, gold is prime money: as its physical possession underpins the sovereignty of governments, which misappropriate it to enforce central bank money production monopolies on free people. Paradoxically, it was the actions of free people that generated the sovereignty that is now wielded against

them by governments and central banks. This "duopoly of monopolists" has proclaimed time and time again that gold is irrelevant, a mere monetary artifact, and that they alone will lead the world economy to a brighter future. Ignore anti-gold propaganda; just watch their actions:

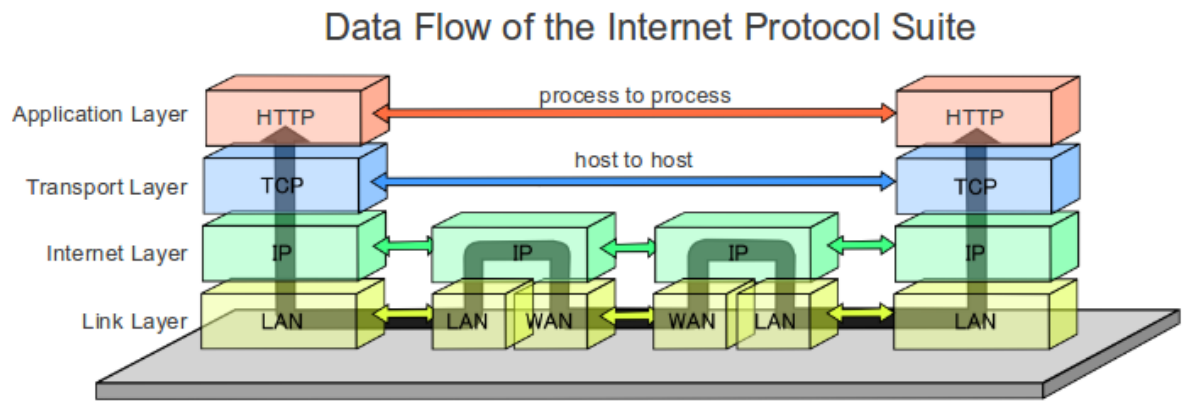


Although gold resisted supply manipulation in many ways, it is far from perfect. Through the London Gold Pool and other machinations (seriously, see Gata.org) central banks cornered the market on gold, enabling them to surreptitiously suppress its price and better insulate fiat currency (soft money) from direct competition with gold (hard money). Market manipulation like this is only possible because of our passivity. In surrendering our sovereignty to unaccountable institutions like central banks, we cede conscious control over most aspects of our lives. Remember: central banks engaged in "expansionary monetary policy" are actively stealing time from free people; as they increase money supplies, they reallocate claims on productive capital from the majority to a politically favored few. This parasitism on the savings of society extends the working lives for most of the citizenry. In this way, monetary inflation is a direct violation of private property rights and individual sovereignty. It is worth repeating: human action is the essence of sovereignty; it is our actions that instill institutions with this divine quality intrinsic to free people. Let us all exercise the utmost vigilance in deciding which institutions to empower with our sacred sovereign energies:

> "Institutional structures are legitimate insofar as they enhance the opportunity to freely inquire and create, out of inner need; otherwise, they are not."
> — Noam Chomsky, On Anarchism

Hard Money Renaissance

Against this usurpation of our individual sovereignty by government, we find hope in the emergence of a modern innovation called the internet — the universal exchange engine for knowledge. The internet has already democratized and disintermediated many aspects of our lives — from lodging and transportation, to media distribution and commerce. Compositionally, the internet is a set of open-source protocols (known as the internet protocol suite) for permissionlessly moving information worldwide in an instant. Constructed in a free market manner, through years of cooperation and standardization efforts, the internet is the greatest knowledge network in history. Today, we all benefit from this readily-accessible library of human knowledge:



As Milton Friedman so aptly pointed out in 1999, about ten years before the invention of Bitcoin, the one thing the internet lacked was a secure, private "e-cash":

"The one thing that's missing, but that will soon be developed, is a reliable e-cash, a method whereby on the Internet you can transfer funds from A to B, without A knowing B or B knowing A."

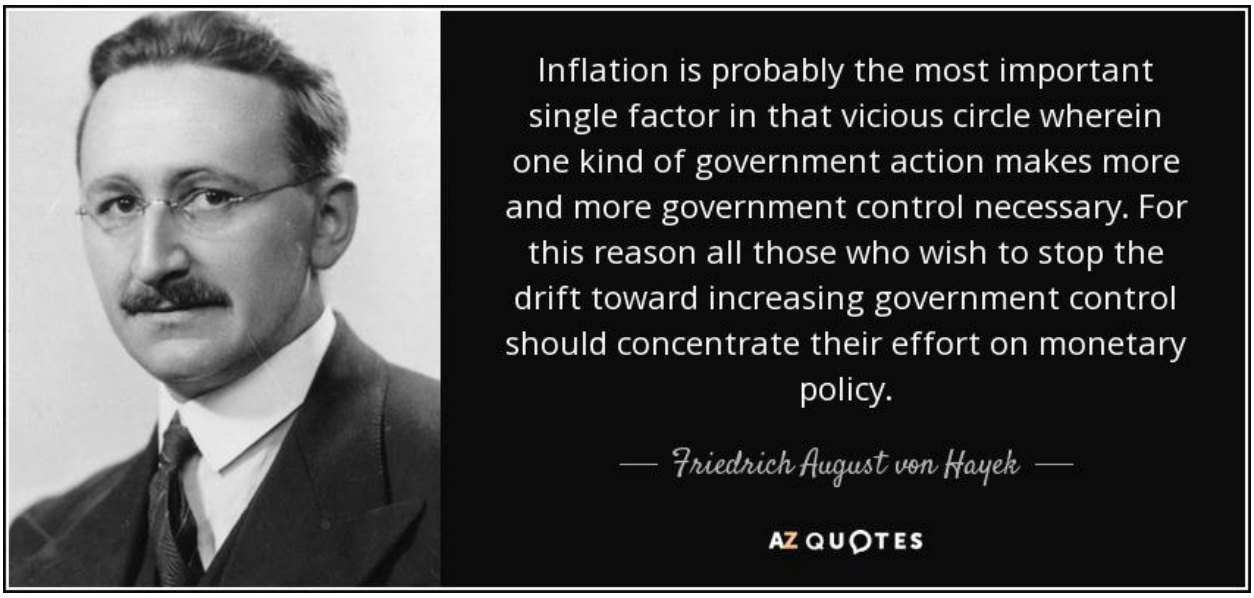
Friedman's prescience proved astonishingly accurate. Coming into the 21st century, we had two key inceptors for digital hard money: gold, the ancient and prevailing monetary sovereignty layer (representing an unmanipulable money supply), and the internet, the ultimate engine of exchange (representing global interconnectivity or liquidity). By combining and building upon the economic

properties of both, Bitcoin is a momentous monetary innovation that has achieved the divisibility, portability, durability, and recognizability of pure information infused with the absolute scarcity of time. As the internet gives us freedom to express and absorb ideas without obstruction, Bitcoin gives us the freedom to express and receive value in a hard money that cannot be stopped. In this sense, Bitcoin is the latest evolutionary layer of the internet protocol suite; a quantum leap over the monetary "Nash Equilibrium" gold represented.

Historically, gold has become more difficult to extract with the passage of time due to chemistry, physical rarity, and game theory. Gold is the ancient anchor to the prime economic reality of time scarcity, precisely why it remains the prime money of modernity. Time is the most objective measure for our intersubjective (opinion-based) valuations, as it is the one unarguable aspect of existence. In a society run on hard money, price levels naturally decline over time as our productivity grows in tandem with the division of labor. Put another way, hard money tends to appreciate over time as human knowledge becomes more specialized. In this way, increases in the value of hard money reflect how far humanity has liberated itself from time scarcity.

Liquidity of Time and Information

Conceptually then, money is both frozen time (as a means of storing time savings) and liquid time (as a means of exchanging time savings). We earn money by sacrificing our intrapersonal time and can trade it for commensurate sacrifices from others. As such, anyone that gains control over a money supply, and can manipulate it at will, can steal time savings directly from the users of its money via the shadow tax of inflation. To shed light on the true nature of fiat currency in one line, let's call it like it is: a pyramid scheme built atop gold that is subject to unlimited supply inflation. Since it bears repeating: inflation is intrapersonal time theft — a legally enforced injustice.



Manipulation of money supplies has other consequences. Money is an economy's main informational utility; a touchstone to measure the value of the time savings (or spending) expected to be made possible by an economic good in the future. When a money supply is manipulated, the objectivity of its

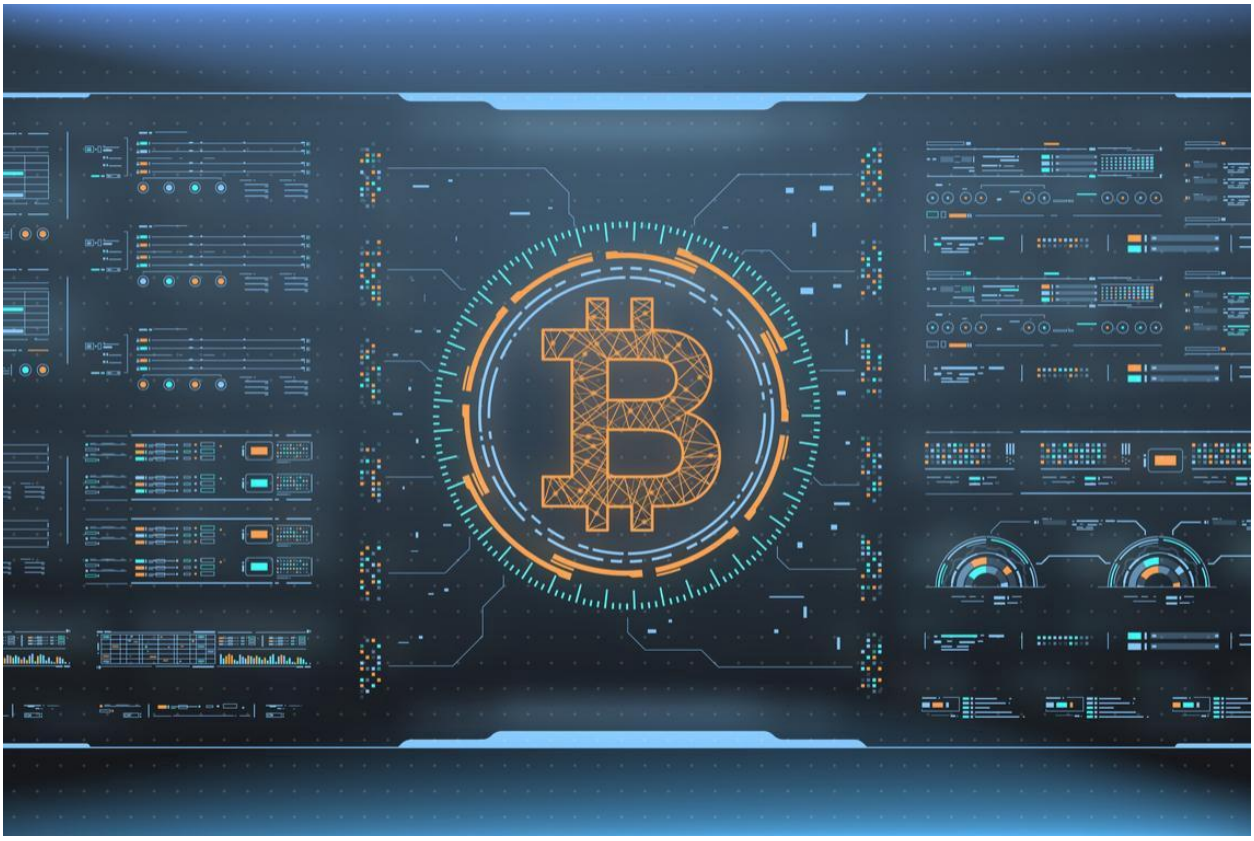
measurement ability is compromised. This breakdown of money's informational utility is called price signal distortion. Such manipulation makes economic calculation less reliable and causes entrepreneurs to overborrow, misallocate capital, and, ultimately, degenerates time savings as capital is consumed instead of being compounded through reinvestment. Price signals provide a system for "market participant telecommunications" and can be explained as follows:

Understanding Price Signals:

Knowledge, due to its dynamic and fluid nature, cannot be fully known by a single entity as it is constantly in flux and widely distributed within many minds. In a free market economic system prices capture this distributed knowledge, convert it into impartial information and disseminate it widely. *Price signals* are the coordinating force of free market systems. Each individual decision maker can faithfully rely on the prices of goods relevant to their production process, as the prices themselves are a distillation of all known market realities into a single, actionable variable. Each individual's buy and sell decisions, in turn, further shape prices which carry this altered information back out into the market. Price signals are to market participants what light is to the eye.

To understand this point, consider the 2010 earthquake which badly damaged an area in Chile responsible for a great deal of the world's copper production. This earthquake severely damaged copper mines and export infrastructure, which immediately reduced the flow of new supply to the world copper market and resulted in a 6.2% increase in its price. Anyone in the world whose business interfaces with the copper market will be affected by this, but they do not need any specific knowledge about the earthquake in Chile or market conditions to decide how to respond. All the relevant information they need to make effective decisions is contained within the price of copper itself. Immediately, all firms that demand copper are incentivized to demand less, delay purchases or find substitutes. On the other side of the market, all firms that produce copper are incentivized to produce more of it. With a natural shift in price, everyone in the world involved in the copper industry is incentivized to act in a way that alleviates the negative consequences of the earthquake. This is the power of a free market with accurate price signals.

Price signals are the navigational instruments for entrepreneurs sailing the tempestuous seas of markets, and money is the medium through which these signals propagate. Said another way: money is a measurement system for value (a temporal quality) in the same way a ruler is for length (a spatial quality). The less elastic the supply of money is, the better it fulfills this mensural purpose. If you are measuring a table with a ruler that you cannot trust, then you can't be sure whether you're measuring the table or the ruler; you cannot distinguish the signal (the actual length) from the noise (changes in unit of measurement). [4] Gold outcompeted historically because of its relative supply inelasticity, which made it both the best store of value and conveyor of price signals. Uniquely, Bitcoin is a money with perfect supply inelasticity; it is the most uncompromising measurement system for value the world has ever known. In this sense, Bitcoin is like an inviolable ruler: a perfectly objective unit of measurement for the endless variations of market values.

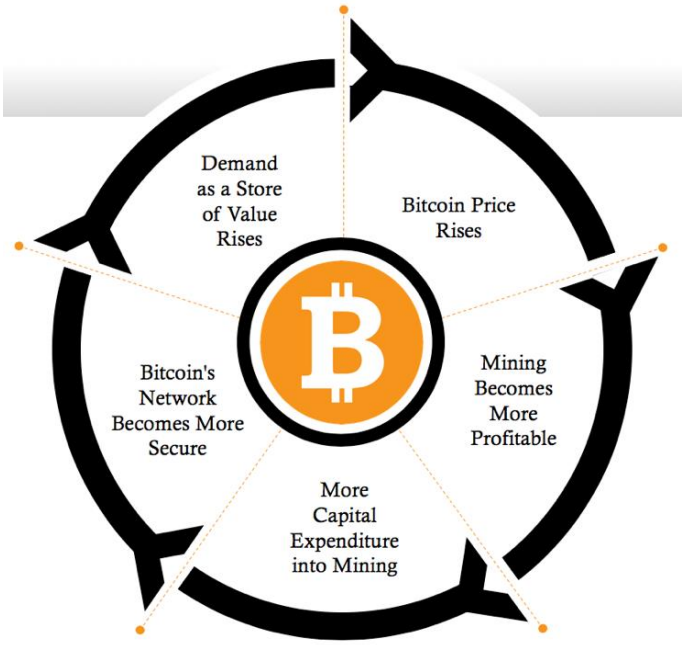


Therefore, the more closely a money supply is credibly congruent with the absolutely scarcity of time, the better it communicates the time savings generated by our collective productivity gains. In this way, both gold and Bitcoin share the same principal attractiveness: they are more closely reflective of the impersonal, irreproducible, irreversible, unstoppable, and absolutely scarce nature of the experiential element money is intended to symbolize in the marketplace — time.

Temporal Anchorage

When money is disconnected from time scarcity (as fiat currency is), its "skin in the game" is compromised and the economies it facilitates start suffering from distorted price signals, malinvestments, recessions, and an exacerbated boom-and-bust business cycle. As with most systems, money requires skin in the game to function properly — meaning that money must be costly to produce,[5] otherwise those who can produce it cheaply will do so to steal the value of time savings stored therein (as central banks do).

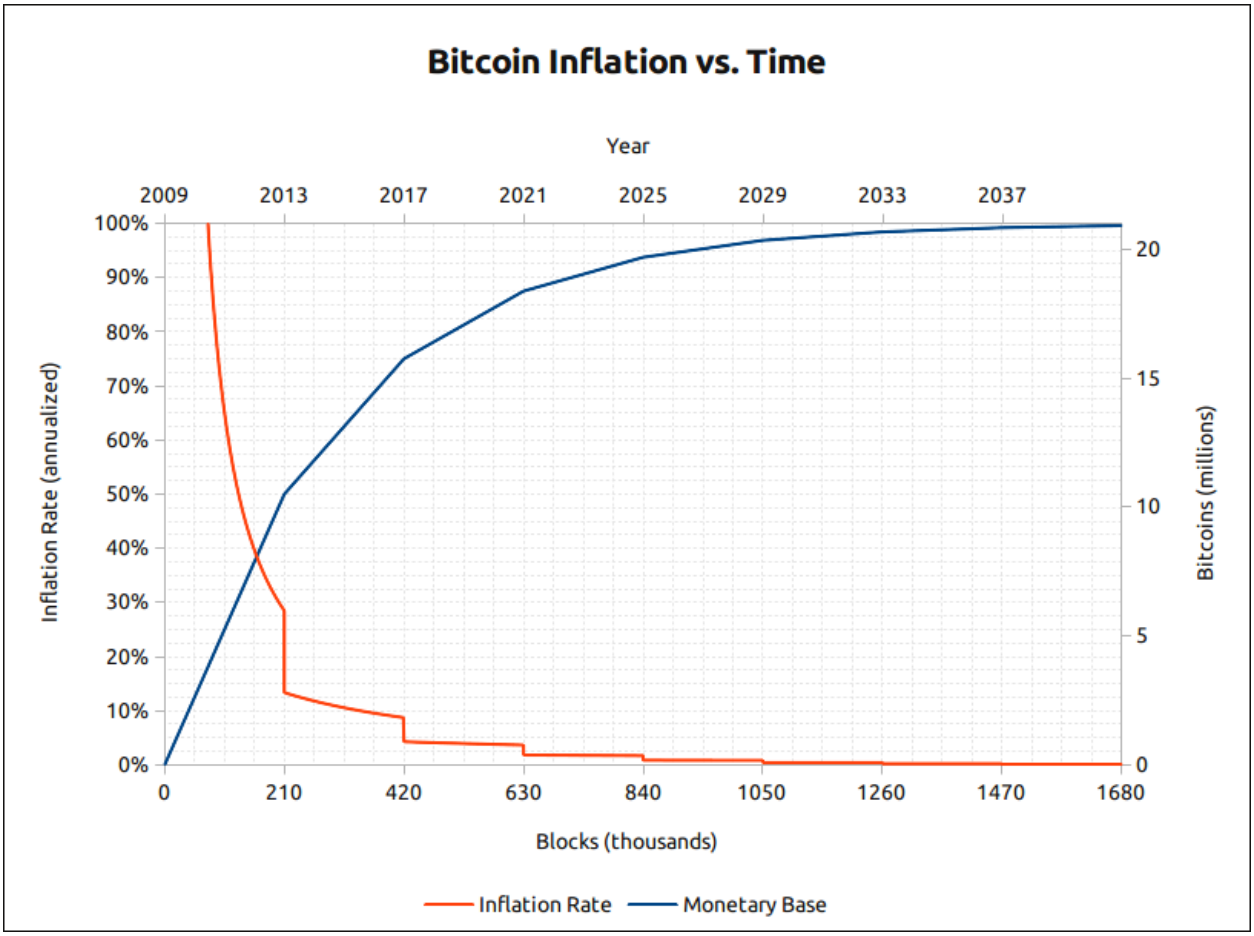
For gold, the costs associated with mining provide this critical skin in the game characteristic. For Bitcoin, an ingenious composite of proof-of-work energy expenditure (skin in the game) and economic incentives (game theory) enabled it to digitize scarcity. In this sense, Bitcoin's blockchain is like a bridge between physical and digital reality — the first incarnation of a digital asset with provable scarcity. An innovative amalgamation of open-source software and behavioral economics, Bitcoin was designed to be a monetary network that reproduces itself relentlessly:



From this perspective, the value of mining both gold and Bitcoin is the "unforgeable costliness" that each represents — a measure of the time sacrificed in production, which is redeemable for the time of others. Imbued with digital scarcity, Bitcoin preserves the advantages offered by gold's physicality (self-sovereignty, irreversible transactions, final settlement) while eliminating its disadvantages (ease of confiscation, expensive safeguarding, high settlement costs). Digitization also makes Bitcoin a weightless, intangible, and (potentially) everlasting monetary technology. As a totally impersonal and self-sovereign monetary network capable of adopting market-proven features from competitors over time, while simultaneously resisting changes that negatively impact its users, Bitcoin may be the last evolution we ever see in global prime money. Gold is the "pristine collateral" which underpins the entirety of the highly-levered fiat currency financial complex; Bitcoin is poised to become the foundation for an entirely new economic order.

Monetary Horizons

In the near future and for the first time in history, the world will have a money that is harder to produce than gold. A fixed supply of 21 million units makes Bitcoin absolutely scarce — a property never before achieved by anything other than time itself. In the same way that Galelio's invention of the telescope led to discoveries that reoriented our relationship with space, so too has the invention of Bitcoin led to the discovery of absolute scarcity; a bewildering breakthrough that perfectly parallels and will forever change mankind's relationship with time. Soon, in accordance with its perfectly predictable issuance schedule, Bitcoin will become the scarcest liquid asset in human history. At this point, Bitcoin will become the monetary technology most closely aligned with the absolutely scarce nature of time. From there, every block produced will (asymptotically) further perfect this alignment until the last Bitcoin in mined in the mid-22nd century:



The supreme divisibility, portability, durability, recognizability, and scarcity characteristics of Bitcoin constantly increase the likelihood (via the Lindy Effect) that it will continue to outcompete gold and fiat currencies in its long climb toward becoming global prime money. Bitcoin, with a supply more closely aligned with the prime economic reality of time scarcity, is slowly but surely *undermining* gold's role as prime money. The word *undermine* literally means "to dig under fortifications to collapse them". In this sense, Satoshi designed Bitcoin to "dig deeper" into reality than gold and, in doing so, undermine its role as prime money by more closely mirroring the fundamental nature of time. As a result, the value of fiat currencies will also diminish as gold slips from its position of primacy.

Temporal Metaphor

Time is the ultimate experiential element we all share. It is ruthlessly egalitarian, flowing equally for all alike. Time is our objective anchor in a world of ceaselessly shifting intersubjective valuations. Abstractly, money is our metaphor for time. As a tool, it best serves mankind when its supply is as inelastic as the absolute scarcity of time. Here, gold does well; yet Bitcoin, the first money with a supply that is absolutely scarce, reflects time perfectly.

Money is the medium through which many minds become one; it is the coordinating mechanism of human action. Money matters because only through cooperation and innovation do we mortals gain ground in our struggle against the immortal tyrant of time scarcity. Perhaps one day to be regarded as the most impactful technology ever invented, Bitcoin is simply a tool for saving time; it stores the value created from our time spent serving one another, reduces the time needed to establish trustful coordination, and it protects our mutually generated time savings from confiscation. Furthermore, Bitcoin promises to reduce the money, capital, and life wasted in warfare. Bitcoin accomplishes this by transcending laws and outcompeting money production monopolies, which use taxation via inflation to stealthily fund perpetual warfare. As Ron Paul said: "It is no coincidence that the century of total war coincided with the century of central banking.":

Table 5.1 Conflicts steadily cost more in human lives

Period	Conflict-related deaths (millions)	World population, mid-century (millions)	Conflict-related deaths as share of world population (%)
Sixteenth century	1.6	493.3	0.32
Seventeenth century	6.1	579.1	1.05
Eighteenth century	7.0	757.4	0.92
Nineteenth century	19.4	1,172.9	1.65
Twentieth century	109.7	2,519.5	4.35

Bitcoin also promises to help generate even more time savings by deepening the division of labor, a direct result of financial disintermediation, the benefits of which flow to everyone. Finally, Bitcoin encourages us to adopt lower time preferences and think long-term. Hard money incentivizes us to save and invest, and disincentivizes excessive debt and spending, since it naturally appreciates over time as our collective productivity grows. Fiat currency is the reverse: it pushes up our time preferences and disintegrates societies. As the repeated fall of ancient civilizations shows, monetary integrity and social cohesion are inexorably linked.

Breaking the Chains

Bitcoin belongs in a certain class of momentous innovations — like antiseptics, electricity, or the internet — that either extend our lifespans individually or enhance our productivity and, therefore, our time savings collectively. These innovations expand our relationship with time in one or more ways: extending life expectancies, lowering time preferences, or enhancing productivity. Bitcoin promises to contribute to all three by being the best self-sovereign savings technology in history: reducing death tolls and capital destruction from warfare by financially starving governments, incentivizing savings and investment in innovation, and accelerating our productivity gains by reducing artificial and arbitrary trade frictions.

Bitcoin has the potential to bend the grand arc of human history back towards a free market paradigm. Bitcoin is doing this in the market for money, and its underlying technology may one day be applied to other markets like equities, bonds, and real estate. Going forward, Bitcoin promises to further liberate us from the clutches of time scarcity, eliminate time theft via inflation, reinvigorate individual sovereignty, and, as a cumulative result, radically increase social scalability worldwide. As Alfred North Whitehead said:

"*It is a profoundly erroneous truism repeated by all copy-books and by eminent people when they're making speeches, that we should cultivate the habit of thinking about what we're doing. The precise opposite is the case. Civilization advances by extending the number of important operations which we can perform without thinking about them.*"

As we continue our endless contentions with time scarcity, government-authorized money monopolies remain a scourge on our humanity. Central banking, an institution of monetary socialism and systemized time theft, has repeatedly wounded our individual sovereignty, time preferences, and freedoms throughout history. We mortals must break the shackles of this oppressive institution and focus our energies on innovating against time scarcity — the immortal tyrant. In doing so, we will create a world in which our children, their children, and all future generations are born able to live totally self-sovereign lives — forever free from the chains of governmental tyranny.

By Robert Breedlove Oct, 2019

Thank you for reading "Bitcoin and the Tyranny of Time Scarcity" My sincerest gratitude to these amazing minds:

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The Number Zero and Bitcoin

By Robert Breedlove

Posted March 28, 2020

Satoshi gave the world Bitcoin, a true "something for nothing." His discovery of absolute scarcity for money is an unstoppable idea that is changing the world tremendously, just like its digital ancestor: the number zero.

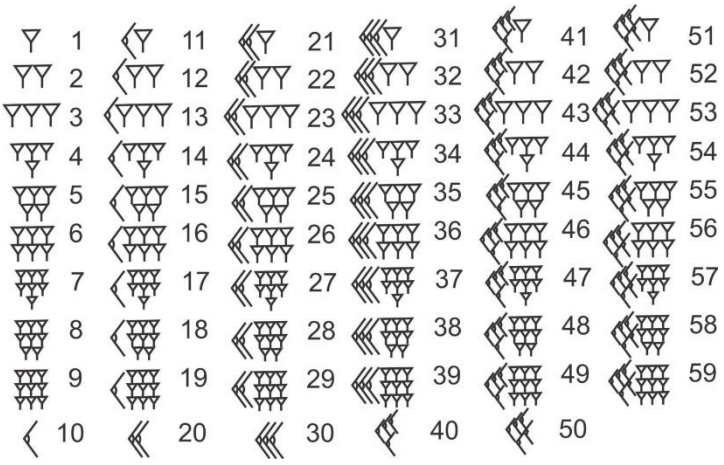
Zero is Special

"In the history of culture the discovery of zero will always stand out as one of the greatest single achievements of the human race." — Tobias Danzig, Number: The Language of Science

Many believe that Bitcoin is "just one of thousands of cryptoassets"—this is true in the same way that the number zero is just one of an infinite series of numbers. In reality, Bitcoin is special, and so is zero: each is an invention which led to a discovery that fundamentally reshaped its overarching system—for Bitcoin, that system is money, and for zero, it is mathematics. Since money and math are mankind's two universal languages, both Bitcoin and zero are critical constructs for civilization.

For most of history, mankind had no concept of zero: an understanding of it is not innate to us—a symbol for it had to be invented and continuously taught to successive generations. Zero is an abstract conception and is not discernible in the physical world—no one goes shopping for zero apples. To better understand this, we will walk down a winding path covering more than 4,000 years of human history that led to zero becoming part of the empirical bedrock of modernity.

Numerals, which are symbols for numbers, are the greatest abstractions ever invented by mankind: virtually everything we interact with is best grasped in numerical, quantifiable, or digital form. Math, the language of numerals, originally developed from a practical desire to count things—whether it was the amount of fish in the daily catch or the days since the last full moon. Many ancient civilizations developed rudimentary numeral systems: in 2000 BCE, the Babylonians, who failed to conceptualize zero, used two symbols in different arrangements to create unique numerals between 1 and 60:



Babylonian cuneiform was a relatively inefficient numeral system — notice how many more written strokes are necessary for each number symbol — and calculation using it was even more cumbersome.

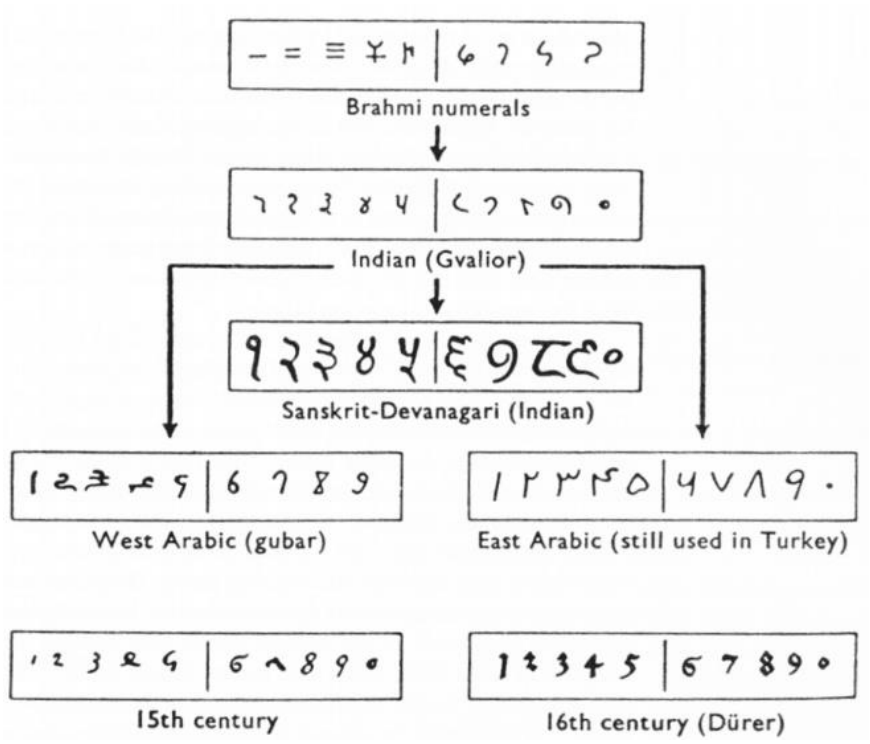
Vestiges of the base-60 Babylonian cuneiform system still exist today: there are 60 seconds in a minute, 60 minutes in an hour, and 6 sets of 60 degrees in a circle. But this ancient system lacked a zero, which severely limited its usefulness.

Ancient Greeks and Mayans developed their own numeral systems, each of which contained rough conceptions of zero. However, the first explicit and arithmetic use of zero came from ancient Indian and Cambodian cultures. They created a system with nine number symbols and a small dot used to mark the absence of a number—the original zero. This numeral system would eventually evolve into the one we use today:

The first known written zero: from the Bakhshali manuscript which contains pages dating back to the 3rd and 4th centuries AD.

Inscription K-127 bears the earliest zero ever discovered—dated from the 7th century, it was discovered in the 19th century in Cambodia.

In the 7th century, the Indian mathematician Brahmagupta developed terms for zero in addition, subtraction, multiplication, and division (although he struggled a bit with the latter, as would thinkers for centuries to come). As the discipline of mathematics matured in India, it was passed through trade networks eastward into China and westward into Islamic and Arabic cultures. It was this western advance of zero which ultimately led to the inception of the Hindu-Arabic numeral system—the most common means of symbolic number representation in the world today:



The Economization of Math

When zero reached Europe roughly 300 years later in the High Middle Ages, it was met with strong ideological resistance. Facing opposition from users of the well-established Roman numeral system, zero struggled to gain ground in Europe. People at the time were able to get by without zero, but (little did they know) performing computation without zero was horribly inefficient. An apt analogy to keep in mind arises here: both math and money are possible without zero and Bitcoin, respectively—however both are tremendously more wasteful systems without these core elements. Consider the difficulty of doing arithmetic in Roman numerals:

Using Roman numerals, the sum 1,223 + 1,104 becomes:			
MCCXXIII	**+**	**MCIV**	
= MCCXXIII	**+**	**MCIIII**	
M	**CC**	**XX**	**III**
+ M	**C**		**IIII**
= MM	**CCC**	**XX**	**IIIIII**
= MMCCCXXVII			**= 2,327**

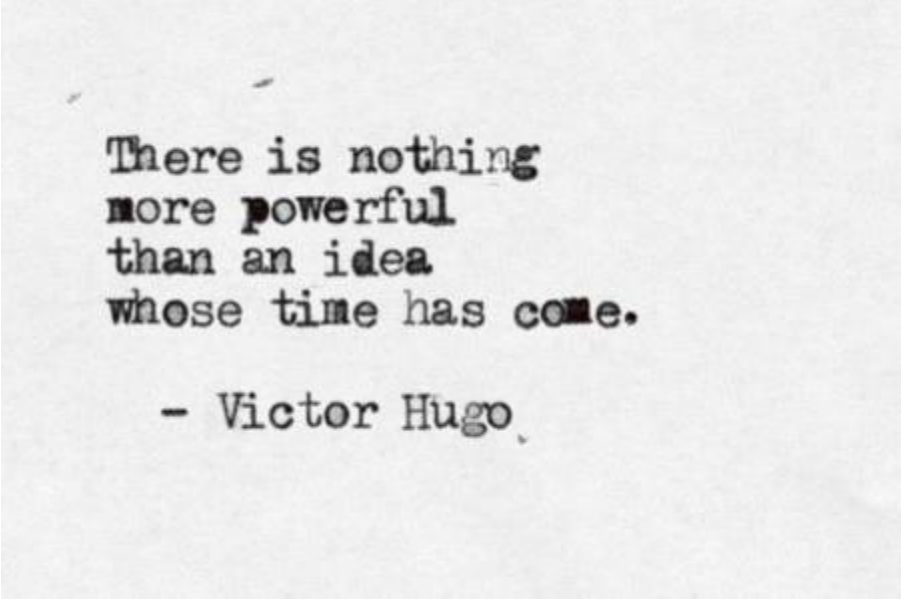
If you thought you were bad at arithmetic using numbers, just try doing it with letters.

Calculation performed using the Hindu-Arabic system is significantly more straightforward than with Roman numerals—and energy-efficient systems have a tendency to win out in the long run, as we saw

when the steam engine outcompeted animal-sourced power or when capitalism prevailed over socialism (another important point to remember for Bitcoin later). This example just shows the pains of addition—multiplication and division were even more painstaking. As Amir D. Aczel described it in his book *Finding Zero*:

"[The Hindu-Arabic numeral system] allowed an immense economy of notation so that the same digit, for example 4, can be used to convey itself or forty (40) when followed by a zero, or four hundred and four when written as 404, or four thousand when written as a 4 followed by three zeros (4,000). The power of the Hindu-Arabic numeral system is incomparable as it allows us to represent numbers efficiently and compactly, enabling us to perform complicated arithmetic calculations that could not have been easily done before."

Roman numeral inefficiency would not be tolerated for long in a world enriching itself through commerce. With trade networks proliferating and productivity escalating in tandem, growing prospects of wealth creation incentivized merchants to become increasingly competitive, pushing them to always search for an edge over others. Computation and record-keeping with a zero-based numeral system was qualitatively easier, quantitatively faster, and less prone to error. Despite Europe's resistance, this new numeral system simply could not be ignored: like its distant progeny Bitcoin would later be, zero was an unstoppable idea whose time had come:



Functions of Zero

Zero's first function is as a placeholder in our numeric system: for instance, notice the "0" in the number "1,104" in the equation above, which indicates the absence of value in the tens place. Without zero acting as a symbol of absence at this order of magnitude in "1,104," the number could not be represented unambiguously (without zero, is it "1,104" or "114"?). Lacking zero detracted from a numeral system's capacity to maintain constancy of meaning as it scales. Inclusion of zero enables other digits to take on new meaning according to their position relative to it. In this way, zero lets us perform calculation with

less effort—whether its pen strokes in a ledger, finger presses on a calculator, or mental gymnastics. Zero is a symbol for emptiness, which can be a highly useful quality—as Lao Tzu said:

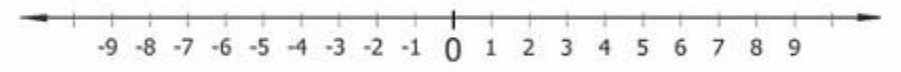
"We shape clay into a pot, but it is the emptiness inside that holds whatever we want."

More philosophically, zero is emblematic of *the void*, as Aczel describes it:

"...the void is everywhere and it moves around; it can stand for one truth when you write a number a certain way — no tens, for example — and another kind of truth in another case, say when you have no thousands in a number!"

Drawing analogies to the functions of money: zero is the "store of value" on which higher order of magnitude numerals can scale; this is the reason we always prefer to see another zero at the end of our bank account or Bitcoin balance. In the same way a sound economic store of value leads to increased savings, which undergirds investment and productivity growth, so too does a sound mathematical placeholder of value give us a numeral system capable of containing more meaning in less space, and supporting calculations in less time: both of which also foster productivity growth. Just as money is the medium through which capital is continuously cycled into places of optimal economic employment, zero gives other digits the ability to cycle—to be used again and again with different meanings for different purposes.

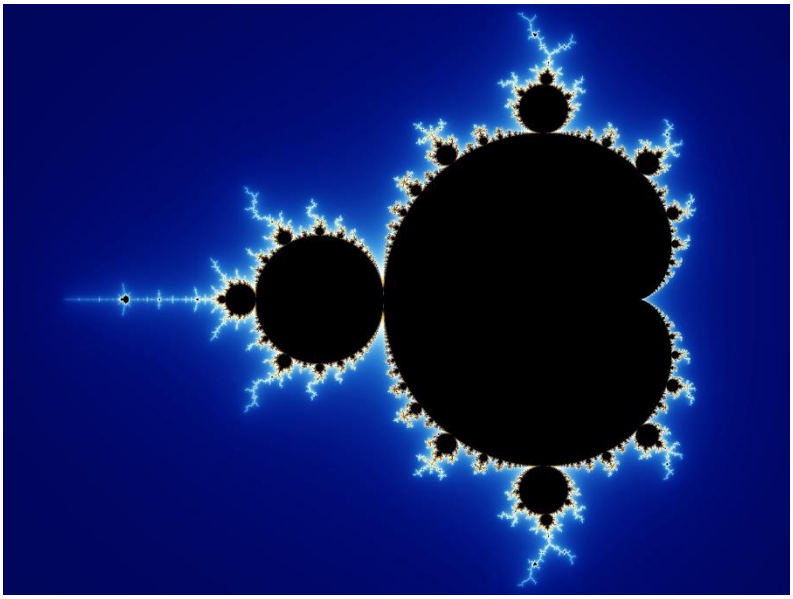
Zero's second function is as a number in its own right: it is the midpoint between any positive number and its negative counterpart (like +2 and -2). Before the concept of zero, negative numbers were not used, as there was no conception of "nothing" as a number, much less "less than nothing." Brahmagupta inverted the positive number line to create negative numbers and placed zero at the center, thus rounding out the numeral system we use today. Although negative numbers were written about in earlier times, like the Han Dynasty in China (206 BCE to 220 BCE), their use wasn't formalized before Brahmagupta, since they required the concept of zero to be properly defined and aligned. In a visual sense, negative numbers are a reflection of positive numbers cast across zero:



Zero is the center of gravity for our entire numeral system, just as money is central to any economic system.

Interestingly, negative numbers were originally used to signify debts—well before the invention of double-entry accounting, which opted for debits and credits (partly to avoid the use of negative numbers). In this way, zero is the "medium of exchange" between the positive and negative domains of numbers—it is only possible to pass into, or out of, either territory by way of zero. By going below zero and conceptualizing negative numbers, many new and unusual (yet extremely useful) mathematical constructs come into being including imaginary numbers, complex numbers, fractals, and advanced

astrophysical equations. In the same way the economic medium of exchange, money, leads to the acceleration of trade and innovation, so too does the mathematical medium of exchange, zero, lead to enhanced informational exchange, and its associated development of civilizational advances:



The *Mandlebrot Set*: one of the most famous examples of a fractal, a mind-bending mathematical structure formed with complex numbers that models the geometry of nature and its intrinsic complexity. One of the best known examples of mathematical beauty, this fractal exhibits infinite depth, breadth, and non-repeating self-similarity. Zero is a necessary prerequisite to such fractal modeling.

Zero's third function is as a facilitator for fractions or ratios. For instance, the ancient Egyptians, whose numeral system lacked a zero, had an extremely cumbersome way of handling fractions: instead of thinking of 3/4 as a ratio of three to four (as we do today), they saw it as the sum of 1/2 and 1/4. The vast majority of Egyptian fractions were written as a sum of numbers as 1/n, where n is the counting number—these were called unit fractions. Without zero, long chains of unit fractions were necessary to handle larger and more complicated ratios (many of us remember the pain of converting fractions from our school days). With zero, we can easily convert fractions to decimal form (like 1/2 to 0.5), which obsoletes the need for complicated conversions when dealing with fractions. This is the "unit of account" function of zero. Prices expressed in money are just exchange ratios converted into a money-denominated price decimal: instead of saying "this house costs eleven cars" we say, "this house costs $440,000," which is equal to the price of eleven $40,000 cars. Money gives us the ability to better handle exchange ratios in the same way zero gives us the ability to better handle numeric ratios.

Numbers are the ultimate level of objective abstraction: for example, the number 3 stands for the _idea _of "threeness" – a quality that can be ascribed to anything in the universe that comes in treble form. Equally, 9 stands for the quality of "nineness" shared by anything that is composed of nine parts. Numerals and math greatly enhanced interpersonal exchange of knowledge (which can be embodied in goods or services), as people can communicate about almost anything in the common language of numeracy. Money, then, is just the mathematized measure of capital available in the marketplace: it is the least common denominator among all economic goods and is necessarily the most liquid asset with the least mutable supply. It is used as a measuring system for the constantly shifting valuations of capital (this is why gold became money—it is the monetary metal with a supply that is most difficult to change). Ratios of money to capital (aka prices) are among the most important in the world, and ratios are a foundational element of being:

“In the beginning, there was the ratio, and the ratio was with God, and the ratio was God.” — John 1:1*

*(A more “rational” translation of Jesus’s beloved disciple John: the Greek word for ratio was λόγος (logos), which is also the term for word.)

An ability to more efficiently handle ratios directly contributed to mankind’s later development of rationality, a logic-based way of thinking at the root of major social movements such as the Renaissance, the Reformation, and the Enlightenment. To truly grasp the strange logic of zero, we must start with its point of origin—the philosophy from which it was born.

Philosophy of Zero

“In the earliest age of the gods, existence was born from non-existence.” — The Rig Veda

Zero arose from the bizarre logic of the ancient East. Interestingly, the Buddha himself was a known mathematician — in early books about him, like the Lalita Vistara, he is said to be excellent in numeracy (a skill he uses to woo a certain princess). In Buddhism, the logical character of the phenomenological world is more complex than true or false:

“Anything is either true,

Or not true,

Or both true and not true,

Or neither true nor not true.

This is the Lord Buddha’s teaching.”

This is the Tetralemma (or the four corners of the catuskoti): the key to understanding the seeming strangeness of this ancient Eastern logic is the concept of Shunya, a Hindi word meaning zero: it is derived from the Buddhist philosophical concept of Śūnyatā (or Shunyata). The ultimate goal of meditation is the attainment of enlightenment, or an ideal state of nirvana, which is equivalent to emptying oneself entirely of thought, desire, and worldly attachment. Achievement of this absolute emptiness is the state of being in Shunyata: a philosophical concept closely related to *the void*—as the Buddhist writer Thich Nhat Hanh describes it:

“The first door of liberation is emptiness, Shunyata

Emptiness always means empty of something

Emptiness is the Middle Way between existent and nonexistent

Reality goes beyond notions of being and nonbeing

True emptiness is called “wondrous being,” because it goes beyond existence and nonexistence

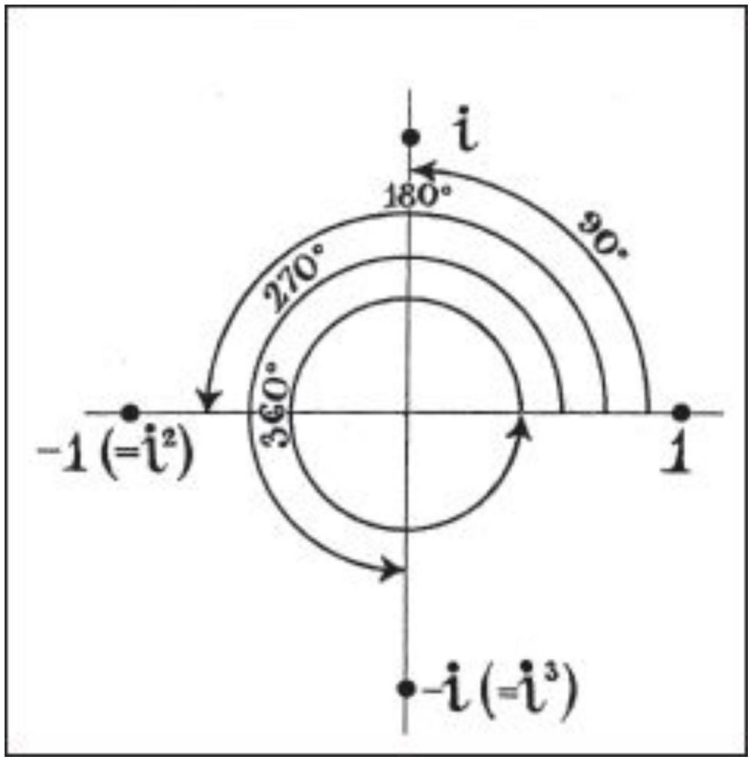
The concentration on Emptiness is a way of staying in touch with life as it is, but it has to be practiced and not just talked about.”

Or, as a Buddhist monk of ancient Wats temple in Southeast Asia described the meditative experience of the void:

"When we meditate, we count. We close our eyes and are aware only of where we are at in the moment, and nothing else. We count breathing in, 1; and we count breathing out, 2; and we go on this way. When we stop counting, that is the void, the number zero, the emptiness."

A direct experience of emptiness is achievable through meditation. In a true meditative state, the Shunyata and the number zero are one and the same. Emptiness is the conduit between existence and nonexistence, in the same way zero is the door from positive to negative numbers: each being a perfect reflection of the other. Zero arose in the ancient East as the epitome of this deeply philosophical and experiential concept of absolute emptiness. Empirically, today we now know that meditation benefits the brain in many ways. It seems too, that its contribution to the discovery of zero helped forge an idea that benefits mankind's collective intelligence — our global hive-mind.

Despite being discovered in a spiritual state, zero is a profoundly practical concept: perhaps it is best understood as a fusion of philosophy and pragmatism. By traversing across zero into the territory of negative numbers, we encounter the imaginary numbers, which have a base unit of the square root of -1, denoted by the letter i. _The number _i _is paradoxical: consider the equations $x^2 + 1 = 0$ and $x^3 + 1 = 0$, the only possible answers are positive square root of -1 (_i) and negative square root of -1 (-_i or i^3), respectively. Visualizing these real and imaginary domains, we find a rotational axis centered on zero with orientations reminiscent of the tetralemma: one true (1), one not true (_i), one both true and not true (-1 or i^2), and one neither true nor not true (-_i or i^3_):

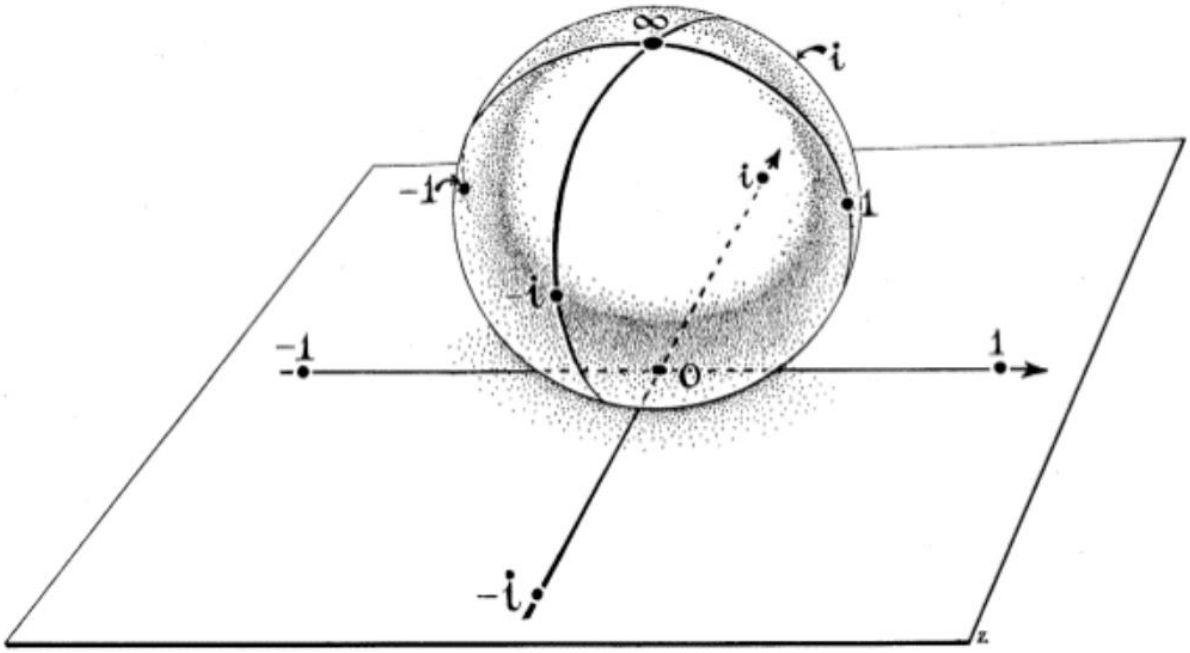


Zero is the fulcrum between real and imaginary number planes.

Going through the gateway of zero into the realms of negative and imaginary numbers provides a more continuous form of logic when compared to the discrete either-or logic, commonly accredited to Aristotle and his followers. This framework is less "black and white" than the binary Aristotelean logic system, which was based on true or false, and provides many gradations of logicality; a more accurate map to the many "shades of grey" we find in nature. Continuous logic is insinuated throughout the world: for instance, someone may say "she wasn't unattractive," meaning that her appeal

was ambivalent, somewhere between attractive and unattractive. This perspective is often more realistic than a binary assessment of attractive or not attractive.

Importantly, zero gave us the concept of infinity: which was notably absent from the minds of ancient Greek logicians. The rotations around zero through the real and imaginary number axes can be mathematically scaled up into a three-dimensional model called the *Riemann Sphere*. In this structure, zero and infinity are geometric reflections of one another and can transpose themselves in a flash of mathematical permutation. Always at the opposite pole of this three-dimensional, mathematical interpretation of the tetralemma, we find zero's twin—infinity:



Scaling the real and imaginary number planes into the third dimension, we discover zero's twin: infinity.

The twin polarities of zero and infinity are akin to yin and yang — as Charles Seife, author of *Zero: Biography of a Dangerous Idea*, describes them:

"Zero and infinity always looked suspiciously alike. Multiply zero by anything and you get zero. Multiply infinity by anything and you get infinity. Dividing a number by zero yields infinity; dividing a number by infinity yields zero. Adding zero to a number leaves it unchanged. Adding a number to infinity leaves infinity unchanged."

In Eastern philosophy, the kinship of zero and infinity made sense: only in a state of absolute nothingness can possibility become infinite. Buddhist logic insists that everything is endlessly intertwined: a vast causal network in which all is inexorably interlinked, such that no single thing can truly be considered independent — as having its own isolated, non-interdependent essence. In this view, interrelation is the sole source of substantiation. Fundamental to their teachings, this truth is what Buddhists call dependent co-origination, meaning that all things depend on one another. The only exception to this truth is nirvana:

liberation from the endless cycles of reincarnation. In Buddhism, the only pathway to nirvana is through pure emptiness:

Nirvana, the ultimate spiritual goal in Buddhism, is attained by entering the void in meditation—this is where zero was discovered.

Some ancient Buddhist texts state: "the truly absolute and the truly free must be nothingness." In this sense, the invention of zero was special; it can be considered the discovery of absolute nothingness, a latent quality of reality that was not previously presupposed in philosophy or systems of knowledge like mathematics. Its discovery would prove to be an emancipating force for mankind, in that zero is foundational to the mathematized, software-enabled reality of convenience we inhabit today.

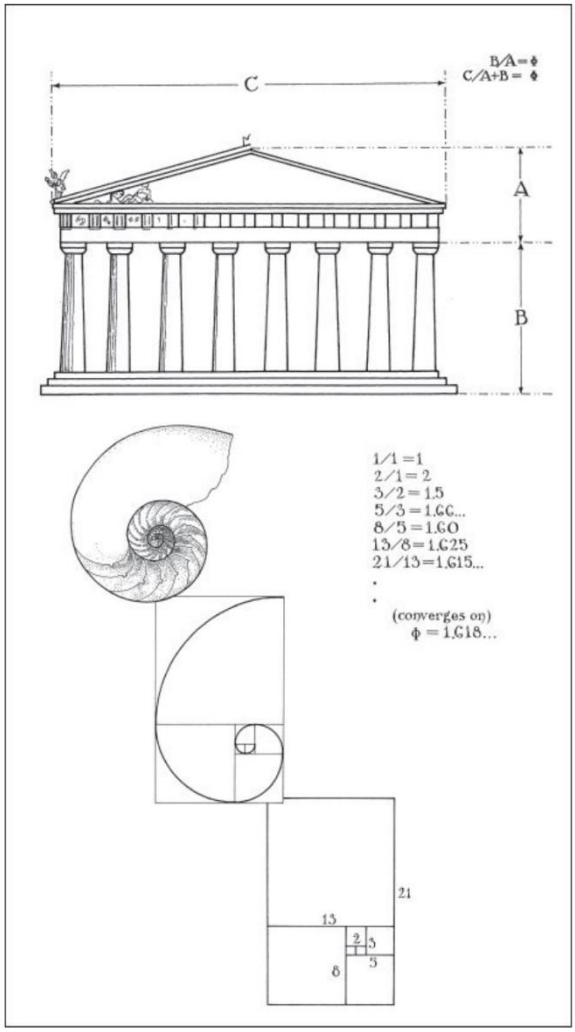
Zero was liberation discovered deep in meditation, a remnant of truth found in close proximity to nirvana — a place where one encounters universal, unbounded, and infinite awareness: God's kingdom within us. To buddhists, zero was a whisper from the universe, from dharma,_from _God (words always fail us in the domain of divinity). Paradoxically, zero would ultimately shatter the institution which built its power structure by monopolizing access to God. In finding footing in the void, mankind uncovered the deepest, soundest substrate on which to build modern society: zero would prove to be a critical piece of infrastructure that led to the interconnection of the world via telecommunications, which ushered in the gold standard and the digital age (Bitcoin's two key inceptors) many years later.

Blazing a path forward: the twin conceptions of zero and infinity would ignite the Renaissance, the Reformation, and the Enlightenment — all movements that mitigated the power of The Catholic Church as the dominant institution in the world and paved the way for the industrialized nation-state.

Power of The Church Falls to Zero

The universe of the ancient Greeks was founded on the philosophical tenets of Pythagoras, Aristotle, and Ptolemy. Central to their conception of the cosmos was the precept that there is no void, no nothingness, no zero. Greeks, who had inherited their numbers from the geometry-loving Egyptians, made little distinction between shape and number. Even today, when we square a number (x^2), this is equivalent to converting a line into a square and calculating its area. Pythagoreans were mystified by this connection between shapes and numbers, which explains why they didn't conceive of zero as a number: after all, what shape could represent nothingness? Ancient Greeks believed numbers had to be visible to be real, whereas the ancient Indians perceived numbers as an intrinsic part of a latent, invisible reality separate from mankind's conception of them.

The symbol of the Pythagorean cult was the pentagram (a five-pointed star); this sacred shape contained within it the key to their view of the universe—the golden ratio. Considered to be the "most beautiful number," the golden ratio is achieved by dividing a line such that the ratio of the small part to the large part is the same as the ratio of the large part to the whole. Such proportionality was found to be not only aesthetically pleasing, but also naturally occurring in a variety of forms including nautilus shells, pineapples, and (centuries later) the double-helix of DNA. Beauty this objectively pure was considered to be a window into the transcendent; a soul-sustaining quality. The golden ratio became widely used in art, music, and architecture:



A simple sequence of calculations converges on the golden ratio, the "beautiful number" bountiful in nature. Beauty of this caliber heavily influenced many domains including architecture (as seen in the design of The Parthenon here).

The golden ratio was also found in musical harmonics: when plucking a string instrument from its specified segments, musicians could create the *perfect fifth*, a dual resonance of notes said to be the most evocative musical relationship. Discordant tritones, on the other hand, were derided as the "devil in music." Such harmony of music was considered to be one and the same with that of mathematics and the universe—in the Pythagorean finite view of the cosmos (later called the Aristotelean *celestial spheres* model_), _movements of planets and other heavenly bodies generated a symphonic "harmony of the spheres"—a celestial music that suffused the cosmic depths. From the perspective of Pythagoreans, "all was number," meaning ratios ruled the universe. The golden ratio's seemingly supernatural connection to aesthetics, life, and the universe became a central tenet of Western Civilization and, later, The Catholic Church (aka The Church).

Zero posed a major threat to the conception of a finite universe. Dividing by zero is devastating to the framework of logic, and thus threatened the perfect order and integrity of a Pythagorean worldview. This was a serious problem for The Church which, after the fall of the Roman Empire, appeared as the dominant institution in Europe. To substantiate its dominion in the world, The Church proffered itself as the gatekeeper to heaven. Anyone who crossed The Church in any way could find themselves eternally barred from the holy gates. The Church's claim to absolute sovereignty was critically dependent on the Pythagorean model, as the dominant institution over Earth—which was in their view the center of the universe—necessarily held dominion in God's universe. Standing as a symbol for both the void and the infinite, zero was heretical to The Church. Centuries later, a similar dynamic would unfold in the discovery of absolute scarcity for money, which is dissident to the dominion of The Fed—the false church of modernity.

Ancient Greeks clung tightly to a worldview that did not tolerate zero or the infinite: rejection of these crucial concepts proved to be their biggest failure, as it prevented the discovery of calculus—the mathematical machinery on which much of the physical sciences and, thus, the modern world are constructed. Core to their (flawed) belief system was the concept of the "indivisible atom," the elementary particle which could not be subdivided ad infinitum. In their minds, there was no way beyond the micro barrier of the atomic surface. In the same vein, they considered the universe a "macrocosmic atom" that was strictly bound by an outermost sphere of stars winking down towards the cosmic core—Earth. As above, so below: with nothing conceived to be above this stellar sphere and nothing below the atomic surface, there was no infinity and no void:

A finite universe with Earth at the center was the central tenet of ancient Greek philosophy and, later, of The Catholic Church's institutional dominion over the world.

Aristotle (with later refinements by Ptolemy) would interpret this finite universe philosophically and, in doing so, form the ideological foundation for God's existence and The Church's power on Earth. In the Aristotelean conception of the universe, the force moving the stars, which drove the motion of all elements below, was the prime mover: God. This cascade of cosmic force from on high downward into the movements of mankind was considered the officially accepted interpretation of divine will. As Christianity swept through the West, The Church relied upon the explanatory power of this Aristotelean

philosophy as proof of God's existence in their proselytizing efforts. Objecting to the Aristotelean doctrine was soon considered an objection to the existence of God and the power of The Church.

Infinity was unavoidably actualized by the same Aristotelean logic which sought to deny it. By the 13th century, some bishops began calling assemblies to question the Aristotelean doctrines that went against the omnipotence of God: for example, the notion that "God can not move the heavens in a straight line, because that would leave behind a vacuum." If the heavens moved linearly, then what was left in their wake? Through what substance were they moving? This implied either the existence of the void (the vacuum), or that God was not truly omnipotent as he could not move the heavens. Suddenly, Aristotelean philosophy started to break under its own weight, thereby eroding the premise of The Church's power. Although The Church would cling to Aristotle's views for a few more centuries—it fought heresy by forbidding certain books and burning certain Protestants alive—zero marked the beginning of the end for this domineering and oppressive institution.

An infinite universe meant there were, at least, a vast multitude of planets, many of which likely had their own populations and churches. Earth was no longer the center of the universe, so why should The Church have universal dominion? In a grand ideological shift that foreshadowed the invention of Bitcoin centuries later, zero became the idea that broke The Church's grip on humanity, just as absolute scarcity of money is breaking The Fed's stranglehold on the world today. In an echo of history, us moderns can once again hear the discovery of nothing beginning to change everything.

Zero was the smooth stone slung into the face of Goliath, a death-stroke to the dominion of The Church; felled by an unstoppable idea, this oppressive institution's fall from grace would make way for the rise of the nation-state—the dominant institutional model in modernity.

Zero: An Ideological Juggernaut

Indoctrinated in The Church's dogma, Christianity initially refused to accept zero, as it was linked to a primal fear of the void. Zero's inexorable connection to nothingness and chaos made it a fearsome concept in the eyes of most Christians at the time. But zero's capacity to support honest weights and measures, a core Biblical concept, would prove more important than the countermeasures of The Church (and the invention of zero would later lead to the invention of the most infallible of weights and measures, the most honest money in history—Bitcoin). In a world being built on trade, merchants needed zero for its superior arithmetic utility. As Pierre-Simon Laplace said:

"...[zero is] a profound and important idea which appears so simple to us now that we ignore its true merit. But its very simplicity and the great ease which it lent to all computations put our arithmetic in the first rank of useful inventions."

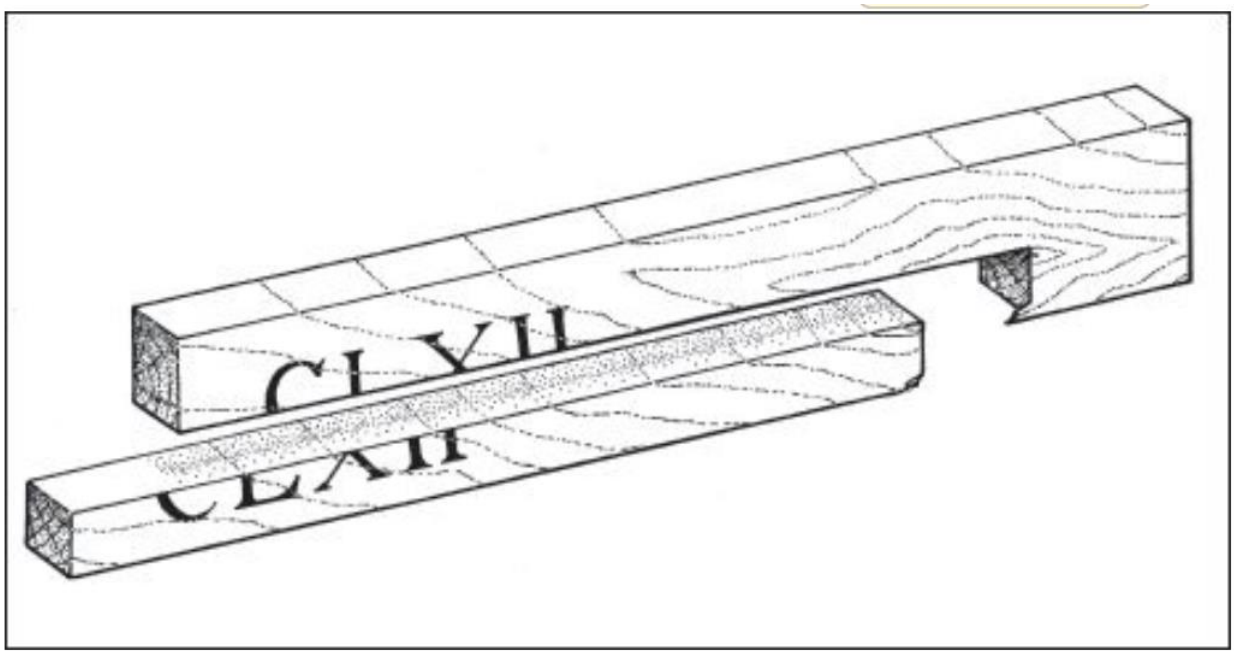
In the 13th century, academics like the renowned Italian mathematician Fibonacci began championing zero in their work, helping the Hindu-Arabic system gain credibility in Europe. As trade began to flourish and generate unprecedented levels of wealth in the world, math moved from purely practical applications to ever more abstracted functions. As Alfred North Whitehead said:

"The point about zero is that we do not need to use it in the operations of daily life. No one goes out to buy zero fish. It is in a way the most civilized of all the cardinals, and its use is only forced on us by the needs of cultivated modes of thought."

As our thinking became more sophisticated, so too did our demands on math. Tools like the abacus relied upon a set of sliding stones to help us keep track of amounts and perform calculation. An abacus was like an ancient calculator, and as the use of zero became popularized in Europe, competitions were held between users of the abacus (the abacists) and of the newly arrived Hindu-Arabic numeral system (the algorists) to see who could solve complex calculations faster. With training, algorists could readily outpace abacists in computation. Contests like these led to the demise of the abacus as a useful tool, however it still left a lasting mark on our language: the words calculate, calculus, and calcium are all derived from the Latin word for pebble—calculus.

The algorists competing against the abacists: contests like these empirically proved the supremacy of a zero-based numeral system over others, even when aided by ancient mathematical tools like the abacus.

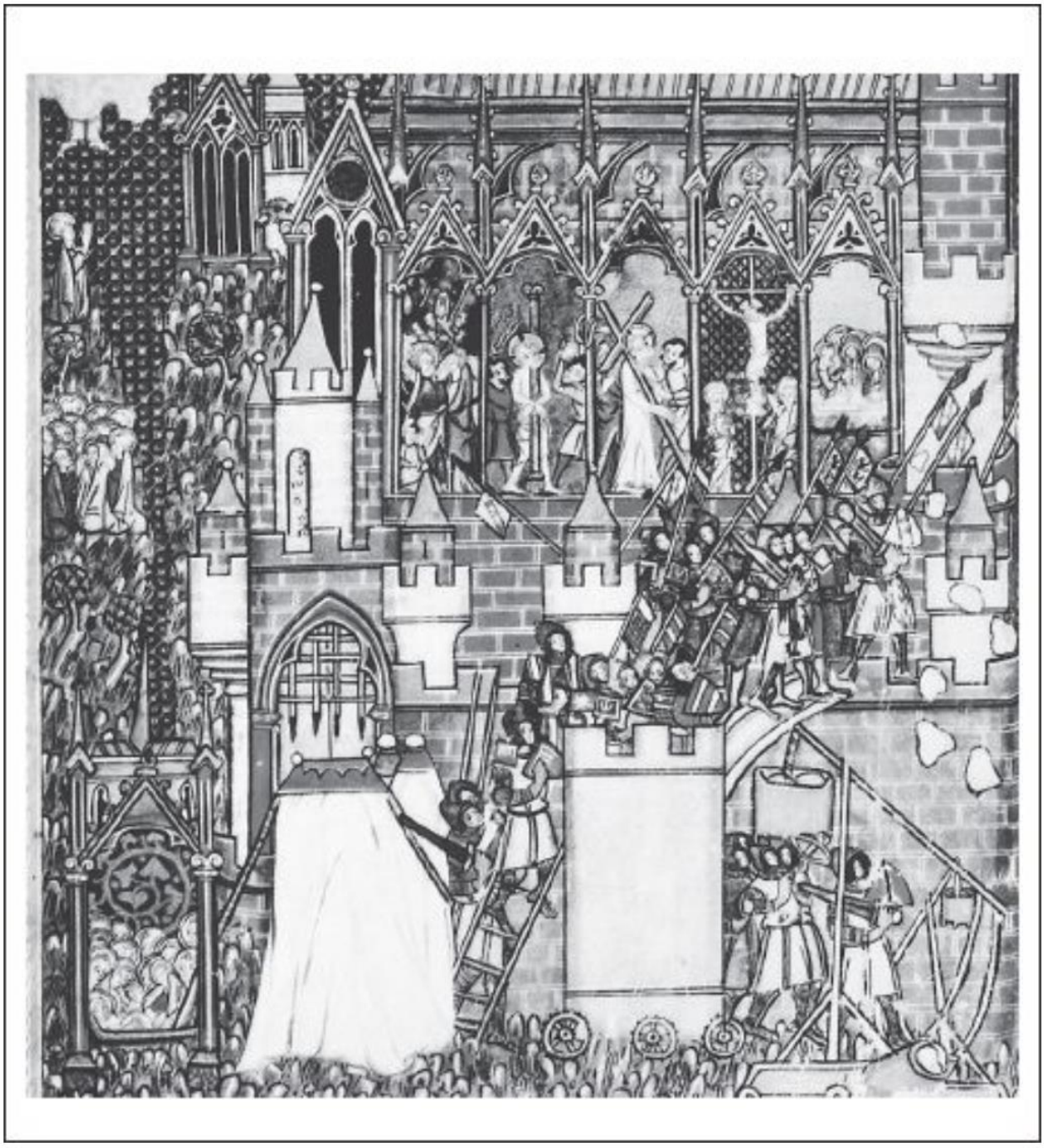
Before the Hindu-Arabic numerals, money counters had to use the abacus or a counting board to keep track of value flows. Germans called the counting board a Rechenbank, which is why moneylenders came to be known as banks. Not only did banks use counting boards, but they also used tally sticks to keep track of lending activities: the monetary value of a loan was written on the side of a stick, and it was split into two pieces, with the lender keeping the larger piece, known as the stock—which is where we get the term stockholder:



An ancient loan tracking device called a _tally stick: the lender kept the larger portion, the stock, and became a stockholder in the bank that made the loan._

Despite its superior utility for business, governments despised zero. In 1299, Florence banned the Hindu-Arabic numeral system. As with many profound innovations, zero faced vehement resistance from entrenched power structures that were threatened by its existence. Carrying on lawlessly, Italian merchants continued to use the zero-based numeral system, and even began using it to transmit encrypted messages. Zero was essential to these early encryption systems—which is why the word cipher, which originally meant zero, came to mean "secret code." The criticality of zero to ancient encryption systems is yet another aspect of its contribution to Bitcoin's ancestral heritage.

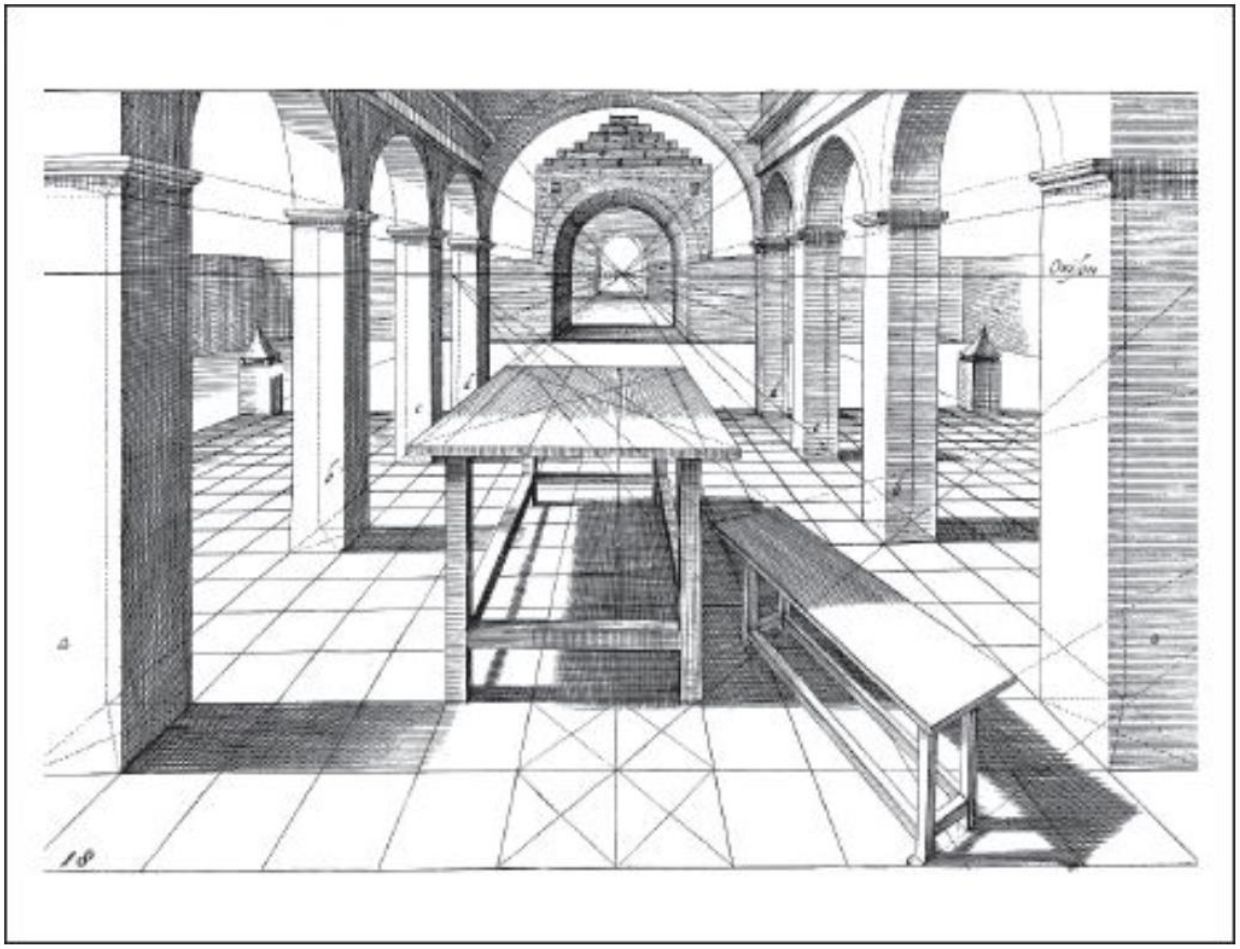
At the beginning of the Renaissance, the threat zero would soon pose to the power of The Church was not obvious. By then, zero had been adapted as an artistic tool to create the vanishing point: an acute place of infinite nothingness used in many paintings that sparked the great Renaissance in the visual arts. Drawings and paintings prior to the vanishing point appear flat and lifeless: their imagery was mostly two-dimensional and unrealistic. Even the best artists couldn't capture realism without the use of zero:



Pre-Renaissance art: still better than a banana duct taped to a canvas.

With the concept of zero, artists could create a zero-dimension point in their work that was "infinitely far" from the viewer, and into which all objects in the painting visually collapsed. As objects appear to recede from the viewer into the distance, they become ever-more compressed into the "dimensionlessness" of the vanishing point, before finally disappearing. Just as it does today, art had a strong influence on people's perceptions. Eventually, Nicholas of Cusa, a cardinal of The Church declared, "Terra non est centra mundi," which meant "the Earth is not the center of the universe." This declaration

would later lead to Copernicus proving heliocentrism—the spark that ignited The Reformation and, later, the Age of Enlightenment:



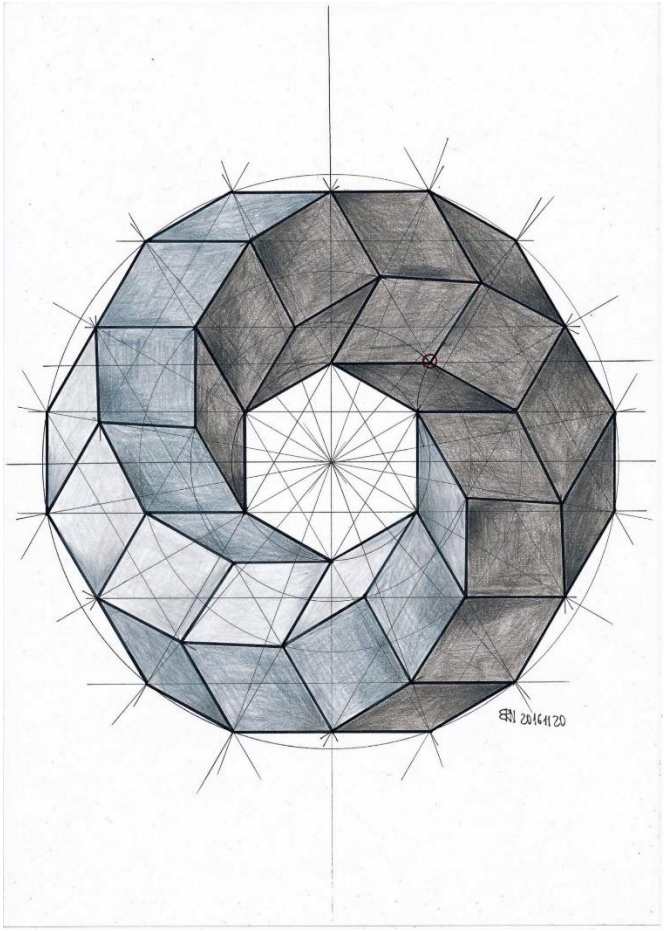
By adding the vanishing point (a visual conception of zero) to drawings and paintings, art gained the realistic qualities of depth, breadth, and spatial proportion.

A dangerous, heretical, and revolutionary idea had been planted by zero and its visual incarnation, the vanishing point. At this point of infinite distance, the concept of zero was captured visually, and space was made infinite—as Seife describes it:

"It was no coincidence that zero and infinity are linked in the vanishing point. Just as multiplying by zero causes the number line to collapse into a point, the vanishing point has caused most of the universe to sit in a tiny dot. This is a singularity, a concept that became very important later in the history of science—but at this early stage, mathematicians knew little more than the artists about the properties of zero."

The purpose of the artist is to the mythologize the present: this is evident in much of the consumerist "trash art" produced in our current fiat-currency-fueled world. Renaissance artists (who were often also mathematicians, true Renaissance men) worked assiduously in line with this purpose as the vanishing point became an increasingly popular element of art in lockstep with zero's proliferation across the world. Indeed, art accelerated the propulsion of zero across the mindscape of mankind.

Modernity: The Age of Ones and Zeros



Eventually, zero became the cornerstone of calculus: an innovative system of mathematics that enabled people to contend with ever-smaller units approaching zero, but cunningly avoided the logic-trap of having to divide by zero. This new system gave mankind myriad new ways to comprehend and grasp his surroundings. Diverse disciplines such as chemistry, engineering, and physics all depend on calculus to fulfill their functions in the world today:

Calculus enables us to make symphonic arrangements of matter in precise accordance with our imaginations; this mathematical study of continuous change is fundamental to all physical sciences.

Zero serves as the source-waters of many technological breakthroughs—some of which would flow together into the most important invention in history: Bitcoin. Zero punched a hole and created a vacuum in the framework of mathematics and shattered Aristotelean philosophy, on which the power of The Church was premised. Today, Bitcoin is punching a hole and creating a vacuum in the market for money; it is killing Keynesian economics—which is the propagandistic power-base of the nation-state (along with its apparatus of theft: the central bank).

In modernity, zero has become a celebrated tool in our mathematical arsenal. As the binary numerical system now forms the foundation of modern computer programming, zero was essential to the development of digital tools like the personal computer, the internet, and Bitcoin. Amazingly, all modern miracles made possible by digital technologies can be traced back to the invention of a figure for numeric nothingness by an ancient Indian mathematician: Brahmagupta gave the world a real "something for nothing," a generosity Satoshi would emulate several centuries later. As Aczel says:

"Numbers are our greatest invention, and zero is the capstone of the whole system."

A composition of countless zeroes and ones, binary code led to the proliferation and standardization of communications protocols including those embodied in the internet protocol suite. As people freely experimented with these new tools, they organized themselves around the most useful protocols like http, TCP/IP, etc. Ossification of digital communication standards provided the substrate upon which new societal utilities—like email, ride sharing, and mobile computing—were built. Latest (and arguably the

greatest) among these digital innovations is the uninflatable, unconfiscatable, and unstoppable money called Bitcoin.

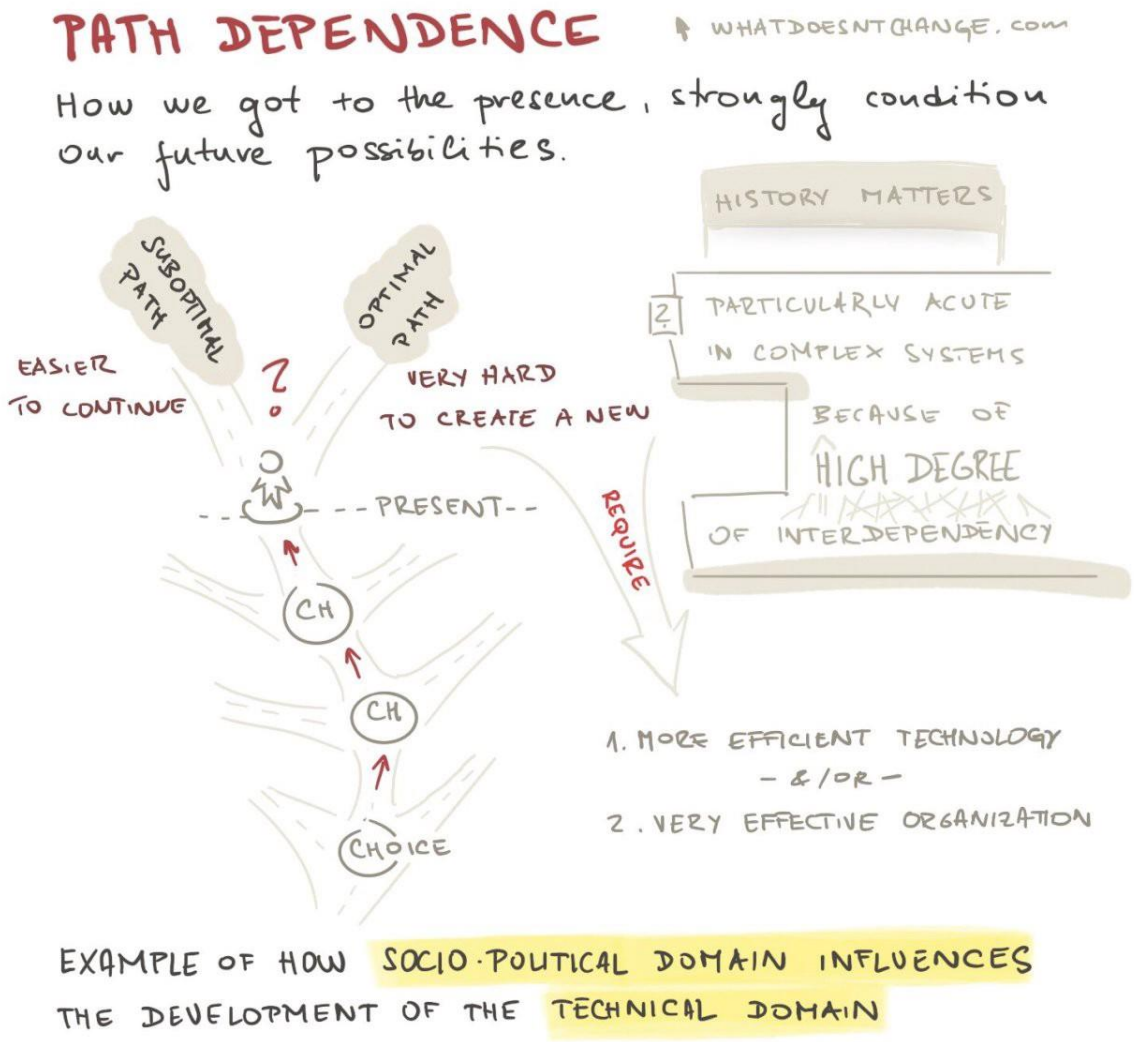
A common misconception of Bitcoin is that it is just one of thousands of cryptoassets in the world today. One may be forgiven for this misunderstanding, as our world today is home to many national currencies. But all these currencies began as warehouse receipts for the same type of thing—namely, monetary metal (usually gold). Today, national currencies are not redeemable for gold, and are instead liquid equity units in a pyramid scheme called fiat currency: a hierarchy of thievery built on top of the freely selected money of the world (gold) which their issuers (central banks) hoard to manipulate its price, insulate their inferior fiat currencies from competitive threats, and perpetually extract wealth from those lower down the pyramid.

Given this confusion, many mistakenly believe that Bitcoin could be disrupted by any one of the thousands of alternative cryptoassets in the marketplace today. This is understandable, as the reasons that make Bitcoin different are not part of common parlance and are relatively difficult to understand. Even Ray Dalio, the greatest hedge fund manager in history, said that he believes Bitcoin could be disrupted by a competitor in the same way that iPhone disrupted Blackberry. However, disruption of Bitcoin is extremely unlikely: Bitcoin is a path-dependent, one-time invention; its critical breakthrough is the discovery of absolute scarcity—a monetary property never before (and never again) achievable by mankind.

Like the invention of zero, which led to the discovery of "nothing as something" in mathematics and other domains, Bitcoin is the catalyst of a worldwide paradigmatic phase change (which some have started calling The Great Awakening). What numeral is to number, and zero is to the void for mathematics, Bitcoin is to absolute scarcity for money: each is a symbol that allows mankind to apprehend a latent reality (in the case of money, time). More than just a new monetary technology, Bitcoin is an entirely new economic paradigm: an uncompromisable base money protocol for a global, digital, non-state economy. To better understand the profundity of this, we first need to understand the nature of path-dependence.

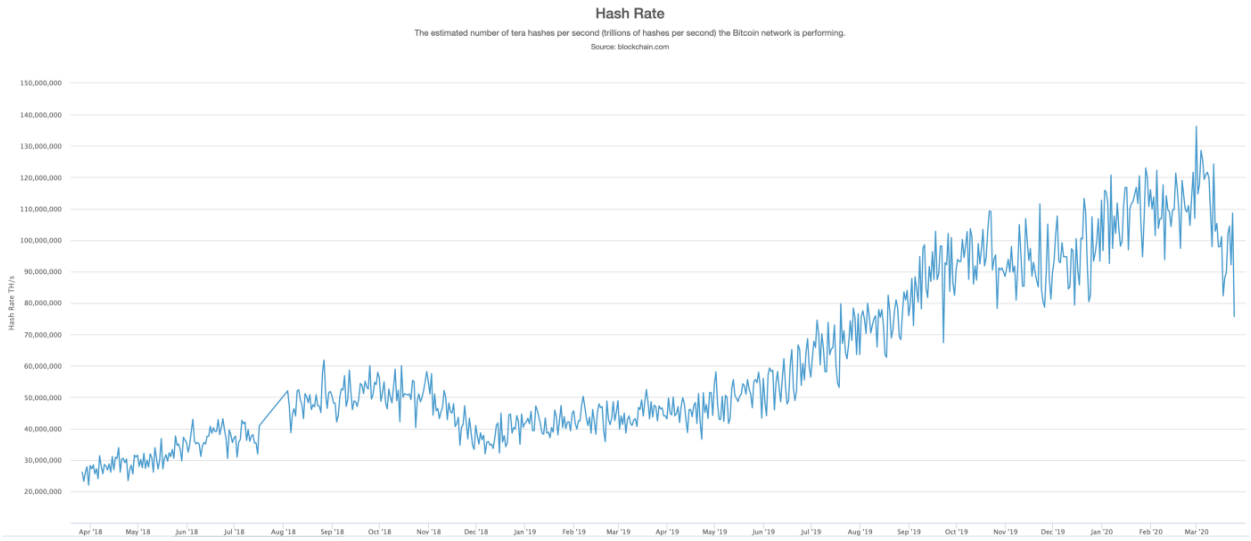
The Path-Dependence of Bitcoin

Path-dependence is the sensitivity of an outcome to the order of events that led to it. In the broadest sense, it means history has inertia:



Path-dependence entails that the sequence of events matters as much as the events themselves: as a simple example, you get a dramatically different result if you shower and then dry yourself off versus if you dry yourself off first and then shower. Path-dependence is especially prevalent in complex systems due to their high interconnectivity and numerous (often unforeseeable) interdependencies. Once started down a particular pathway, breaking away from its sociopolitical inertia can become impossible—for instance, imagine if the world tried to standardize to a different size electrical outlet: consumers, manufacturers, and suppliers would all resist this costly change unless there was a gigantic prospective gain. To coordinate this shift in standardization would require either a dramatically more efficient technology (a pull method—by which people stand to benefit) or an imposing organization to force the change (a push method—in which people would be forced to change in the face of some threat). Path-dependence is why occurrences in the sociopolitical domain often influence developments in the technical; US citizens saw path-dependent pushback firsthand when their government made a failed attempt to switch to the metric system back in the 1970s.

Bitcoin was launched into the world as a one of a kind technology: a non-state digital money that is issued on a perfectly fixed, diminishing, and predictable schedule. It was strategically released into the wild (into an online group of cryptographers) at a time when no comparative technology existed. Bitcoin's organic adoption path and mining network expansion are a non-repeatable sequence of events. As a thought experiment, consider that if a "New Bitcoin" was launched today, it would exhibit weak chain security early on, as its mining network and hash rate would have to start from scratch. Today, in a world that is aware of Bitcoin, this "New Bitcoin" with comparatively weak chain security would inevitably be attacked—whether these were incumbent projects seeking to defend their head start, international banking cartels, or even nation-states:

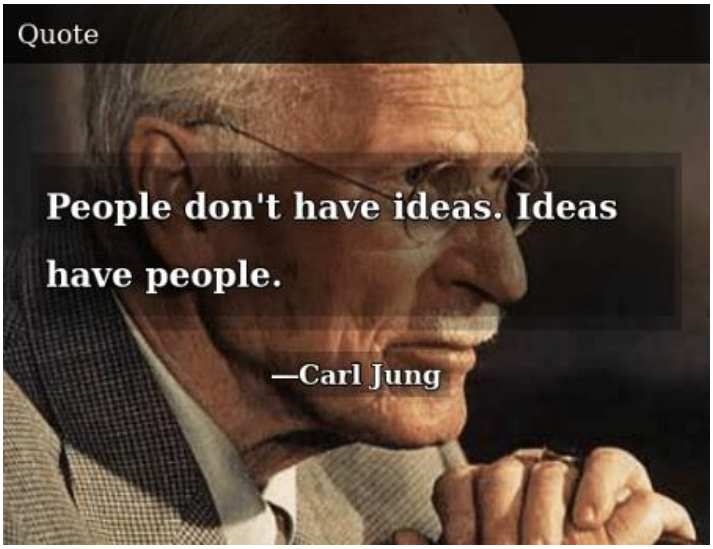


Bitcoin's head start in hash rate is seemingly insurmountable.

Path-dependence protects Bitcoin from disruption, as the organic sequence of events which led to its release and assimilation into the marketplace cannot be replicated. Further, Bitcoin's money supply is absolutely scarce; a totally unique and one-time discovery for money. Even if "New Bitcoin" was released with an absolutely scarce money supply, its holders would be incentivized to hold the money with the greatest liquidity, network effects, and chain security. This would cause them to dump "New Bitcoin" for the original Bitcoin. More realistically, instead of launching "New Bitcoin," those seeking to compete with Bitcoin would take a social contract attack-vector by initiating a hard fork. An attempt like this was already made with the "Bitcoin Cash" fork, which tried to increase block sizes to (ostensibly) improve its utility for payments. This chain fork was an abject failure and a real world reinforcement of the importance of Bitcoin's path-dependent emergence:

Bitcoin Cash is considering a rebrand to Bitcoin Crash.

Continuing our thought experiment: even if "New Bitcoin" featured a diminishing money supply (in other words, a deflationary monetary policy), how would its rate of money supply decay (deflation) be determined? By what mechanism would its beneficiaries be selected? As market participants (nodes and miners) jockeyed for position to maximize their accrual of economic benefit from the deflationary monetary policy, forks would ensue that would diminish the liquidity, network effects, and chain security for "New Bitcoin," causing everyone to eventually pile back into the original Bitcoin—just like they did in the wake of Bitcoin Cash's failure.



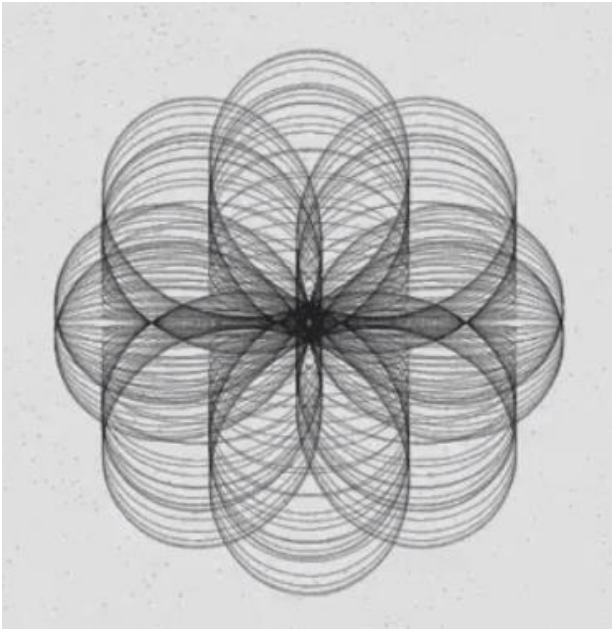
Path-dependence ensures that those who try to game Bitcoin get burned. Reinforced by four-sided network effects, it makes Bitcoin's first-mover advantage seemingly insurmountable. The idea of absolute monetary scarcity goes against the wishes of entrenched power structures like The Fed: like zero, once an idea whose time has come is released into the world, it is nearly impossible to put the proverbial genie back in the bottle. After all, unstoppable ideas are independent lifeforms:

Finite and Infinite Games

Macroeconomics is essentially the set of games played globally to satisfy the demands of mankind (which are infinite) within the bounds of his time (which is strictly finite). In these games, scores are tracked in monetary terms. Using lingo from the groundbreaking book *Finite and Infinite Games*, there are two types of economic games: unfree (or centrally planned) markets are theatrical, meaning that they are performed in accordance with a predetermined script that often entails dutifulness and disregard for humanity. The atrocities committed in Soviet Russia are exemplary of the consequences of a theatrical economic system. On the other hand, free markets are dramatic, meaning that they are enacted in the present according to consensual and adaptable boundaries. Software development is a good example of a dramatic market, as entrepreneurs are free to adopt the rules, tools, and protocols that best serve customers. Simply: theatrical games are governed by imposed rules (based on tyranny), whereas rulesets for dramatic games are voluntarily adopted (based on individual sovereignty).

From a moral perspective, sovereignty is always superior to tyranny. And from a practical perspective, tyrannies are less energy-efficient than free markets because they require tyrants to expend resources enforcing compliance with their imposed rulesets and protecting their turf. Voluntary games (free market capitalism) outcompete involuntary games (centrally planned socialism) as they do not accrue these enforcement and protection costs: hence the reason capitalism (freedom) outcompetes socialism (slavery) in the long run. Since interpersonal interdependency is at the heart of the comparative advantage and division of labor dynamics that drive the value proposition of cooperation and competition, we can say that money is an infinite game: meaning that its purpose is not to win, but rather to continue to play. After all, if one player had all the money, the game would end (like the game of Monopoly).

In this sense, Bitcoin's terminal money supply growth (inflation) rate of absolute zero is the ultimate monetary Schelling point — a game-theoretic focal point that people tend to choose in an adversarial game. In game theory, a game is any situation where there can be winners or losers, a strategy is a decision-making process, and a Schelling point is the default strategy for games in which the players cannot fully trust one another (like money):



Among many spheres of competing interpersonal interests, scarcity is the Schelling point of money.

Economic actors are incentivized to choose the money that best holds its value across time, is most widely accepted, and most clearly conveys market pricing information. All three of these qualities are rooted in scarcity: resistance to inflation ensures that money retains its value and ability to accurately price capital across time, which leads to its use as an exchange medium. For these reasons, holding the scarcest money is the most energy-efficient strategy a player can employ, which makes the absolute scarcity

of Bitcoin an irrefutable Schelling point—a singular, unshakable motif in games played for money.

A distant digital descendent of zero, the invention of Bitcoin represents the discovery **of absolute scarcity for money: an idea as equally unstoppable.**

Similar to the discovery of absolute nothingness symbolized by zero, the discovery of absolutely scarce money symbolized by Bitcoin is special. Gold became money because out of the monetary metals it had the most inelastic (or relatively scarce) money supply: meaning that no matter how much time was allocated towards gold production, its supply increased the least. Since its supply increased the slowest and most predictable rate, gold was favored for storing value and pricing things—which encouraged people to voluntarily adopt it, thus making it the dominant money on the free market. Before Bitcoin, gold was the world's monetary Schelling point, because it made trade easier in a manner that minimized the need to trust other players. Like its digital ancestor zero, Bitcoin is an invention that radically enhances exchange efficiency by purifying informational transmissions: for zero, this meant instilling more meaning per proximate digit, for Bitcoin, this means generating more salience per price signal. In the game of money, the objective has always been to hold the most relatively scarce monetary metal (gold); now, the goal is to occupy the most territory on the absolutely scarce monetary network called Bitcoin.

A New Epoch for Money

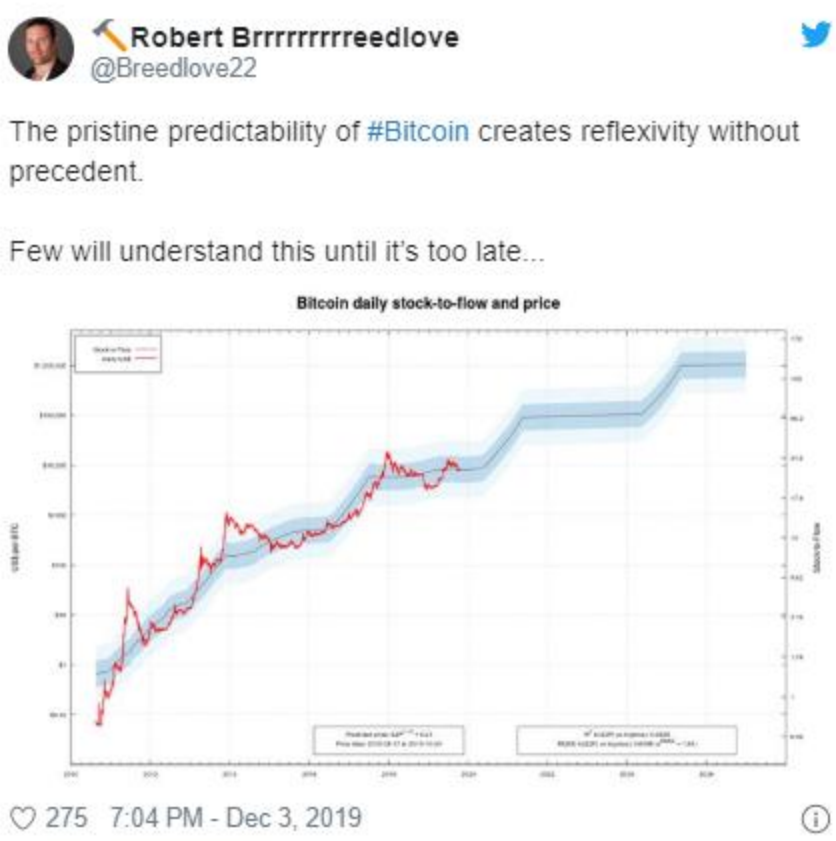
Historically, precious metals were the best monetary technologies in terms of money's five critical traits: divisibility, durability, portability, recognizability, and scarcity. Among the monetary metals, gold was relatively the most scarce, and therefore it outcompeted others in the marketplace as it was a more sound store of value. In the ascension of gold as money, it was as if free market dynamics were trying to zero-in on a sufficiently divisible, durable, portable, and recognizable monetary technology that was also absolutely scarce (strong arguments for this may be found by studying the Eurodollar system). Free markets are distributed computing systems that zero-in on the most useful prices and technologies based on the prevailing demands of people and the available supplies of capital: they constantly assimilate all of mankind's intersubjective perspectives on the world within the bounds of objective reality to produce our best approximations of truth. In this context, verifiable scarcity is the best proxy for the truthfulness of money: assurance that it will not be debased over time.

As a (pre-Bitcoin) thought experiment, had a "new gold" been discovered in the Earth's crust, assuming it was mostly distributed evenly across the Earth's surface and was exactly comparable to gold in terms of these five monetary traits (with the exception that it was more scarce), free market dynamics would have led to its selection as money, as it would be that much closer to absolute scarcity, making it a better means of storing value and propagating price signals. Seen this way, gold as a monetary technology was the closest the free market could come to absolutely scarce money before it was discovered in its only possible form—digital. The supply of any physical thing can only be limited by the time necessary to procure it: if we could flip a switch and force everyone on Earth to make their sole occupation gold mining, the supply of gold would soon soar. Unlike Bitcoin, no physical form of money could possibly guarantee a permanently fixed supply—so far as we know, absolute scarcity can only be digital.

Digitization is advantageous across all five traits of money. Since Bitcoin is just information, relative to other monetary technologies, we can say: its divisibility is supreme, as information can be infinitely

subdivided and recombined at near-zero cost (like numbers); its durability is supreme, as information does not decompose (books can outlast empires); its portability is supreme, as information can move at the speed of light (thanks to telecommunications); and its recognizability is supreme, as information is the most objectively discernible substance in the universe (like the written word). Finally, and most critically, since Bitcoin algorithmically and thermodynamically enforces an absolutely scarce money supply, we can say that its scarcity is infinite (as scarce as time, the substance money is intended to tokenize in the first place). Taken in combination, these traits make absolutely scarce digital money seemingly indomitable in the marketplace.

In the same way that the number zero enables our numeric system to scale and more easily perform calculation, so too does money give an economy the ability to socially scale by simplifying trade and economic calculation. Said simply: scarcity is essential to the utility of money, and a zero-growth terminal money supply represents "perfect" scarcity — which makes Bitcoin as near a "perfect" monetary technology as mankind has ever had. Absolute scarcity is a monumental monetary breakthrough. Since money is valued according to reflexivity, meaning that investor perceptions of its future exchangeability influence its present valuation, Bitcoin's perfectly predictable and finite future supply underpins an unprecedented rate of expansion in market capitalization:



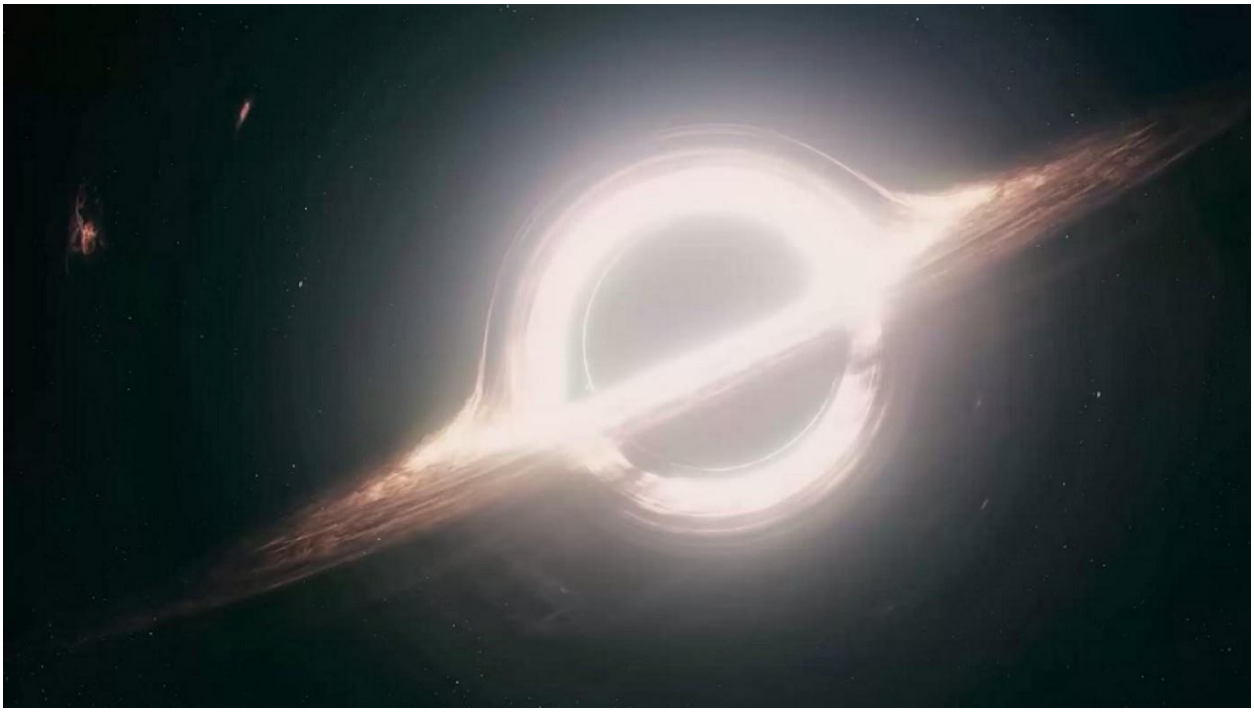
Bitcoin is truly unique: a perfectly scarce and predictably supplied money.

In summary: the invention of Bitcoin represents the discovery of absolute scarcity, or absolute irreproducibility, which occurred due to a particular sequence of idiosyncratic events that cannot be reproduced. Any attempt to introduce an absolutely scarce or diminishing supplied money into the world would likely collapse into Bitcoin (as we saw with the Bitcoin Cash fork). Absolute scarcity is a one-time discovery, just like heliocentrism or any other major scientific paradigm shift. In a world where Bitcoin already exists, a successful launch via a proof-of-work system is no longer possible due to path-dependence; yet another reason why Bitcoin cannot be replicated or disrupted by another cryptoasset using this consensus mechanism. At this point, it seems

absolute scarcity for money is truly a one-time discovery that cannot "disrupted" any more than the concept of zero can be disrupted.

A true "Bitcoin killer" would necessitate an entirely new consensus mechanism and distribution model; with an implementation overseen by an unprecedentedly organized group of human beings: nothing to date has been conceived that could even come close to satisfying these requirements. In the same way that there has only ever been one analog gold, there is likely to only ever be one digital gold. For the same quantifiable reasons a zero-based numeral system became a dominant mathematical protocol, and capitalism outcompetes socialism, the absolute scarcity of Bitcoin's supply will continue outcompeting all other monetary protocols in its path to global dominance.

Numbers are the fundamental abstractions which rule our world. Zero is the vanishing point of the mathematical landscape. In the realm of interpersonal competition and cooperation, money is the dominant abstraction which governs our behavior. Money arises naturally as the most tradable thing within a society—this includes exchanges with others and with our future selves. Scarcity is the trait of money that allows it to hold value across time, enabling us to trade it with our future selves for the foregone opportunity costs (the things we could have otherwise traded money for had we not decided to hold it). Scarce money accrues value as our productivity grows. For these reasons, the most scarce technology which otherwise exhibits sufficient monetary traits (divisibility, durability, recognizability, portability) tends to become money. Said simply: the most relatively scarce money wins. In this sense, what zero is to math, absolute scarcity is to money. It is an astonishing discovery, a window into the void, just like its predecessor zero:

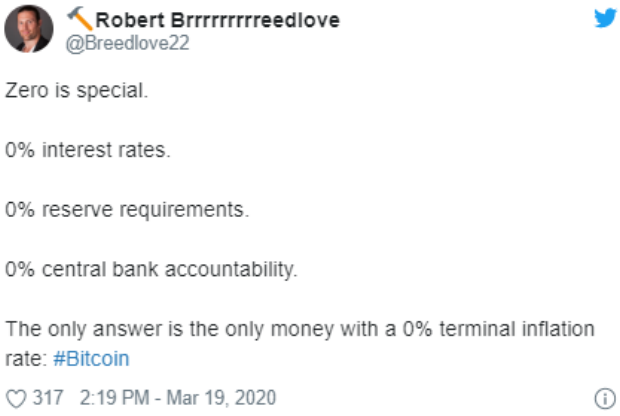


Actual footage of Bitcoin devouring fiat currencies.

Bitcoin is the global economic singularity: the ultimate monetary center of gravity — an exponential devourer of liquid value in the world economy, the epitome of time, and the zero-point of money.

Fiat Currency Always Falls to Zero

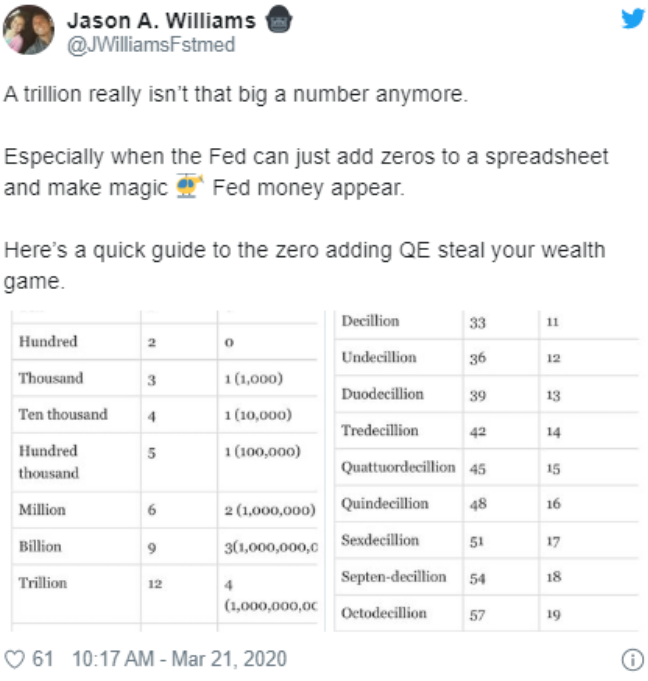
Zero has proven itself as the capstone of our numeral system by making it scalable, invertible, and easily convertible. In time, Bitcoin will prove itself as the most important network in the global economic system by increasing social scalability, causing an inversion of economic power, and converting culture into a realignment with Natural Law. Bitcoin will allow sovereignty to once again inhere at the individual level, instead of being usurped at the institutional level as it is today—all thanks to its special forebear, zero:



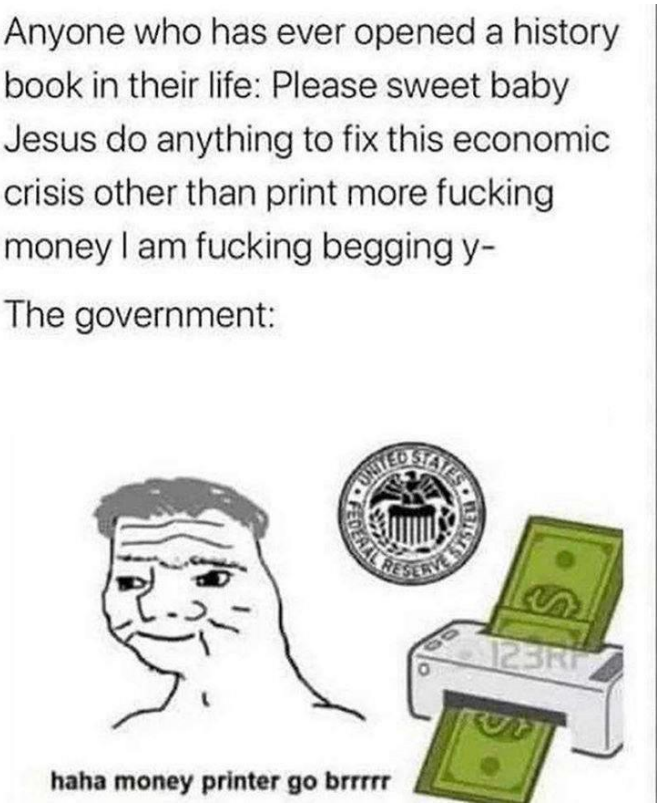
Central planning in the market for money (aka monetary socialism) is dying. This tyrannical financial hierarchy has increased worldwide wealth disparities, funded perpetual warfare, and plundered entire commonwealths to "bail out" failing institutions. A reversion to the free market for money is the only way to heal the devastation it has wrought over the past 100+ years. Unlike central bankers, who are fallible human beings that give into political pressure to pillage value from people by printing money, Bitcoin's monetary policy does not bend for anyone: it gives zero fucks. And in a world where central banks can "just add zeros" to steal your wealth, people's only hope is a "zero fucks" money that cannot be confiscated, inflated, or stopped:

Central banks literally "just add zeros" to steal vast swathes of societal wealth.

Bitcoin was specifically designed as a countermeasure to "expansionary monetary policies" (aka wealth confiscation via inflation) by central bankers. Bitcoin is a true zero-to-one invention, an innovation that profoundly changes society instead of just introducing an incremental advancement. Bitcoin is ushering in a new paradigm for money, nation-states, and energy-efficiency. Most importantly, it promises to break the cycle of criminality in which governments continuously privatize gains (via seigniorage) and socialize losses (via inflation). Time and time again, excessive inflation has torn societies apart, yet the lessons of history remain unlearned—once again, here we are:



Thank you internet for all the hilarious yet meaningful memes.



The Zero Hour

How much longer will monetary socialism remain an extant economic model? The countdown has already begun: Ten. Nine. Eight. Seven. Six. Five. Four. Three. Two. One. Liftoff. Rocket technicians always wait for zero before ignition; countdowns always finalize at the zero hour. Oil price wars erupting in Eurasia, a global pandemic, an unprecedented expansionary monetary policy response, and another quadrennial Bitcoin inflation-rate halving: 2020 is quickly becoming the zero hour for Bitcoin.

Inflation rate and societal wellbeing are inversely related: the more reliably value can be stored across time, the more trust can be cultivated among market participants. When a money's roots to economic reality are severed—as happened when the peg to gold was broken and fiat currency was born—its supply inevitably trends towards infinity (hyperinflation) and the functioning of its underlying society deteriorates towards zero (economic collapse). An unstoppable free market alternative, Bitcoin is anchored to economic reality (through proof-of-work energy expenditure) and has an inflation rate predestined for zero, meaning that a society operating on a Bitcoin standard would stand to gain in virtually infinite ways. When Bitcoin's inflation rate finally reaches zero in the mid 22nd century, the measure of its soundness as a store of value (the stock-to-flow ratio) will become infinite; people that realize this and adopt it early will benefit disproportionately from the resultant mass wealth transfer.

Zero and infinity are reciprocal: $1/\infty = 0$ and $1/0 = \infty$. In the same way, a society's wellbeing shrinks towards zero the more closely the inflation rate approaches infinity (through the hyperinflation of fiat currency). Conversely, societal wellbeing can, in theory, be expanded towards infinity the more closely the inflation rate approaches zero (through the absolute scarcity of Bitcoin).Remember: The Fed is now doing whatever it takes to make sure there is "infinite cash" in the banking system, meaning that its value will eventually fall to zero:

Market value of money always converges to its marginal cost of production: "Infinite cash" means dollars will inevitably become as valuable as the paper on which they are printed.

Zero arose in the world as an unstoppable idea because its time had come; it broke the dominion of The Church and put an end to its monopolization over access to knowledge and the gates to heaven. The resultant movement—The Separation of Church and State—reinvigorated self-sovereignty in the world, setting the individual firmly as the cornerstone of the state. Rising from The Church's ashes came a nation-state model founded on sound property rights, rule of law, and free market money (aka hard money). With this new age came an unprecedented boom in scientific advancement, wealth creation, and worldwide wellbeing. In the same way, Bitcoin and its underlying discovery of absolute scarcity for money is an idea whose time has come. Bitcoin is shattering the siege of central banks on our financial sovereignty; it is invoking a new movement—The Separation of Money and State—as its revolutionary banner; and it is restoring Natural Law in a world ravaged by a mega-wealth-parasite—The Fed.

Only unstoppable ideas can break otherwise immovable institutions: zero brought The Church to its knees and Bitcoin is bringing the false church of The Fed into the sunlight of its long-awaited judgement day.

Both zero and Bitcoin are emblematic of the void, a realm of pure potentiality from which all things spring forth into being — the nothingness from which everything effervesces, and into which all possibility finally collapses. Zero and Bitcoin are unstoppable ideas gifted to mankind; gestures made in the spirit of "something for nothing." In a world run by central banks with zero accountability, a cabal that uses the specious prospects of "infinite cash" to promise us everything (thereby introducing the specter of hyperinflation), nothingness may prove to be the greatest gift we could ever receive...

Thank you Brahmagupta and Satoshi Nakamoto for your generosity.

Everything is Nothing.

0

With a Twist.

∞

Thank you for reading The Number Zero and Bitcoin.

Follow me on Twitter: https://twitter.com/Breedlove22

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Thank you Charles Seife, author of Zero: The Biography of a Dangerous Idea, whose work inspired much of this essay. Many images used exploring the history of zero came from his book: https://www.amazon.com/gp/product/B000QUEHLM/ref=ppx_yo_dt_b_search_asin_title?ie=UTF8&psc=1

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Thanks to Ben Prentice and Stephen Cole.

Masters and Slaves of Money

By Robert Breedlove

Posted July 5, 2020

Money is a tool for trading human time. Central banks, the modern-era masters of money, wield this tool as a weapon to steal time and inflict wealth inequality. History shows us that the corruption of monetary systems leads to moral decay, social collapse, and slavery. As the temptation to manipulate money has always proven to be too strong for mankind to resist, the only antidote for this poison is an incorruptible money — Bitcoin.

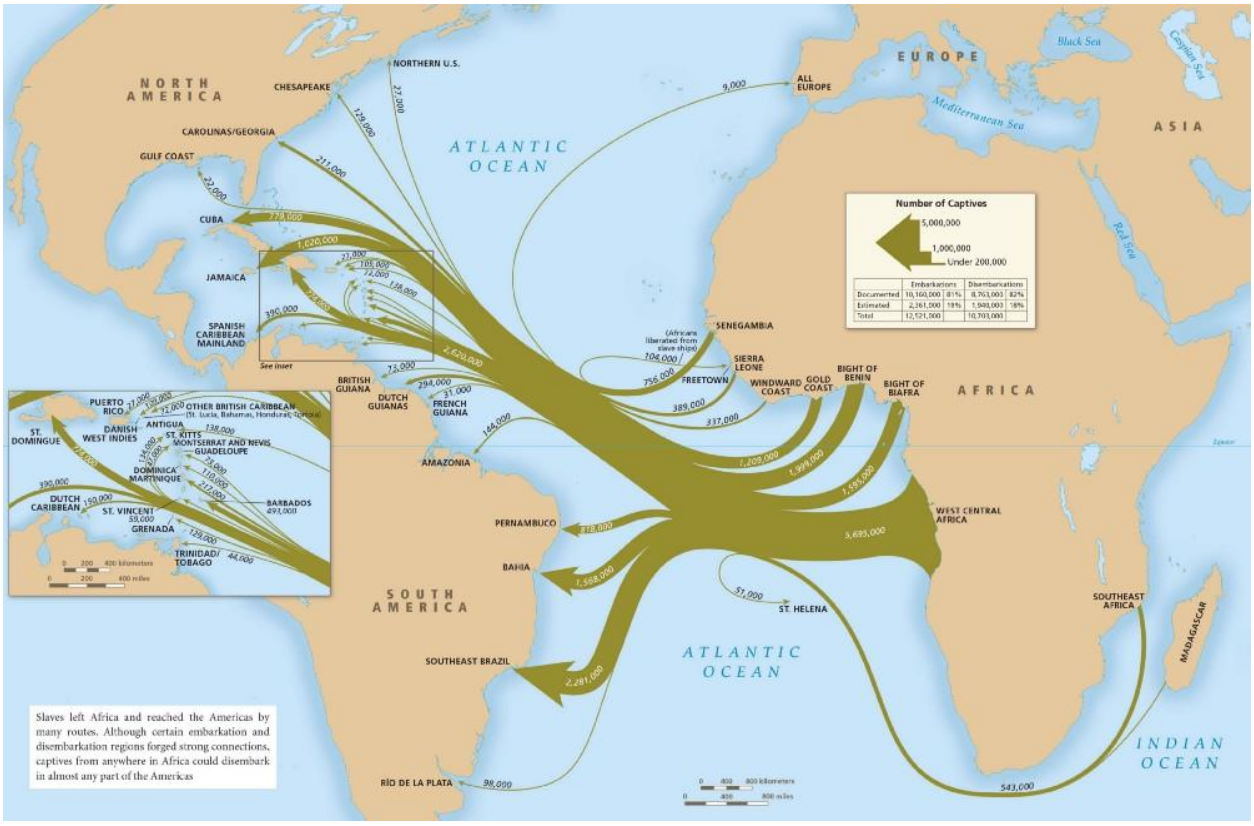
Counterfeiters are Slavemasters

"Knowledge makes a man unfit to be a slave." —Frederick Douglass

In ancient western Africa, _aggry beads—_small, decorative glass beads—were used as money for many centuries. Of uncertain origins, these beads were a means of wealth transfer between people in trade (as money) and across generations (as dowries or heirlooms). When European explorers appeared in Africa in the 16th century, it was quickly apparent to them that aggry beads were highly valued by African locals. Since glass-making technology in Africa was primitive at the time, aggry beads were difficult to produce and, therefore, reliably scarce relative to other goods—a monetary property which supported their market value.

Back in Europe, glass-making technology was more sophisticated; counterfeit beads virtually identical to aggry beads could be mass produced at a low cost. Seizing the economic opportunity, many crafty Europeans soon began arranging expeditions to western Africa, shipping in huge quantities of (indistinguishably counterfeit) aggry beads expertly fashioned in European glass-making facilities. This scheme was one of the first known large-scale money counterfeiting operations in the world. What followed this seemingly innocuous exportation of glass beads was a multi-decade plundering of African wealth, natural resources, and—ultimately—time.

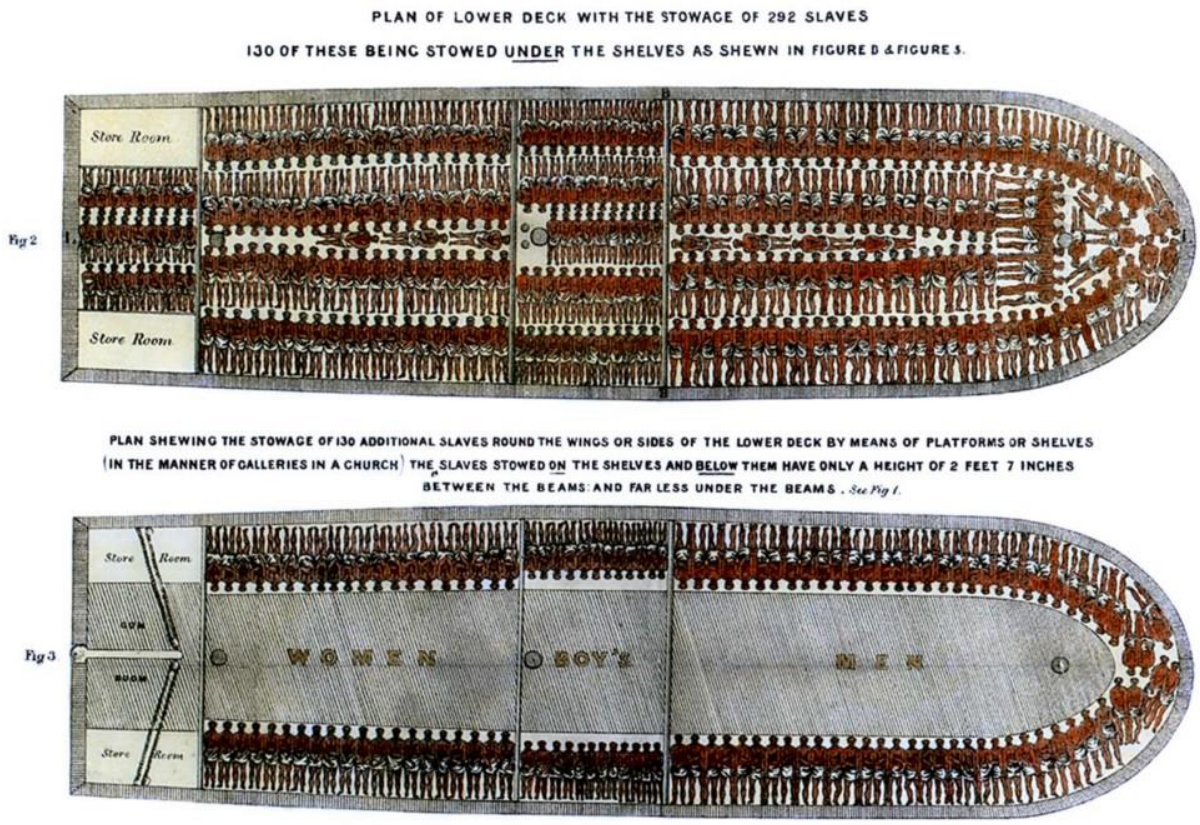
As European ships arrived on African shores, many with hulls packed full of glass beads, locals readily traded their hard-earned assets for what they believed were precious aggry beads. Spanning the course of decades, this trading of real assets for counterfeit beads facilitated a surreptitious confiscation of African wealth by Europeans—a slow-motion criminal episode that crippled African society for centuries to come. Aggry beads would later become known as "slave beads"; as newly impoverished Africans became desperate, some were forced to sell themselves or others as slaves to their European usurpers. Slave beads—one of history's many monetary systems weaponized by counterfeiters—became instrumental in the multi-century trans-Atlantic slave trade.



Over the course of 365 years, over 12.5M slaves were transited from Africa to Europe and the Americas.

In a barbaric irony of history, ships landing in Africa stuffed with (counterfeit) aggry beads later departed for European and American shores with full payloads of precious human cargo. Inhumane and unforgivingly precise, masters of these slave ships packed their hulls

tightly with African slaves, just like the glass beads that were used to purchase their captive human cargo in the first place.



Like the counterfeit aggry beads used to purchase them, African slaves were packed tightly inside the hulls of ships for transit to Europe and the Americas.

Unfortunately, this pillaging of wealth was not an isolated episode. Cloth strips were another form of money used in ancient Africa, which became a well-established transactional medium over many centuries of dealing with Muslim traders from the north. Local African tribes soon began producing these cloth strips—known colloquially as panos—but were outcompeted by the more efficient production methods employed by the Portuguese. A perversely profitable economic arrangement ensued, in which the Portuguese used panos to purchase African slaves who were then put to work producing the very cloth strips with which their freedom was stolen. As Scottish historian Christopher Fyfe described this dreadful trade relationship:

"Some of the slaves were weavers by profession, and wove the cotton into country cloths as they had done on the mainland. New elaborate patterns of North African type were introduced, and from the middle of the 16th century Cape Verde panos [cloth strips] were regularly exported to Guiné to be exchanged for slaves."

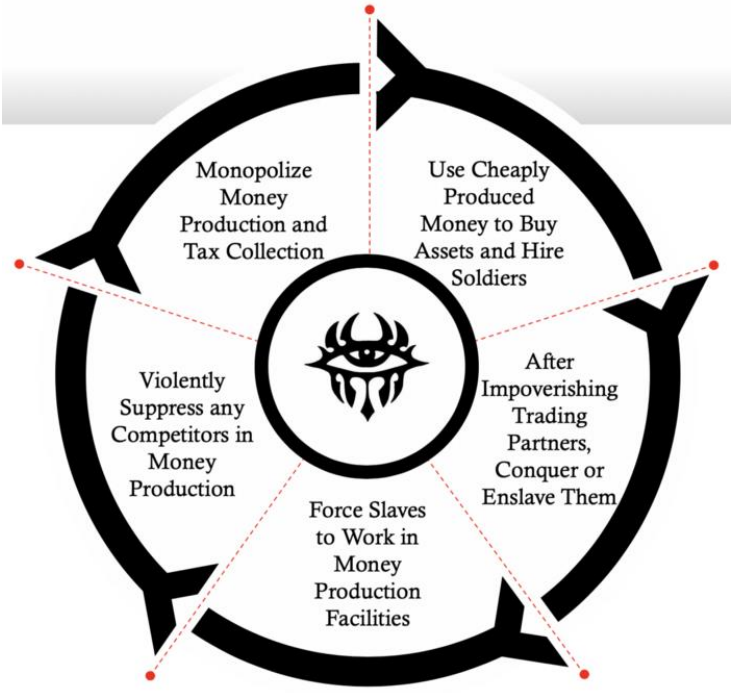
Lured by a virtually limitless profit potential, Portuguese panos producers soon established a state-sponsored monopoly called the Grão Pará and Maranhão Company, which mandated the use of its warehousing and trading-post operations for all financial flows denominated in panos. This company

enforced the use of panos for tax payments, to forcibly denominate slave trade contracts, and to hire soldiers. To name just one similar, non-coincidental example today: the US government enforces the use of dollars for tax collections, as legal tender, as the nominal currency for contracts on oil (the energy slave of modernity), and as the international reserve currency (the infamous "exorbitant privilege").

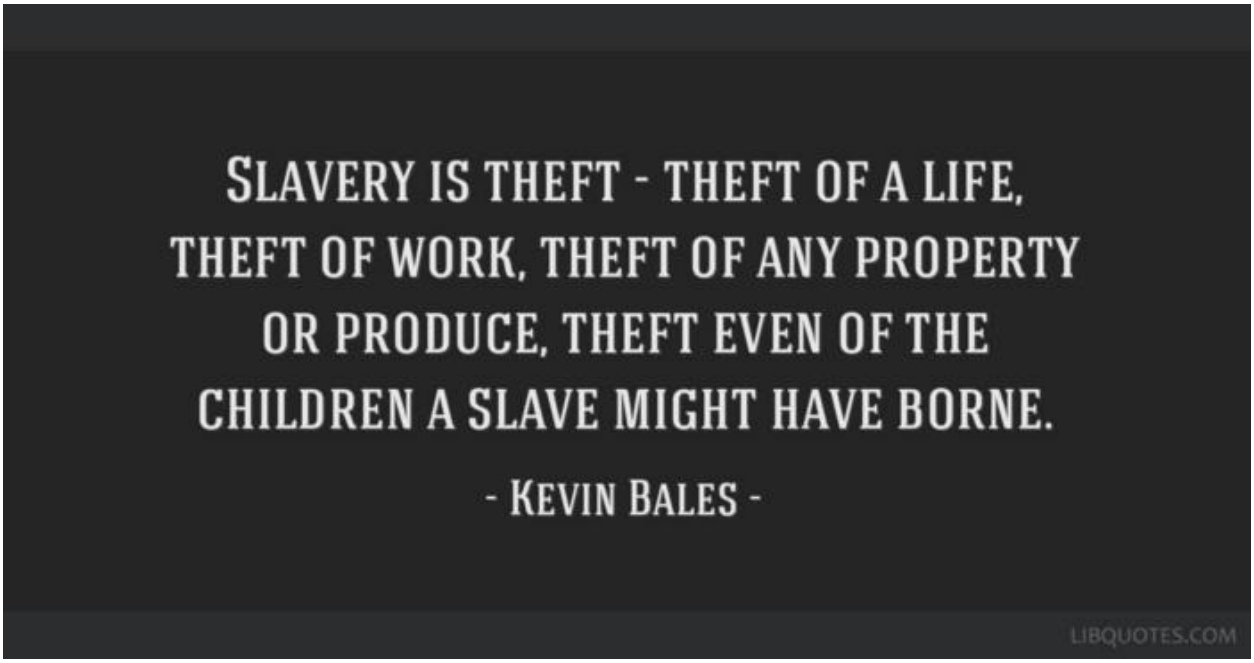
Events strikingly similar to aggry beads and panos are playing out today throughout the global economy: the US dollar in your pocket, the one you sacrificed so much to obtain, was recently mass-produced by the US government with a (near-effortless) keystroke. In the same way Europeans had access to superior glass-making technology that gave them the ability to counterfeit money at a low cost, or the Portuguese monopolized panos production, central banks have an exclusive privilege to produce money at near-zero cost, enabling them to confiscate wealth from all users of dollars at will. Although less visible and overtly violent, central banks today carry out operations using the same weaponized methods of theft as those wielded by wily Europeans against unsuspecting Africans.

Histories of human action related to aggry beads and panos hold important lessons for societies suffering under central banking: those who can monopolize money production become de facto currency counterfeiting operations that steal human labor in perpetuity. When free market forces are manipulated, producers gain an asymmetric ability to set prices without regard to customer preferences, thereby converting economic democracies into dictatorships, and freedom into tyranny. For money, this implies monopolists can acquire human time (aka labor) in the marketplace at an unfair price. Said differently: money monopolists can steal human time—a malevolent power that effectively makes them slavemasters.

An exclusive right to produce money without regard for competitive market pressures is an apparatus of enslavement—a vile privilege that monopolists can only preserve through deception and violence.



Counterfeit aggry beads and panos were weapons used to acquire human time; acts which led to the direct theft of 12.5M human lives between 1501 and 1806 (and the indirect theft of their progeny). The trans-Atlantic slave trade was a slow-motion holocaust on Africans; roughly 2M died in transit through the infamous Middle Passage, and those who survived spent the rest of their waking lives toiling away, or bearing children to replenish their slavemaster's stock. Quantifying this atrocity from an economic perspective (not counting those born into slavery): assuming the average slave could labor 5,000 hours each year for 40 years, the staggering total time stolen amounts to over 2.5T (2,5000,000,000,000) hours, or 6.8B hours stolen per year for 365 years (source link).



The trans-Atlantic slave trade was a travesty as gruesome as it was gigantic; if only money production monopolies had faced free market competition, this horror of human history would not have reached such a colossal scale. In (non-violent) market competition, producer actions are guided by the preferences of customers: a dynamic that drives low prices and technological innovation. Absent this accountability, producers are incentivized to do anything necessary to expand their market share—up to and including violent coercion. Simply, market pressures keep people honest: as such, the structures of markets and moralities are mutually intertwined.

Markets, Sovereignty, and Morality

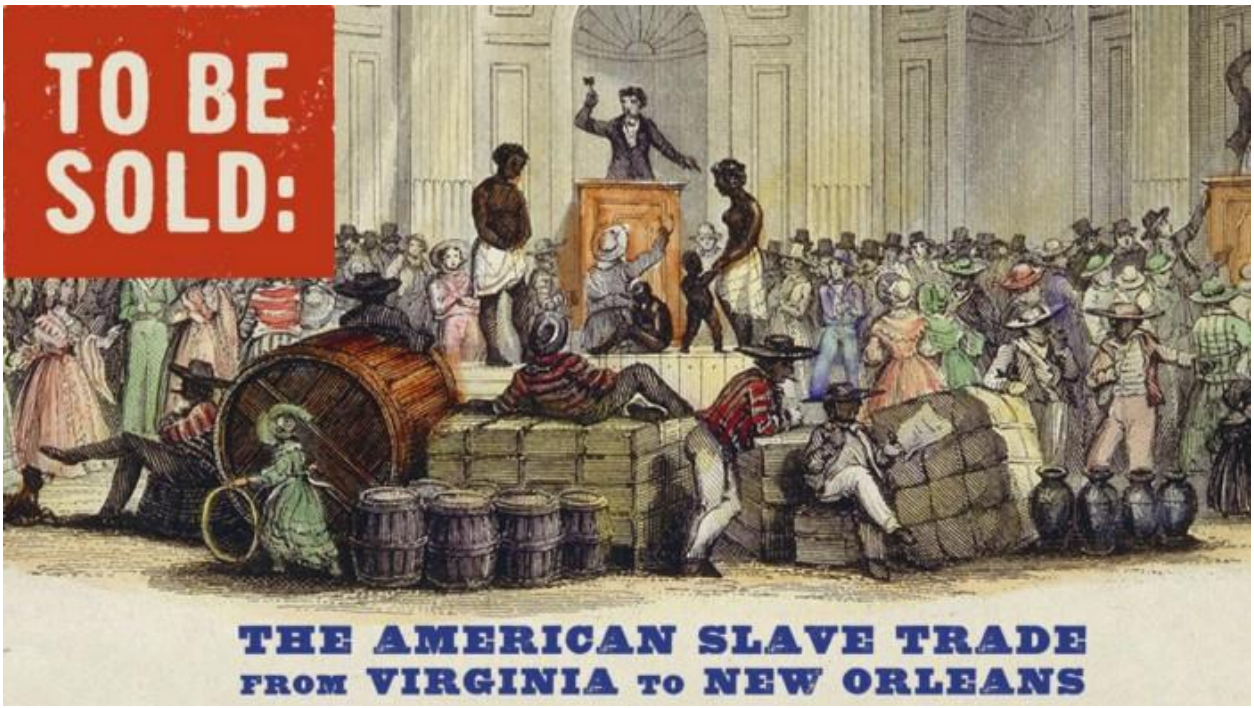
"To be moral, an act must be free." — **Murray N. Rothbard**

Competition is a natural process of discovery: in sports, it is the way we discover which team is more competent in any single game; throughout an entire season of play, repeated competition is how we discover which team is best overall. In free markets, competition is the set of games played to discover "satisfactions of wants": each entrepreneur places "bets" (investments of capital, money, and time) as they attempt to prove their competitors wrong in the marketplace by delivering better, faster, or cheaper solutions to the problems their customers want solved. Market competition is the catalyst of honest work and true progress for civilization. As the American pragmatists said: "truth is the end of inquiry"—in this sense, the free market may be thought of as a setting of continuous inquiry that zeroes-in on truth. The ideas competition generates, which withstand its sustained entrepreneurial inquisition, are our best approximations of truth—as William James said:

"Any idea upon which we can ride … any idea that will carry us prosperously from any one part of our experience to any other part, linking things satisfactorily, working securely, saving labor; is true for just so much, true in so far forth, true instrumentally"

Pragmatically, truth is difficult to distinguish from that which is most useful. In forums of free exchange, truth is generated in the form of accurate prices, useful tools, and individual virtue. Prices dynamically represent market participant concurrences on relative exchange ratios, a derivation of countless trade decisions across time. A tool with superior usefulness is the manifestation of mankind's sharpest present knowledge for solving a specific problem. Put another way: as entrepreneurs inquire about the nature of reality through experimentation, the tools they produce—and the knowledge structure with which these tools are configured—adapt according to customer preferences until one or a few favored solutions become market dominant. Virtue and competitive competency are the character traits infused into successful entrepreneurs that manage to survive the constant economic pressures holding them accountable for profit generation. This truth-seeking function of free markets is inherently iterative: prices, tools, and virtues are constantly changing according to market conditions.

"Points" in market-based games of discovery are denominated in money — the tool used to calculate, negotiate, and execute trades most effectively. Market competition is the process that keeps producers honest: when it is suppressed through coercion or violence—as it is within "legal monopolies"—truth becomes distorted into inaccurate prices, low-quality tools, and individual wickedness. For money producers, monopolization means dishonest producers become counterfeiters and gain a (deceptive and violent) dominion over human time.



Stealing human time through currency counterfeiting led to the the auctioning of slave labor.

Contrary to conventional wisdom, money is not "the root of all evil," it is actually just a tool for trading time (or labor)—the means by which market participants signify sacrifices and successes to one another across the history of economic transactions. Like all tools, money has no independent morality of its own. Tools are amoral, meaning they can be used for both good and evil purposes alike. The moral outcome of using a tool is inextricably dependent on the intention of its user. Money is a temporal trading tool, but (as

we've seen) it can also be wielded maliciously to steal time, in the same way a hammer can be used to build a house or bash a skull.

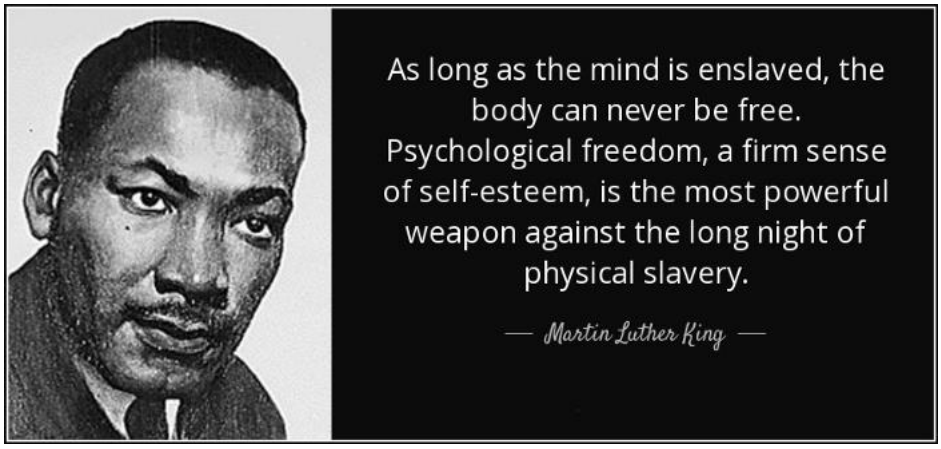
More accurately, money—along with its precursors action and speech—is "the root of all sovereignty": the authority to act in the world as one sees fit. Sovereignty — a word etymologically associated with monarchy, money, and royalty — refers to the locus of supreme power in the sphere of human action. According to Natural Law, sovereignty inheres within the individual, as each person must consciously decide what actions to take, despite any exogenous influences they may face. An inner sanctum of sovereignty's generative source lives within each of us — an inviolable principle of reason known as the *logos*. An interface layer between the primary domains of experience—order and chaos—the logos is the defining feature of humanity: our ability to tell and believe stories is what distinguishes man from animal. Victor Frankl calls this interiorized space the "last human freedom":

"The last of the human freedoms: to choose one's attitude in any given set of circumstances, to choose one's own way. And there were always choices to make. Every day, every hour, offered the opportunity to make a decision, a decision which determined whether you would or would not submit to those powers which threatened to rob you of your very self, your inner freedom; which determined whether or not you become the plaything to circumstance, renouncing freedom and dignity..."

From sovereignty, we derive the word reign, which commonly refers to a period of royal rulership. Most of us now live in an era well-past submission to a royal family, and our civilizational conception of sovereignty has been steadily decentralizing over time, moving closer to a clear reflection of Natural Law. As Jordan Peterson charts this historical progression:

"First of all, the only sovereign was the king. Then the nobles became sovereign. Then all men became sovereign. Then came the Christian revolution and every individual soul, impossibly, became sovereign. That idea of individual sovereignty and worth is the core presupposition of our legal and cultural systems, so we all walk around acting as if every one of us is a divine centre of logos. We grant each other the respect of individual citizens who are sovereign and are equal before the law."

At the foundation of Western Civilization today is the precept that the sovereignty of the individual is held higher than the state: an embodied belief at the heart of legal principles such as habeus corpus, the presumption of "innocent until proven guilty," and freedom of speech rights.



Freedom of speech is essential to a peaceful society, as our ideas must be free to clash and resolve conflicts so that our bodies don't. Speech arose in humans as a direct result of our evolutionary development: once a vertical stance was adopted by our ancestral primates, our visual field was expanded, and our hands became more adept at manipulating the natural environment since they were no longer needed for locomotion. Newly outfitted with opposable thumbs, we developed a dexterity that enabled us to particularize the natural world in useful ways—like sorting things, counting, and making tools. Fine musculature in the face and tongue evolved alongside this precision of hand, giving rise to spoken language, which complemented the hand's ability to categorize the world, and the mind's ability to comprehend it (even our internal dialogue is composed of speech). An ability to manually reconfigure the world reinforced our abstractive capacity to do so verbally, thereby forming a feedback dynamic between these two defining faculties of man. This co-evolution of craftsmanship and verbal articulation led naturally to trade, and (quite simply) the most exchangeable thing in any trading society is its most important tool—money.

Seen this way, money is a direct derivation of action and speech: all three of which are essential media for sovereign self-expression. In this sense, money may be considered a form of speech in and unto itself—the language of value. Placing limitations on the use of this language (the purpose of central banks) is commensurately catastrophic to restricting the freedom of speech (which can lead to absurdities like illegal numbers). Free speech digs the grave for despotism, whereas its suppression is the trademark of totalitarian regimes. Indeed, the first effort of every aspiring dictator is always to restrict the voice of dissent—to darken the light of inquiry radiating from the logos. The 20th century had many logos-suppressing dictatorships, we will name two:

"In 1917, the Russian Bolsheviks moved to limit freedom of speech the very day after the October coup-d'état. They adopted the "Decree on the Press," which shut down any newspapers "sowing discord by libelous distortion of facts." Similarly, only a few months after coming to power in 1933, German National Socialists started to burn books, and the Ministry of Propaganda introduced strict censorship.

Logos (λόγος) is a Greek word that means "ratio" or "word"—the principle at the core of interpersonal communications, which are largely conducted via words and prices (which are exchange ratios expressed in monetary terms). Both words and prices are "categorical comparatives," protocols for encapsulating, comparing, and communicating different aspects of reality — herein lives the power of the divine logos to render order from chaos. In language, consider how all words only have meaning relative to one another: all definitions are comprised of other words. In markets, the intersection of subjective supply and objective demand is the price: a dynamic figure reflecting the consensus of the collective logos on any particular good's exchange value for any other good (for simplicity, expressed in the common language of economic numeracy: money).

For money, governments corrupt the pricing mode of comparative expression by constantly violating the supply of money (via inflation) while simultaneously compelling its demand (via legal tender and tax collection laws). Distorting natural price discovery, a manipulation of the collective logos, is equivalent to perverting the vox populi—the voice of the people. George Orwell once said: "If liberty means anything at all, it means the right to tell people what they do not want to hear." An inability to speak the truth (with words), or prove others wrong in the marketplace (with prices), is the death of liberty; as the 20th century

so painfully taught us, restricting the logos is a slippery slope toward totalitarianism. Free expression in all forms is antecedent to proper moral action.

In Soviet Russia, freedom of speech was suppressed and dissent was punished. Independent political activities were not tolerated, whether these involved participation in free labour unions, private corporations, independent churches or opposition political parties.

Like speech, money lacks an intrinsic morality of its own. However, its economic character does influence moral standards—as Buddha taught us: "Money is the worst discovery of human life, but it is the most trusted material to test human nature." Honest money encourages righteous action, and dishonest money induces moral hazard. To comprehend money's impact on morality, consider the (hypothetical) case of a winemaker living in a centrally banked economy. He knows that his central bank recently doubled the money supply by printing trillions of dollars to "save the economy," and is now faced with three options:

Continue selling his wine for $20, knowing that the value of each dollar has declined 50% due to inflation*

Water down his wine or use cheaper ingredients, thereby decreasing the production cost and the quality of his wine, but continue selling it for $20

Double the selling price of his wine to $40, to get the same value for his wine denominated in post-inflation dollars

**For simplicity, we will ignore the spatiotemporal unevenness of inflation.*

If the winemaker chooses the first option, he incurs a 50% loss. If he decides to water down his wine, he defrauds his customers by selling them an inferior product. If he doubles his price to maintain quality, he risks losing customers to less honest competitors who are willing to compromise on quality. Since diluting wine with water is difficult to detect (for non-connoisseurs) and offers an immediate financial gain, all winemakers face strong incentives to defraud their customers when inflation strikes (a cause of wine scandals). In a similar vein, monetary inflation incentivizes sellers across all industries to deceive their customers. Inflation imposes the temptation of larceny onto seller's hearts, forcing them to weigh financial wellbeing against moral integrity. In this way, inflation is an infectious disease to society's moral fabric. Inflation-resistant money, then, is an antidote to an afflicted social morality. In this (critically important) sense, Bitcoin—the only money with a 0% terminal inflation rate—is the cure for many of the moral cancers riddling our world.

Inflation is a great immiseration on the soul of humanity—a source much moral sickness worldwide.

Money is a source of great temptation, as it can be considered the "list of who owns what," since money can (by definition) be used to buy anything in the marketplace. When a singularly privileged group (a monopoly) can create money out of thin air, they can amend this "list of who owns what" arbitrarily, and have a powerful incentive to do so to their own benefit. This "money as an ownership ledger" angle sheds light on the underlying impetus for central banking—an institution which arrogates itself as "master of the list" with an exclusive privilege to advance the interests of its private shareholders, even at the expense of enslaving everyone else.

Since everything in the marketplace requires sacrifices of human time to produce (even land needs hands to sell), we can say that *money is human time emblematized*. In the same way a stock certificate is title to company capital, money is title to human time; people sacrifice time earning money which they can then spend on commensurate sacrifices from others. Clearly, a tool that can command human time is an object of great temptation, as it is a potent source of power (defined by physics as work over time). A lust for power is the motivation of most warfare—typically involving attempts to forcibly acquire capital, food, or territory. And a lack of power is closely related to unhappiness, which makes its consolidation alluring—as Philo Judaeus said:

"No slave is really happy, for what greater misery is there than to live with no power over anything, including oneself?"

Money has always been a critical piece of mankind's notions of sovereignty and slavery. When naturally selected by free market processes, money is a culmination of the collective logos: a synthesis of individual self-sovereign expressions. But natural money has been hijacked by artificial tyrants: the reason we call states "sovereigns" today is only because they are the gangs that hold most of the world's freely chosen money — gold.

The So-Called Sovereign States

"I did not know I was a slave until I found out I couldn't do the things I wanted." —Frederick Douglass

For over 5,000 years, precious metals have been favored as money since they best fulfilled its five properties: divisibility, durability, portability, recognizability, and scarcity. Gold came to reign supreme because of all the monetary metals, it was the most scarce. Scarcity is arguably the most important property of money, as without an assurance of supply limitation, someone always gives in to the temptation to inflate and steal the value stored therein (see: aggry beads, panos cloth money, or fiat currencies today).

Governments have always interceded in the market for money to commandeer gold coinage and warehousing operations, both of which sought to improve the divisibility, portability, and recognizability properties of money by issuing standardized coins or warehouse receipts. By monopolizing these "certification function" businesses, the state shifted the burden of trust from transacting parties onto itself. States throughout history have always made it their (exclusive) business to certify the value (weight or fineness) of money (coins or bars) and money-substitutes (paper warehouse receipts). Remember: insulation from competition interrupts the truth discovery process engendered by free markets; for this reason, trust placed in any monopoly always ends up shattered.

Government exists to protect property rights: a purpose it defiles by monopolizing and counterfeiting money.

All national currencies began as paper promises for real money. Today, these currencies are no longer redeemable for real money, and instead have been transformed into perennially unfulfilled promises called fiat currencies. Governments require societies (a restriction of the collective logos) to transact in these money-substitutes and reserve the exclusive right to manipulate their supplies as a means of siphoning wealth (aka stealing time) from citizens. In effect, fiat currencies are uncollateralized debts undergoing slow-motion default while their use is forced on society. All the while, central banks continue to hoard the real money—gold—and perform final settlement with one another in this authentic, free-market-selected medium of exchange.

Seen this way, _"_printing money" actually refers to currency counterfeiting—the production of false promises, as currencies are no longer tied to real money. Said simply: fiat currency is a living lie. Regardless of whether you consider it a tool or a weapon (depending on the subjectivities of user intentionality), manipulating money supplies is objectively useful for only one thing: inflicting wealth inequalities (by stealing time). As G. Braschi puts it: "Every tool is a weapon (if you hold it right)." As a means of gaining an advantage in contests of will, currency counterfeiting is a weapon.

In war times, belligerent nations have made attempts to counterfeit opponent currencies to cause hyperinflation. For example, Nazi Germany had plans to bomb England with counterfeit bank notes to sabotage their economy. And in Imperial Japan, the Noborito Laboratory experimented with currency counterfeiting operations as an economic subversion strategy. In peacetimes, currency counterfeiting is the exclusive domain of the central bank, whose "expansionary monetary policy" increases the money supply by, say, 7% per year—that is, stealing only 7% of dollar-holder wealth (an accumulation of time-savings) each year via counterfeiting operations.

Of course, when circumstances become too uncertain, market participants naturally flock back to the trust-minimization of physical gold, since money-substitutes are (at best) promises to receive money in the future, they are vulnerable to default. Unlike fiat currencies, gold is an expression of the collective logos, not compulsion from a counterparty. The self-declared "sovereign" state is a business model built on the confiscation of self-sovereign monies like gold and silver. The superior monetary properties of gold made it the most valuable form of self-sovereign money in history, a reign it has maintained since before the founding of ancient Egypt.

The Great Pyramids

"There are two ways to conquer and enslave a country. One is by the sword. The other is by debt." —John Adams

Ancient Egypt is the archetypal tyranny in the Bible. Egypt is renowned for its Great Pyramids, monoliths which were built on the backs of slave labor. Indeed, the grandeur of these constructions owes a major debt of gratitude to the many slaves whose time was stolen by the Pharaohs—masters of Ancient Egypt. To gain a glimmer of understanding as to just how arduous the construction process was for even a single Great Pyramid, consider this data point from the book Heroes of History by Will Durant:

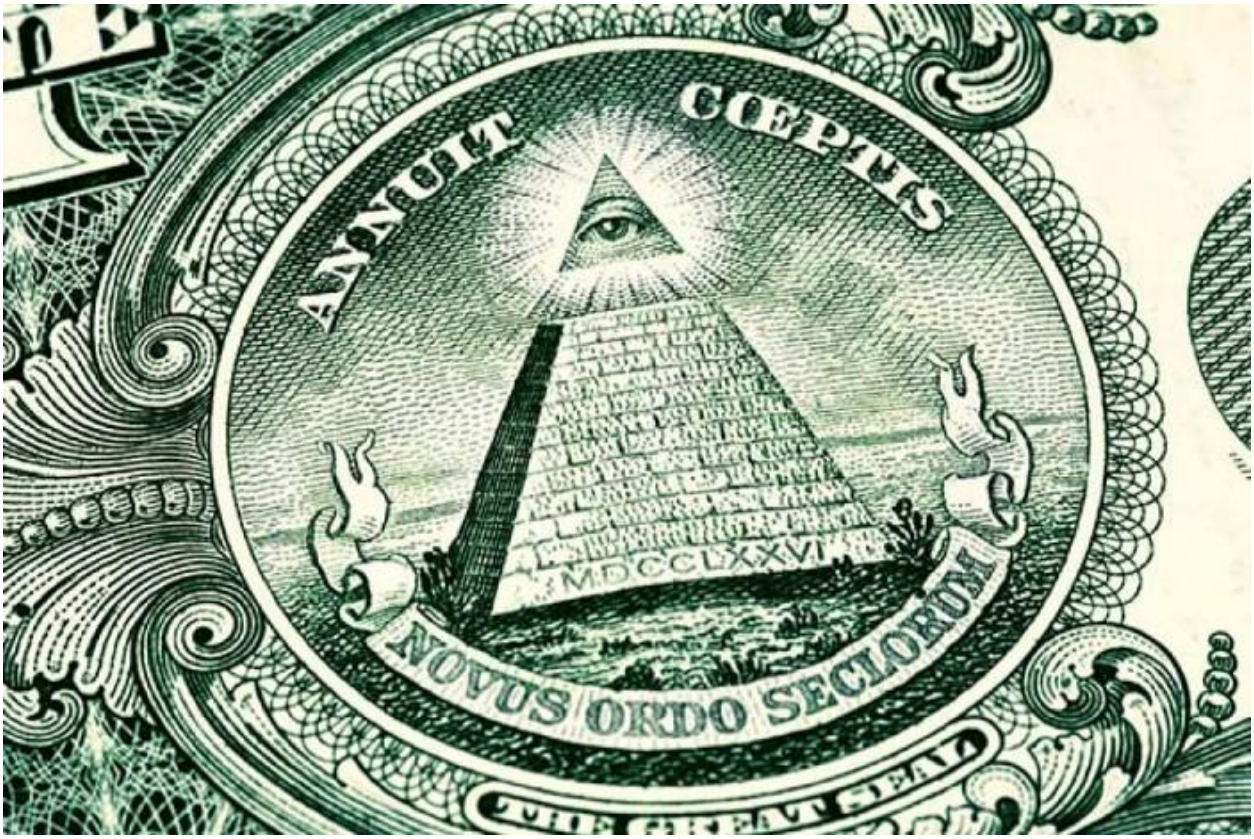
"According to Herodotus... the pyramid itself required the labor of 100,000 men through twenty years."

Many slave hours went into building the Great Pyramids, but history has even worse pyramid schemes...

To quantify this time-theft from Egyptian slaves more precisely, again assuming that each slave spent 5,000 hours per year engaged in manual labor, a workforce of 100,000 slaves building for 20 years equals 10B hours of time stolen. A staggering amount of man hours condemned to the brutality of physical bondage during the construction of a single Great Pyramid, but (terribly) still less than the time stolen by the greatest pyramid schemes in human history—fiat currencies. As Henry Ford foretold:

"It is well enough that people of the nation do not understand our banking and monetary system, for if they did, I believe there would be a revolution before tomorrow morning."

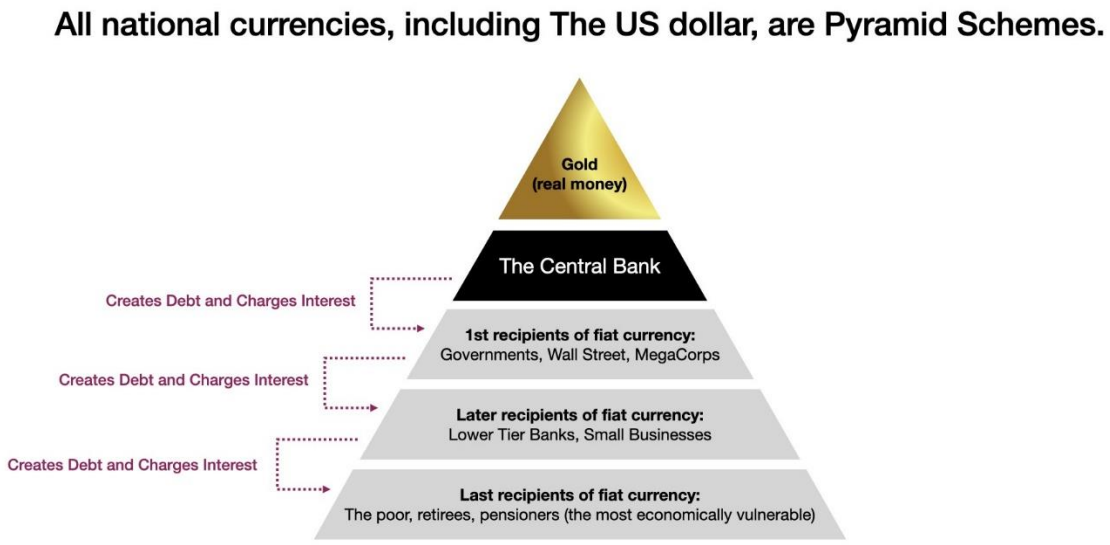
A pyramid scheme is an investment scam based on a hierarchical setup of network marketing, in which higher layer participants profit at the expense of those lower down. Fiat currencies are pyramid schemes erected by central banks, who restrict access to and suppress the price of gold, which would otherwise outcompete their inferior currencies on the free market, since gold is reliably scarce and holds its value across time. The use of fiat currencies is compelled via legal tender and tax laws. It may be hard to believe that the world's most popular currency is a pyramid scheme, but the symbology of the US dollar tells its own story:



Novus Ordo Seclorum is Latin for "New order of the ages" — this symbol appeared soon after the founding of The Fed: perhaps it refers to the new system of slavery implemented under the monicker of "central banking."

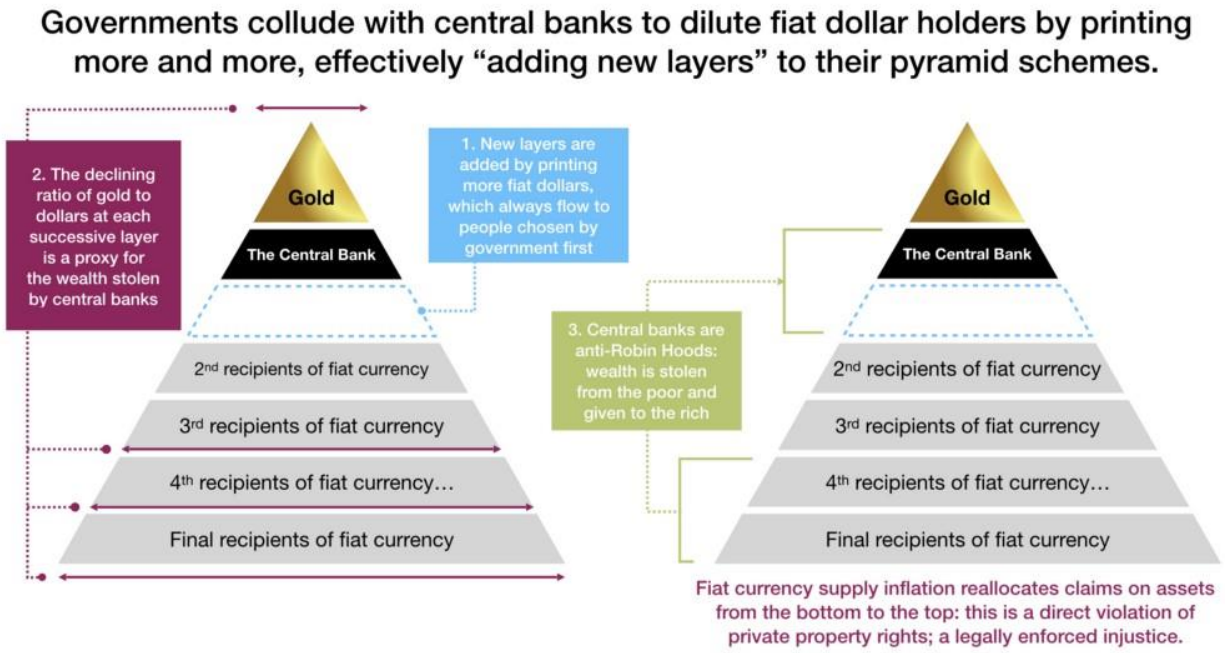
After a long-game legerdemain by governments, these pyramid schemes came to dominate the world. Fiat currencies are debt-based money-substitutes controlled by central banks, which impose these monetary

networks on users and suppress all competition in the market coercively or violently (similar to the Grão Pará and Maranhão Company). Most despicably, it is the poorest people in society—who (by necessity) hold the majority of their wealth in fiat currency—that are most victimized by this fraudulent system.

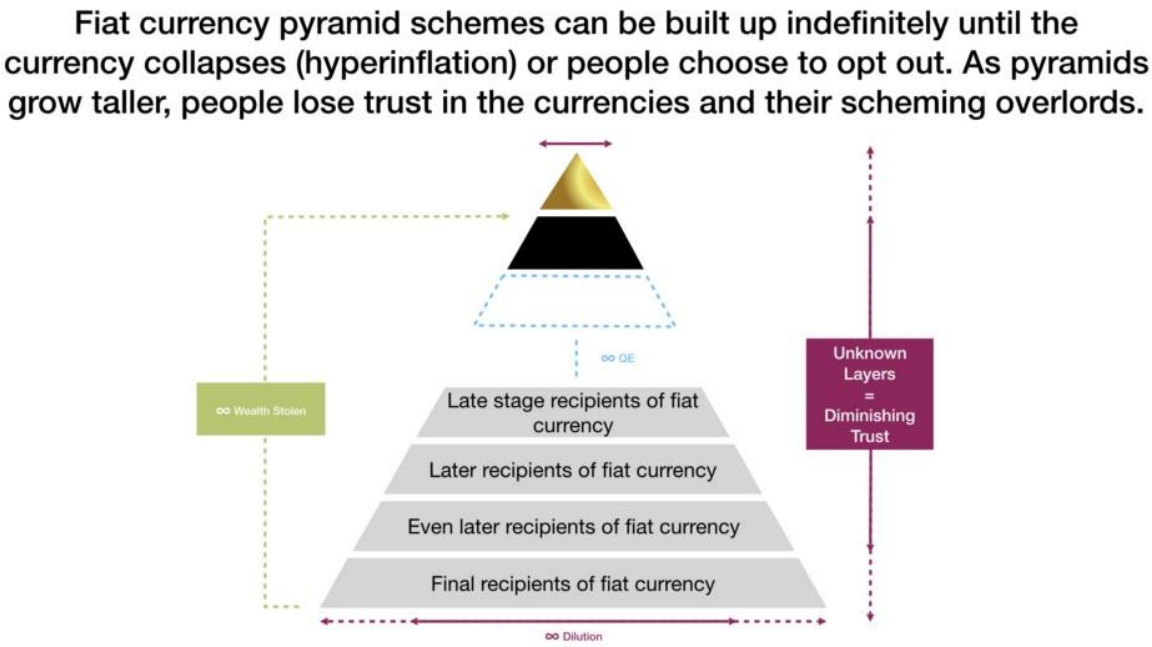


At the pinnacle fiat currency pyramid schemes is gold: a technology selected as money by the cumulative free choice (the collective logos) of countless entrepreneurs throughout history. Paper currency abstractions of gold were introduced purely to make it more convenient for exchange, not to replace it. Over time, the option to redeem currency for gold was eliminated, giving governments full control over currency scarcity, and therefore an unlimited capacity to confiscate wealth from their citizens by compromising its supply.

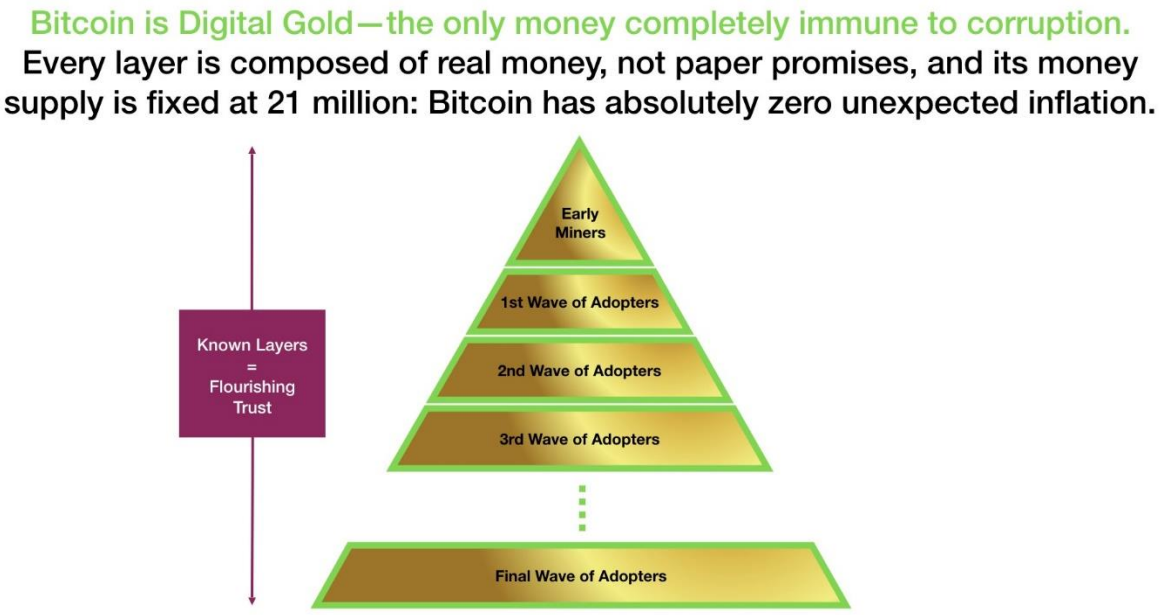
In effect, every time a new unit of fiat currency is printed (euphemistically called "quantitative easing" or QE by central banks), new layers to the pyramid scheme are laid from the top down, and the inflationary costs are externalized onto those using fiat as a store of value. Worse still, each unit of fiat currency is leveraged, so that one unit is multiplied by several orders of magnitude by the time it becomes part of the broad money supply. Looking at The Fed as a specific example: after netting service fee revenue for itself (to fund its operations and a 6% annual dividend to its undisclosed shareholders), The Fed uses the new fiat dollars to purchase US government debt. Freshly printed (more accurately, electronically generated) fiat dollars are then doled out at the discretion of government bureaucrats, who (unsurprisingly) tend to favor the bankers, corporations, and lobbyists that pay for their political campaigns. Detestably, this dynamic reallocates wealth from the poor to the rich (Robin Hood would be ashamed).



So long as people remain sufficiently passive yet productive, these pyramid schemes can be built ever-higher, and continue to operate as a weapon of wealth extraction (time-theft) for their political perpetrators. However, since there are no free lunches in this universe, this fiat currency supply expansion cannot continue forever. As layers continue to accumulate in round after round of QE, and people are implicitly taxed harder and harder through price inflation, trust in the currency becomes diminished. Like Hemingway said about bankruptcy, this happens gradually at first, then suddenly as inflation gives way to hyperinflation: a total meltdown of the economic trust money is intended to facilitate in the first place. At this point, the "central bank master" has pushed his "fiat-slave citizens" too hard, as they finally reach the edge of their economic livelihoods.



Fortunately, thanks to Bitcoin, these financial pyramid schemes can no longer be shielded from direct competition (as they are from gold). All fiat currencies are critically dependent on the ability of central banks to subdue competition—the discovery process that would otherwise disrupt their illusion. Owning 20% of the global gold supply gives central banks significant influence over its price, which they actively suppress in the paper markets. Without intervention, fiat currencies would quickly collapse to the superior value proposition of gold as money, as people always favor a money that holds its value across time (by remaining scarce). In this regard, Bitcoin—the world's only "digital gold"—represents a major breakthrough: a monetary technology that is disruptive to gold, resistant to competitive suppression by central banks, and the one-time discovery of an absolutely scarce money.

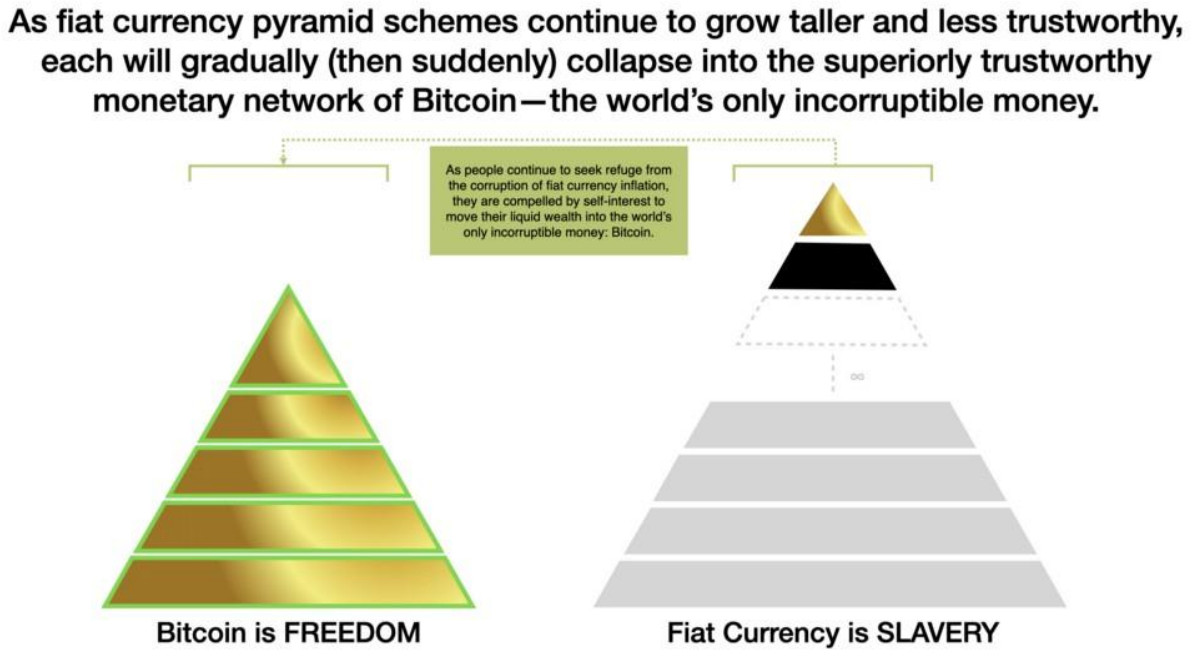


All monies exhibit a multi-level marketing valuation dynamic: for Bitcoin, early adopters benefit disproportionately by anticipating later adoption by others (the Bitcoin economic bootstrapping process is characterized by a virtuous cycle). But unlike the unknowable supplies of fiat currency pyramid schemes, Bitcoin has a universally known supply. For fiat currencies, the "early adopters" are perpetually those with access to the printing press; a positional asymmetry (a political privilege) that makes the game unfair.

A more symmetrical system, Bitcoin is uniquely characterized by [perfect information](https://en.wikipedia.org/wiki/Perfect_information#:~:text=In%20economics%2C%20perfect%20information%20(sometimes,utility%2C%20and%20own%20cost%20functions.)meaning that all market participants can see the rules that govern it, verify that that there will never be more than 21 million units, and determine precisely when each will be produced—meaning all unexpected supply inflation for Bitcoin is optimized for holders at absolute zero. Perfect information is a prerequisite to the economic concept of perfect competition: an ideal (yet unattainable) market condition where competitiveness is entirely unhampered by unnecessary regulations and wealth generation is maximized. A great promise of Bitcoin is to pull global markets closer toward this state of perfection by separating money and state.

Laid in layers of permanence, this "digital gold" pyramid outshines the inherent uncertainties of fiat currencies. Since money is "insurance against uncertainty," its demand is centered on the relative certainty of its monetary properties; and Bitcoin optimizes for all five: it exhibits the divisibility, durability, portability, and recognizability of pure information; and the scarcity of time. Like death and taxes, the certainty of "21 million bitcoin" is a concept that cannot be refuted. Coupled with the incentive to front-run future adoption of this digital, absolutely scarce, and theft-proof money makes Bitcoin a

game-theoretic gravity-well that the market for money simply cannot escape. Paradoxically, it is precisely this inescapability that is leading to the liberation of more and more fiat-slaves worldwide.



Symbolized by its fixed height in the image above, the absolute scarcity of the Bitcoin monetary pyramid increasingly outcompetes fiat currency pyramid schemes as they grow comparatively taller and less trustworthy through supply expansion. Eventually, these proverbial "houses of cards" collapse into the full transparency and certainty of Bitcoin. Whether it is understood or not, in the sphere of money, the known serves as protection from the unknown.

Viewed this way, we have much to be hopeful for in the world, as there is finally an incorruptible alternative to the completely unethical system of central banking. Bitcoin is honest money freeing the world from the falsehood of fiat currency. In a transcendental sense, Bitcoin may actually be what the ancient alchemists spent centuries pursuing: the incorruptible substance—called the lapis philosophorum in archaic texts—that would serve as an antidote to the corruption of the world. As Jordan Peterson wrote of alchemy in his profound book *Maps of Meaning*:

"The sequence of the alchemical transformation paralleled Christ's Passion, paralleled the myth of the hero and his redemption. The essential message of alchemy is that individual rejection of tyranny, voluntary pursuit of the unknown and terrifying — predicated upon faith in the ideal — may engender an individual transformation so overwhelming that its equivalent can only be found in the most profound of religious myths…The lapis philosophorum is "agent of transformation," equivalent to the mythological redemptive hero — able to turn "base metals into gold." It is, as such, something more valuable than gold — just as the hero is more valuable than any of his concrete productions."

Alchemical methodologies were "proto-science": experimental processes practiced for thousands of years that were foundational to the later development of the scientific method (even Isaac Newton was an

alchemist). As a school of thought, alchemy was a "fork" off of The Church premised on the belief that redemptive knowledge could be found in the laboratory of nature (a heretical concept at the time). Standing at the vanguard of human technological achievement, existing as the only money characterized by a manipulation-proof supply, and inspiring earnest transformations in the lives of true believers, perhaps Bitcoin actually is the lapis philosophorum pursued by alchemists for centuries—the incorruptible substance giving rebellion to state tyranny and, in doing so, bringing mankind closer to God. Bitcoin is the truth, and by one definition, God is expressed in the truthful speech that rectifies pathological hierarchies. Or as Benjamin Franklin said:

"Rebellion to tyrants is obedience to God."

Like freedom, love, and truth—God is timeless. I am not talking about a "guy in the sky" here: the ancient idea from Genesis is that God is the force that freely confronts the chaos of potential with courage, truth, and love to convert it into good and useful order. Being made in the image of God, we are all sovereign individuals imbued with the logos, a self-generating power responsible for our ability to harmoniously reconfigure the natural world into good and habitable space. Our future is seeded in our imaginations, a reality we call forth by freely exercising the logos in thought, speech, and action. The logos is the divine spark intrinsic to us all; realizing that words can only miss the mark of spiritual truth, we can venture to say: God is the anti-entropic principle eternally propagating through all life. As G.K. Chesterton said:

"A dead thing can go with the stream, but only a living thing can go against it."

To most truthfully embody the divine principle of the logos individually, and more closely approach the timelessness of God collectively, we must triumph against the evil forces that steal our time secretively and constantly.

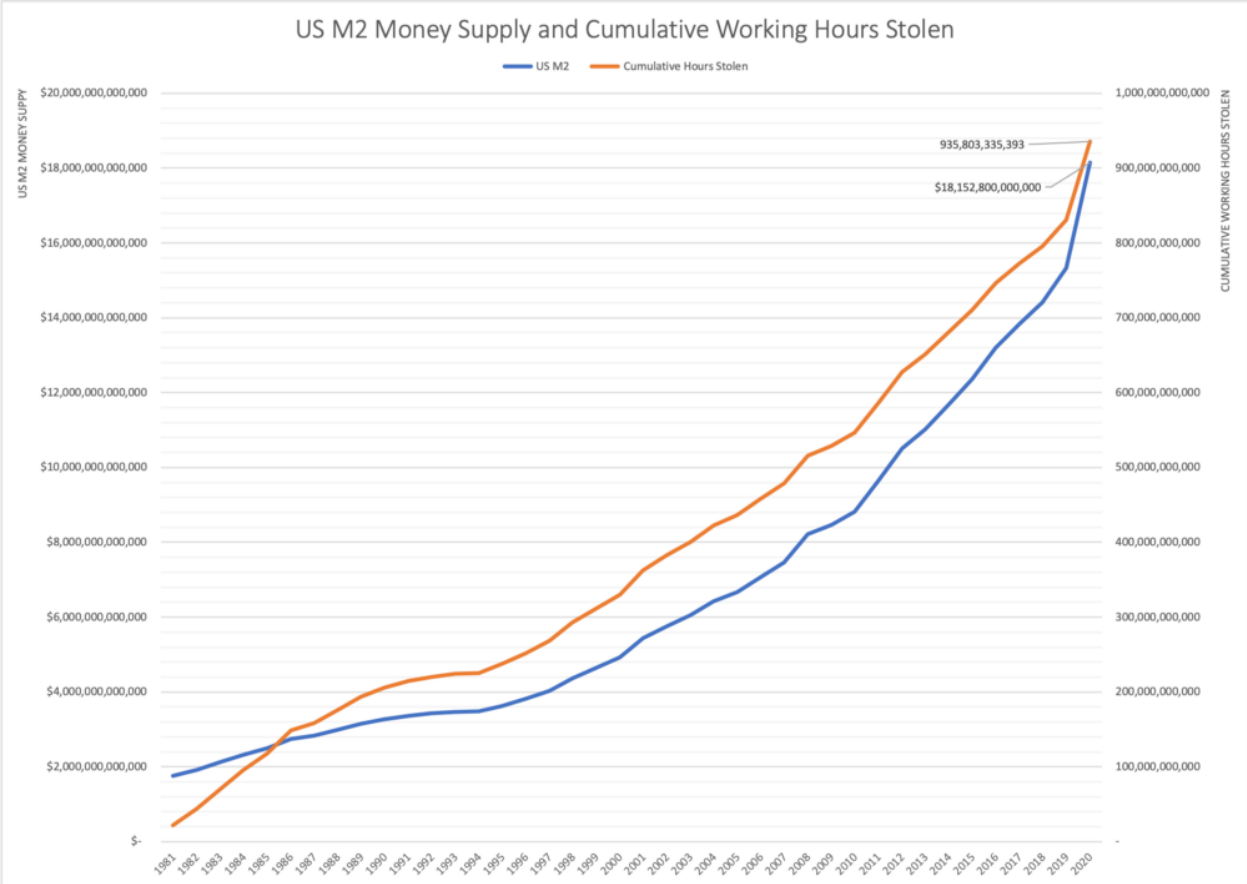
Stealing Time

"There is one kind of robber whom the law does not strike at, and who steals what is most precious to men: time." —Napoleon Bonaparte

Many mistakenly blame capitalism for the myriad economic problems in the world. However, at the heart of every modern economy is an institution of socialism: the central bank. In a primitive sense, the first man who dug a hole to shelter himself from the weather was the first capitalist, and the man who violently encroached on his tiny territory for his own selfish purposes was the first socialist. Capitalism simply means everyone has exclusive rights to the fruits of their own labor; in other words, everyone owns their own time. True capitalists are free to trade any valuables they invest their time to create (goods, services, or knowledge) with other self-owned people doing the same. Socialism, on the other hand, entails that governments (aka other people) own a (greater or lesser) portion of your time; the "pound of flesh" they take through conscription, taxation, and inflation.

Socialistic fiat currency is the lifeblood of state tyranny: to comprehend just how colossal the central banking system of time-theft has become, let's take a close look at The Fed. Using annual wage data from the social security administration, changes in US M2 money supply, and assuming 2,000 average annual working hours per worker, we arrive at some startling figures. By dividing the growth in USD supply by

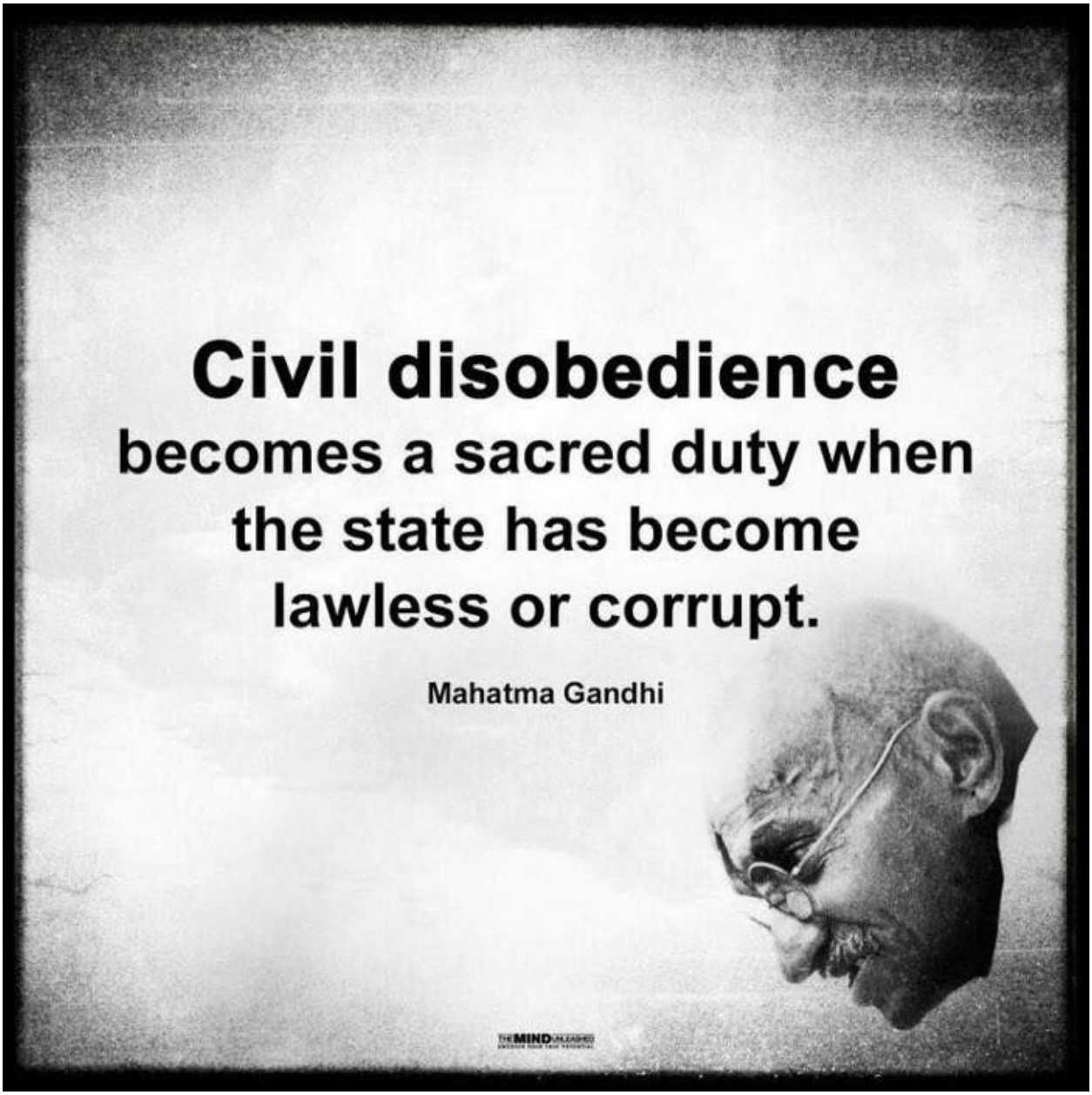
the average hourly wage each year in dollars, we calculate a proxy for the hours stolen from society through USD supply expansion (source link).



"Printing money" is currency counterfeiting and the theft of human time—in a word, slavery.

Stealing an average of 7.6% working hours per year since 1981, bureaucrats at The Fed have managed to scalp nearly one trillion hours off the backs of hard working people. Assuming each person works an average of 2,000 hours per year, **this is equivalent to enslaving 11.7M people for 40 years straight**. This implicit taxation via inflation is in addition to all explicit taxes imposed by the US government—all of which are acts of outright socialism. Unless transactions are made by consensual and willing market participants, then exchange is extortive—this is a central tenet of free market capitalism.

Time stolen by The Fed since 1981 is 341% more per year than the trans-Atlantic slave trade. With 23.4B hours stolen annually, The Fed could (in theory) build 2.3 Great Pyramids each year. In terms of absolute human time stolen per year, fiat currency is the largest pyramid scheme and institution of slavery in human history.



When we stop conceiving of central banking as an economics story, and start to see it as a crime story, we are beginning to get the true picture. Capitalism is established in truth (hard work, delayed gratification, and honest trade), whereas socialism is founded in falsehood (bureaucratizing, propagandizing, and theft). Like counterfeit aggry beads and panos, counterfeit dollars are also used to mobilize military efforts, which (before fiat) required explicit taxation or borrowing to finance. Socialistic money is the stealth funding source of evil: it has been used to finance every dictator, world war, and internment camp in human history. In the 20th century alone, fiat-currency-funded-governments murdered over 169M people—a modern mega-atrocity called democide:

TABLE 1.2
20th Century Democide

REGIMES	YEARS	DEMOCIDE (OOO)[1] TOTAL	DOMESTIC	GENOCIDE	ANNUAL RATE %[2]	
MEGAMURDERERS	**1900-87**	**151,491**	**116,380**	**33,476**		**[4]**
DEKA-MEGAMURDERERS	**1900-87**	**128,168**	**100,842**	**26,690**	**0.18**	**[4]**
U.S.S.R.	1917-87	61,911	54,769	10,000	0.42	
China (PRC)	1949-87	35,236	35,236	375	0.12	
Germany	1933-45	20,946	762	16,315	0.09	
China (KMT)	1928-49	10,075	10,075	Nil	0.07	[5]
LESSER MEGAMURDERS	**1900-87**	**19,178**	**12,237**	**6,184**	**1.63**	**[4]**
Japan	1936-45	5,964	Nil	Nil	Nil	
China (Mao Soviets) [3]	1923-49	3,466	3,466	Nil	0.05	[5]
Cambodia	1975-79	2,035	2,000	541	8.16	
Turkey	1909-18	1,883	1,752	1,883	0.96	
Vietnam	1945-87	1,670	944	Nil	0.10	
Poland	1945-48	1,585	1,585	1,585	1.99	
Pakistan	1958-87	1,503	1,503	1,500	0.06	
Yugoslavia (Tito)	1944-87	1,072	987	675	0.12	
SUSPECTED MEGAMURDE	**1900-87**	**4,145**	**3,301**	**602**	**0.24**	**[4]**
North Korea	1948-87	1,663	1,293	Nil	0.25	
Mexico	1900-20	1,417	1,417	100	0.45	
Russia	1900-17	1,066	591	502	0.02	
CENTI-KILOMURDERERS	**1900-87**	**14,918**	**10,812**	**4,071**	**0.26**	**[4]**
TOP 5	1900-87	4,074	2,192	1,078	0.89	[4]
China (Warlords)	1917-49	910	910	Nil	0.02	
Turkey (Atatürk)	1919-23	878	703	878	2.64	
United Kingdom	1900-87	816	Nil	Nil	Nil	
Portugal (Dictatorship)	1926-82	741	Nil	Nil	Nil	
Indonesia	1965-87	729	579	200	0.02	
LESSER MURDERERS	**1900-87**	**2,792**	**2,355**	**1,019**	**.1**	**[4]**
WORLD TOTAL	**1900-87**	**169,202**	**129,547**	**38,566**	**.1**	**[6]**

1. Includes genocide, politicide, and mass murder; excludes war-dead.
These are most probable mid-estimates in low to high ranges.
Figures may not sum due to round off.
2. The percent of a population killed in democide per year of the regime
3. Guerrilla period. 4. Average.
5. The rate is the average of that for three successive periods.
6. The world annual rate is calculated for the 1944 global population

A table quantifying murders by governments from 1900–1987 in millions: 169,202,000 victims of democide.

History is clear: enforced enactment of the fiat currency lie worldwide leads to loss of life on a monstrous scale. Said simply: socialism is fraud, and those who remain silent on the truth of central banking are complicit in its criminality. As Nassim Taleb succinctly states this ethic:

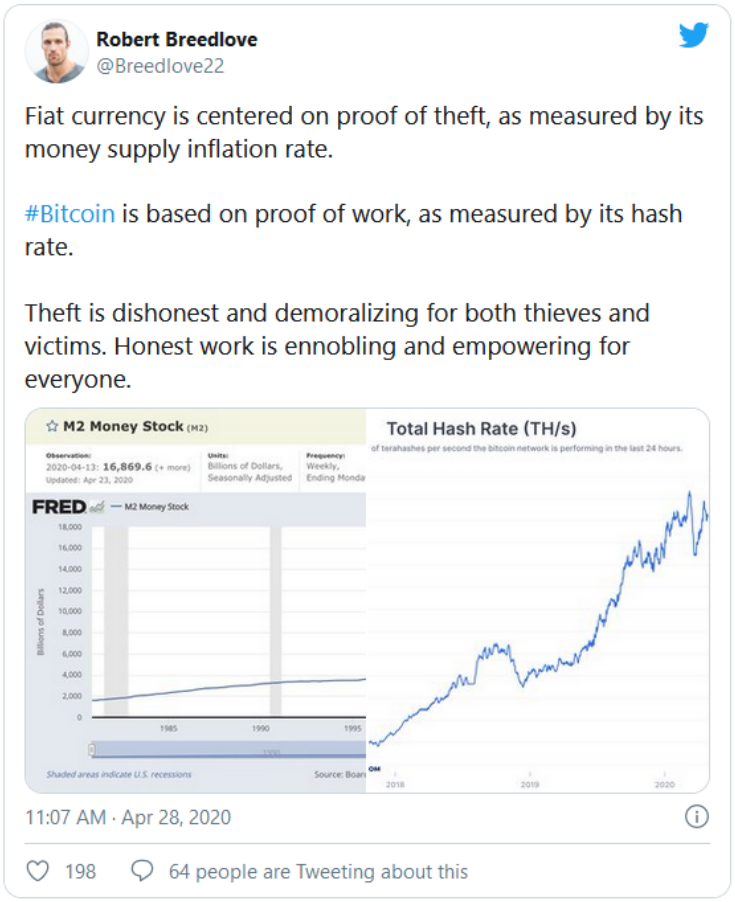
"If you see fraud and do not say fraud, you are a fraud."

The central planning of money is not a new idea. In Marx's 1848 Manifesto to the Communist Party, measure number five reads: "Centralization of credit in the hands of the state, by means of a national bank with State capital and an exclusive monopoly." Straight out of Marx's playbook, there is nothing capitalist at all about central banking; it is an anticapitalist organization, so let us speak of it truthfully: central banking is monetary socialism—an institution of financial slavery. Further, Karl Marx was a known racist; his socialistic system of central banking is solely designed to extract wealth from those the state deems to be "inferior." It is little surprise, then, that an institution centered on Marxist philosophy has mutated into a racist slavemaster.

Slavemasters seek to steal the benefits of work without making the requisite sacrifices. Across trading societies, gold was favored as money because it required "proof of work" to obtain: an unforgeable costliness that could not be counterfeited, and therefore self-represented the collective sacrifices made to procure it. Work is a noble pursuit, as it carries us closer to the timelessness of God, since all innovations are just productivity enhancers — instruments for accomplishing greater results within the same expanse of time. Theft is the opposite: a twisting of the moral fabric of reality to serve the present ego in defiance of the eternal God. Attempts to twist reality in this way always snap back to devastate those who try: our only salvation from this deceit is the truth.

Money is a social construct created to sacrifice time now and store it for later enjoyment. Debt is created by enjoying now at the cost of later sacrifice. Real money is the final extinguisher of debt. Fiat currency is oxymoronic to the concept of money, since it is born by borrowing. Accordingly, fiat-currency-fueled-economies have spent over a century gorging on debt, and the day of reckoning is at hand: economic reality demands its later sacrifices paid—explaining why governments are on the edge of bankruptcy (morally and financially) today.

An integral element of the social contract, the time we spend serving society today must earn us money redeemable for equivalent services from it in the future. When this intertemporal trust arrangement breaks down due to inflation, society slides into disintegration. Fiat currency is a supreme instrument of evil in the world: a weapon of intergenerational dispossession wielded by wily slavemasters over unsuspecting subjects.



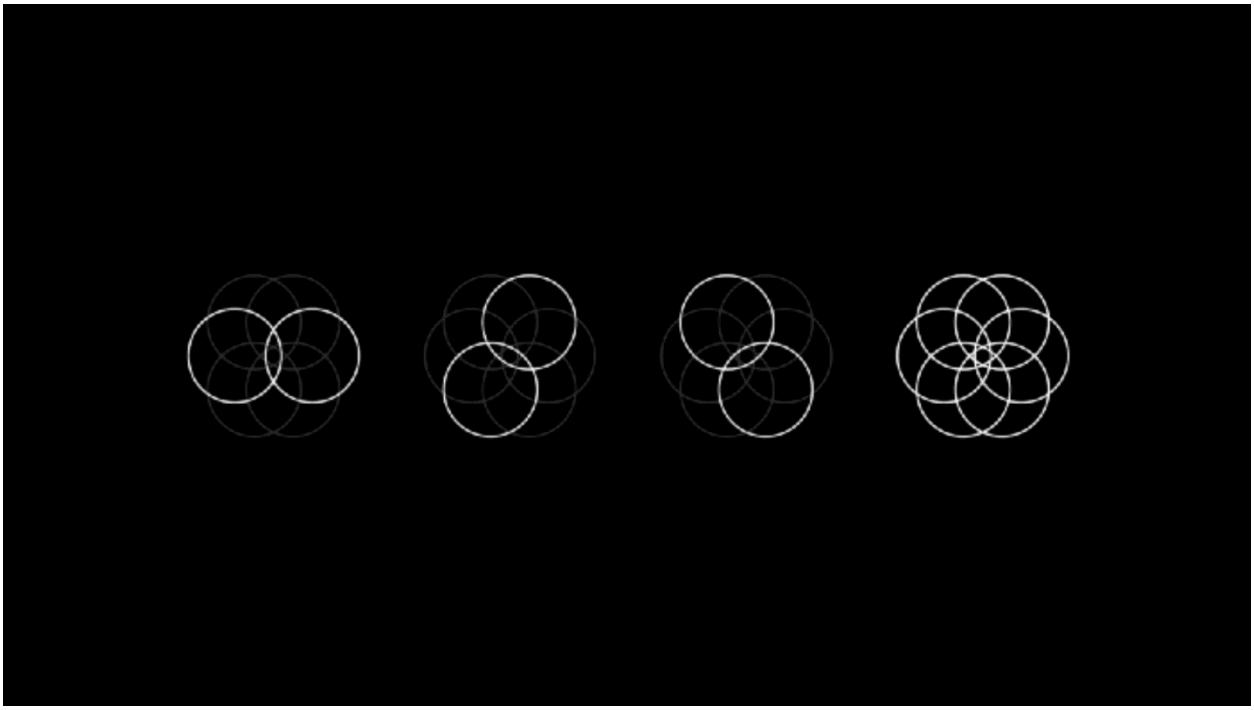
Modern Slavemasters

"To be a poor man is hard, but to be a poor race in a land of dollars is the very bottom of hardships." — W.E.B. Du Bois

Master and slave dynamics have almost always been racial or cultural in nature, a fact that has not changed even in our present "civilized" age. Recent years in the US have witnessed a rash of police brutality largely targeted at African Americans. And it seems the latest act of police brutality was the last straw for a society fed up with the seemingly endless stories of black lives assaulted by police. On May 25, 2020, a 46-year-old father, friend, and brother named George Floyd was murdered by a state police officer. The cop pinned Floyd down with a knee to the neck, executing a nine-minute-long slow-motion homicide in broad daylight with citizens onlooking helplessly.

Remember: truth is the end of all inquiry. In the digital age, the windows of perception have become exponentially multiplied, thus projecting the light of inquiry into prismatic and interpenetrating patterns. This multi-perspective quality of digitized existence is an accelerant to the truth-finding function of free markets: consider the role of digital technology in the Arab Spring uprising, Wikileaks, and now the George Floyd protests occurring worldwide. In 1965, when Martin Luther King led a protest of unequal voting practices in Alabama, police violently attacked the activists as they marched. Although many events similar to this had come before, this one was televised, and that made all the difference. With the eyes of the world watching police brutalize peaceful protestors in real time, the US government was soon pushed to pass legislation banning racial segregation and discrimination.

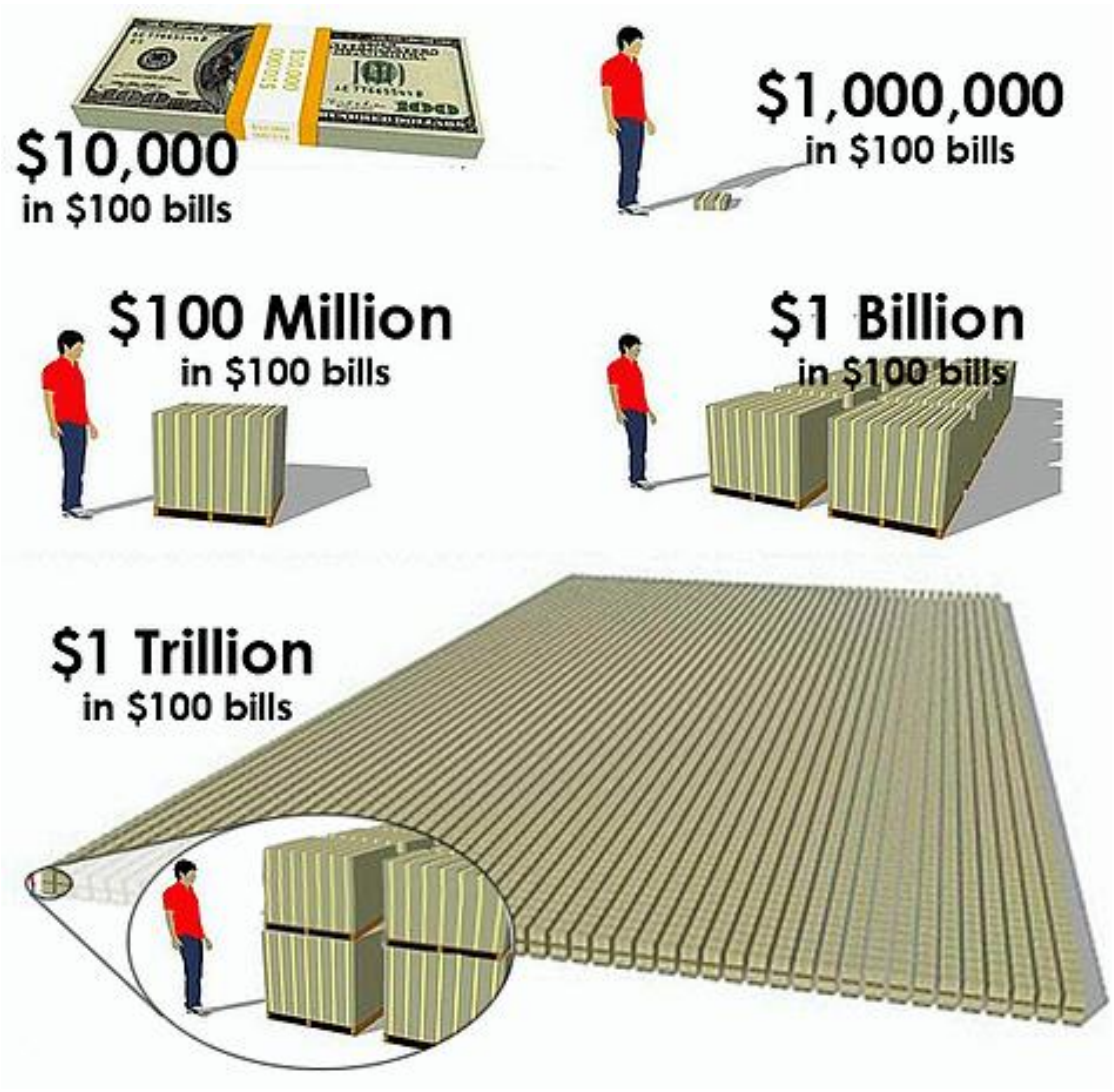
Free market capitalism is a social system in which we see the world through as many eyes as possible (via words and prices) to attain a high resolution picture of reality. In the digital age, this multi-perspectivism of markets has been amplified with smart phones, social media, and live-streaming; thereby further awakening our collective consciousness. The truth is that thousands of tragic stories like George Floyd's have unfolded over time, but the distribution of his via social media sparked a global outcry against police brutality. In the past, murders like this went less noticed, but in modernity the murder of one man can ignite a "fiat-slave rebellion" the world over. George Floyd's murder spreading like wildfire on social media and erupting into a conflagration of protests worldwide is testament to the refractive influence of digital technology on the light of inquiry and, thus, the discovery of truth.



Synthesis of multiple perspectives is the key to gaining a high resolution image of reality: this is the essence of free markets—the forums within which unceasing inquiries become truth.

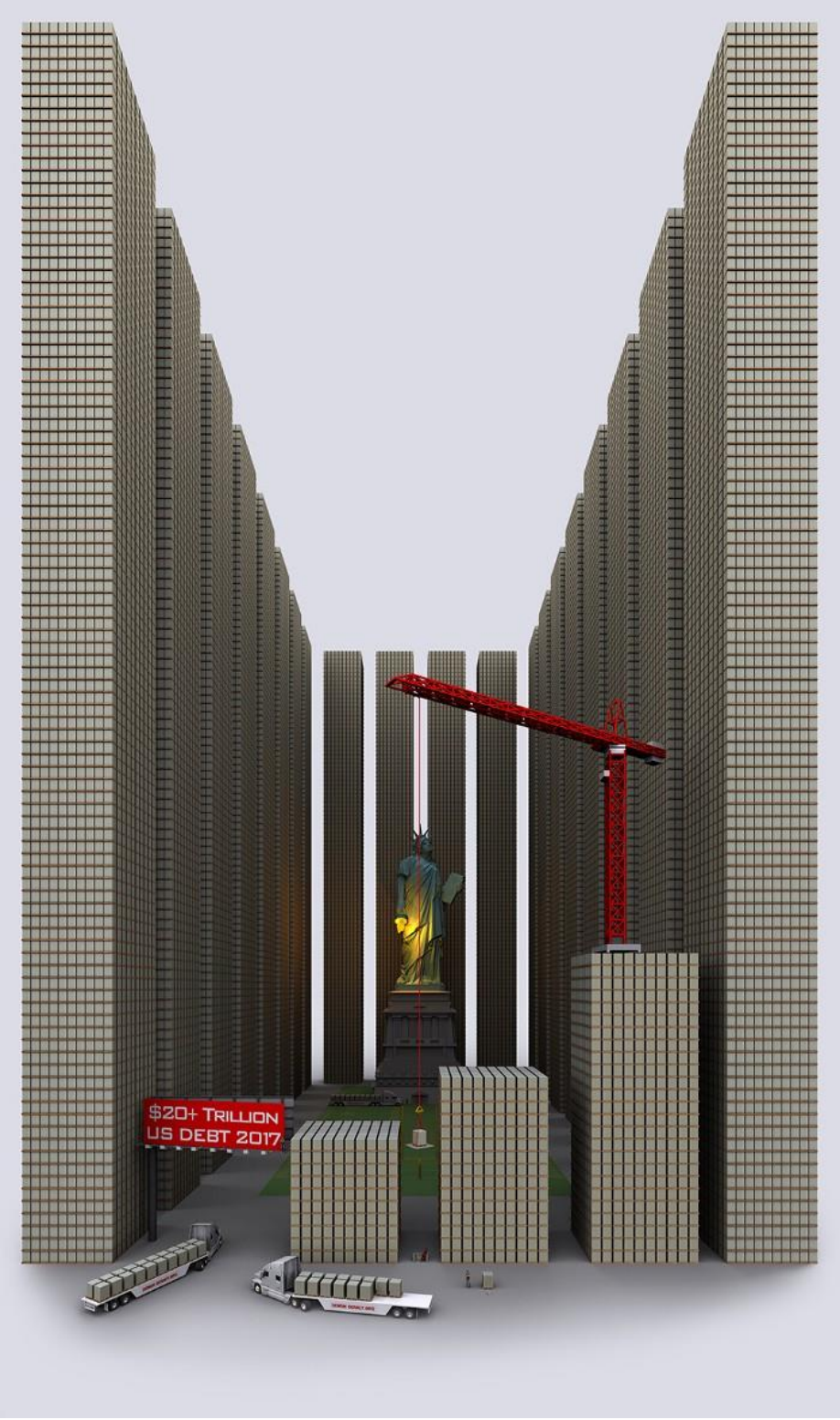
In truth, police are protectors of government "property": their job is to "keep the peace" while the state maintains its scheme of constant confiscation from fiat-slaves. Police departments in many southern US cities began as slave patrols tasked with assisting landowners in the recovery and punishment of runaway slaves—thus preserving the "property rights" of slavemasters. Even today, the job of police is to investigate crime by collecting information for the court, not to protect the lives of citizens. As the axiom goes: "possession is nine-tenths of the law," so clearly the police—a group of militarized fact finders—are truthfully nothing more than glorified government henchmen.

The light of inquiry melts down lies to reveal truth: this is why central banking will fail—it is critically dependent on ignorance, fear, and the suppression of free choice; it cannot stand the galvanizing gaze ever-present in the digital age. Centralized counterfeiting operations will not be tolerated in a world with unprecedented access to knowledge. Before being killed, George Floyd was arrested for attempting to use a counterfeit US $20 bill: the same crime The Fed perpetrates by the trillion. Millions, billions, trillions: it is easy to say these numbers, but much more difficult to comprehend the actual magnitude of state-sponsored counterfeiting operations. A visualization will help:



George Floyd was murdered for using a counterfeit $20 bill whereas The Fed counterfeits bills by the trillion.

Every US dollar printed is proof of time stolen—a visualization of US national debt gives us some sense of just how colossal the central banking system of institutionalized time-theft has become:



The US national debt in physical fiat dollars. This rendering is from 2017; with US national debt now pushing $26T, the Statue of Liberty would no longer be visible today.

Remember: society always slides towards slavery when a privileged few are able to produce money more cheaply than everyone else. As such, a free world is forever beyond reach before central banking is eliminated.

As sickening as it is ironic, George Floyd was pressured to use a counterfeit $20 bill precisely because The Fed counterfeits US dollars at scale. Again, the economic character of money directly influences moral standards: fiat currency pyramid schemes are premised on proof-of-theft, which pushes people to rent-seek, steal, and deceive others to make ends meet. Inflation impacts the poorest among us the worst, which explains why the median wealth held by a black family in modern America is less than 10% of that held by a white family ($17,000 to $171,000) and falling. As Michael Krieger describes this systemic weaponization of debt-based currencies:

“rather than empowering people, it turns them into modern-day indentured servants endlessly stuck on a hamster wheel with little to no hope of getting off. This is not an accident, it’s a tried and tested tool which, when combined with incessant mass media propaganda, is an effective way of creating a submissive, confused, and desperate underclass.”

By buying Bitcoin, you are participating in a global protest against state-controlled currency pyramid schemes in a way that politicians cannot ignore—since money is the only voting system in which your voice cannot be muted.

Buy Bitcoin = bye bye slavemasters.

Although none of us were given the choice of what state to be born in, thanks to Satoshi Nakamoto we are all now free to choose our own money. The first step on this journey is self-education: it is no coincidence that state-owned curriculum teaches us nothing about the origins of money or how it works. Thankfully, the internet is a treasure trove of resources if you know where to look (check out some comprehensive reading here, here, here, here, here, here, here, here, and here).

Again, free markets are economic games played for the purpose of finding truth, and market manipulators are lying cheaters. In this sense, the Fed is like a professional sports franchise that can effortlessly score points at the touch of a button: a malicious team that doesn’t play by the same rules as the rest of us. Facing an “invincible” opponent like this is clearly demoralizing for other players in the marketplace, who are constantly robbed no matter how well they play. Money is a game played for keeps, and it involves the highest stakes imaginable—human freedom. Counterfeiting currency is a mechanism of slavery. By breaking the central bank dominion over money, Bitcoin is an emerging emancipatory force for a world suffering under fiat bondage.

Chasing Starlight

"I prayed for freedom for twenty years, but received no answer, until I prayed with my legs." —Frederick Douglass

Making haste under starry skies, aided by stalwart abolitionists, escaped slaves in the Antebellum South risked everything to flee northward as they attempted to cross into the free states of Canada. Finding true north could be challenging at times, fortunately there were many clues — like moss growing on the north sides of trees or the northbound flight paths of migrating birds — that helped runaway slaves in their quests for freedom. Perhaps the most crucial of these clues was the North Star which, unlike other heavenly bodies, never changes position in the night sky.

Gaining stealth under the cover of darkness, intrepid former slaves relied upon the fixity of the North Star to light their pathway to liberty. Operating under conditions of dire uncertainty and never knowing who to trust, this celestial torch — a true lodestar — served as the guiding light for the Underground Railroad: a network of secret routes and safe-houses providing safe passage for runaway African Americans into Canada. Antislavery activists like Harriet Tubman supported this volunteer-based, flexible, and covert network that was so instrumental in undermining the heavily enforced institution of slavery in pre-Civil War America.

In modernity, we once again find hope of overcoming the financial slavery imposed upon us by The Fed in a volunteer-programmed, open-source, and cryptographically clandestine network guided by its own "North Star": an immutable supply of 21 million bitcoin. For runaway African slaves, the North Star suspended high in the heavens beyond the reach of vengeful masters was a gift from God: an inextinguishable light for liberation. Bitcoin—a free market money with a supply firmly fixed at 21

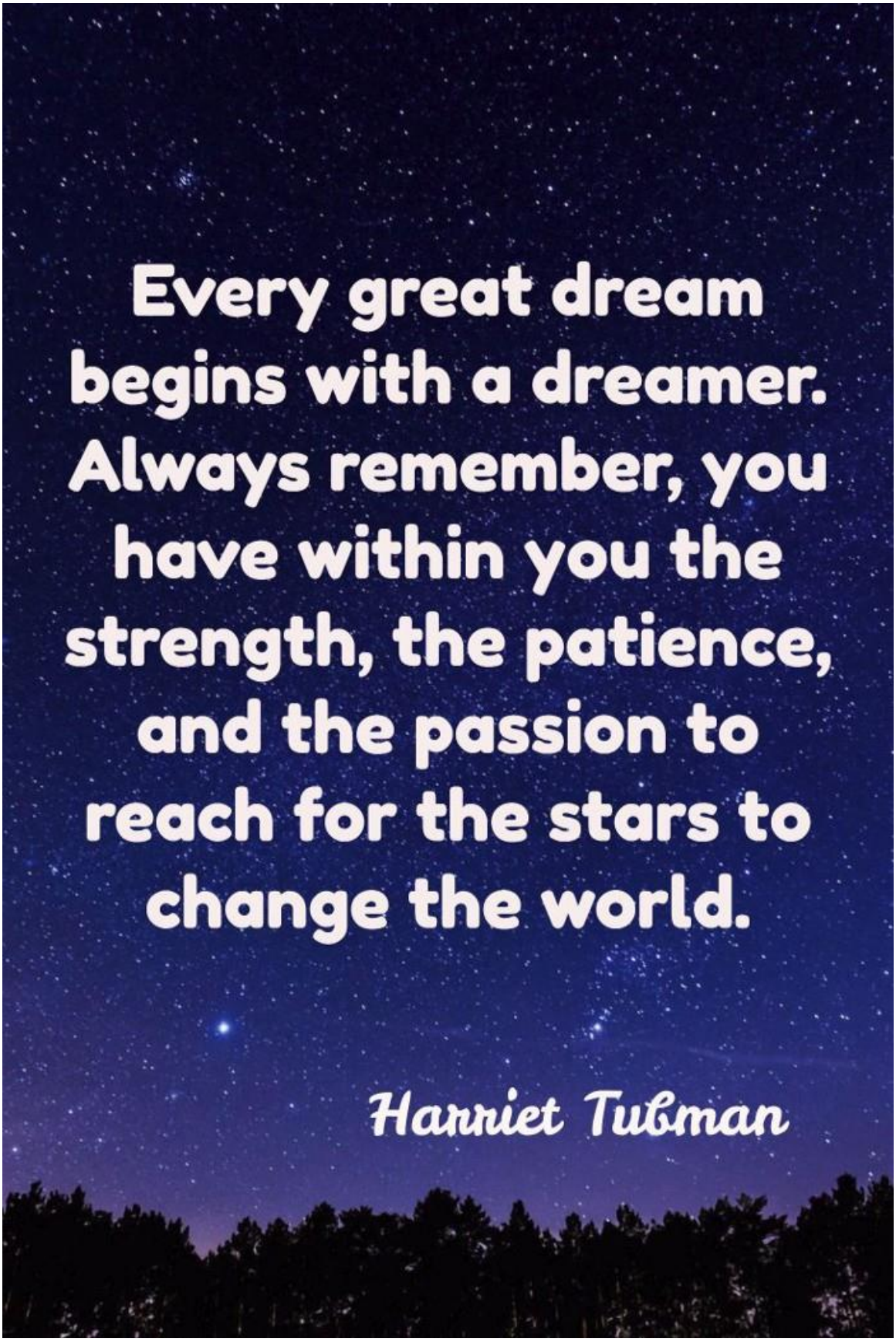
million—is the unclosing gateway for fiat-slaves escaping economies controlled by central banking. Acceptance of Bitcoin is the manumission of humanity from central bank bondage, once and for all.

We are all living witnesses to the incineration of institutional falsity by unstoppable honest money. Bitcoin is a burning star of sincerity engulfing the enforced fiction of fiat currencies everywhere. From the ashes of this phoenix immolation, a society structured on the sound principles of accountability, honor, and integrity can arise. As an implementation of absolutely truthful money, it is a luminous beacon that cannot be coerced or concealed. As Buddha taught us:

"Three things cannot be long hidden: the sun, moon, and truth."

Bitcoin is a rebellion against the most powerful bastion of socialism in the free world: central banking. It is a peaceful revolution involving the permanent disarmament of tyrants who weaponize money to confiscate wealth. Bitcoin is a weapon of peace; the final assassin to time-theft. An alchemical archetype, it is an antidote to state corruption and social moral affliction. As a purely honest free market money, Bitcoin is an irrepressible truth; an expression of pure monetary capitalism and a modern-day declaration of independence for fiat-slaves worldwide.

Bitcoin is money without masters: a system governed by rules instead of rulers. By awakening the world from the nightmare of financial slavery, Bitcoin is a dream of freedom coming true.


Every great dream begins with a dreamer. Always remember, you have within you the strength, the patience, and the passion to reach for the stars to change the world.
Harriet Tubman

Thank you for reading Masters and Slaves of Money.

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Translations:

Spanish

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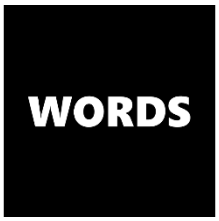

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