
On the Origin of the Value of Cryptocurrencies

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Additional information is available at the end of the chapter

<http://dx.doi.org/10.5772/intechopen.79451>

Abstract

Bitcoin and other cryptocurrencies received a lot of criticism during the last 9 years. It is not surprising that this criticism came from organizations that are threatened by the crypto revolution (banks, government, central banks, finance companies, etc.). Nevertheless, it is very surprising to hear criticism from economics schools, which oppose central banking and advocate free choice in currencies (such as the Austrian school of economics). Unlike the ordinary criticism (that Bitcoin is a scam, a bubble, etc.), which can easily be refuted, the criticism of part of the Austrian school economists is based on interesting arguments, which requires a different level of explanation. For example, it was claimed that Bitcoin should be worthless; otherwise, it contradicts Mises' regression theorem. The object of the chapter is twofold: first to explain why the criticism is unfounded and second to analyze the origin of the value of Bitcoin and other cryptocurrencies from the perspective of the Austrian school of economics. In particular, it is explained that Bitcoin does not contradict the regression theorem for two reasons. First, the initial value estimation can be a random event, and second, the Bitcoin network (even now) has a nonmonetary value.

Keywords: cryptocurrencies, Bitcoin, blockchain, regression theorem, Mises, Austrian school of economics, the value of money

1. Introduction

Bitcoin is based on three technologies: the Internet, encryption methods, and the new blockchain technology. Unlike these technologies, the Bitcoin revolution was both a technological revolution and a monetary one. It completely changed the monetary world, and it seems that its invention opened a Pandora box, whose effect cannot be underestimated or predicted. Since its inception in 2009, the Bitcoin project had many opponents, and like any successful project, their number increases gradually.

It is not very surprising to hear criticism from the industries and organization, which feel intimidated by the new invention. One would expect to find criticism from leaders in the banking industries, the insurance, and investment industries and, of course, from politicians. It is not even surprising to find criticism in the academic world, since, after all, one of the main tasks of the academic world is to instill past knowledge into the future generation and to be skeptical of new ideas.

On the other hand, since Bitcoin is a decentralized technology, it was warmly adopted by anarchist organizations worldwide [1–3], but for similar reasons, it was attacked by many others [4–9]. Some attacked the Bitcoin from the fear of shaking the current centers of powers, but most attacked it out of ignorance. Strangely enough, even in the libertarian community, which in general embraced the new currency, there are some that used allegedly Austrian economics arguments to debunk the foundation of the Bitcoin economy [10–14].

In general, we encounter two strategies to attack Bitcoin: (1) presenting multiple minor or even clearly erroneous arguments. Consequently, the arguments keep reappearing, despite the fact that they are constantly refuted. And (2) using fundamental economic laws to allegedly demonstrate that Bitcoin does not possess the essential properties of money.

The object of the chapter is twofold: (1) to present and refute all the main arguments in a single chapter and (2) to utilize these arguments to reinvestigate the origin of the source of money in general and cryptocurrency in particular.

So, let us begin with the simple arguments:

2. Is Bitcoin a Ponzi scheme?

The most common criticism against Bitcoin is that Bitcoin is actually a Ponzi scheme [7, 10]. Clearly, there is no resemblance between the two. A Ponzi scheme is a fraudulent investment operation. The investors are made to believe that they gain from the investment operation, while in fact, the money comes from new investment, that is, a Ponzi scheme is a pyramid fraud.

While some cryptocurrencies or tokens do seem to be a Ponzi scheme, Bitcoin is definitely not. Everything about Bitcoin: its algorithm, its network, and its development projects are completely transparent. The network, the mining process, and the entire project are all decentralized. There are no managers, no organizers, and no control. Therefore, there could be no fraud.

Bitcoin does not even have a pyramid structure. An investor in Bitcoin can make a profit by selling it at a higher price, just like in any other trade. Unlike pyramid structures, the owner of Bitcoins does not have to convince multiple people to invest in order to make a profit.

It is true that in both cases, the first investors gain more than the last ones, and that their profit rises with the number of traders. However, by the law of demand, it is clear that the price rises with the increase in demand, that is, the price increases with the number of buyers. This is valid for any commodity, and Bitcoin is no exception. This is definitely not a pyramid structure's fingerprint. Moreover, the whole network structure is different. A pyramid is a centralized structure, where there is a clear asymmetry between investors and all profits eventually

dissipate toward the founders of the pyramid (this is a “top-down” business model). Bitcoin is a decentralized network, where all the Bitcoins’ owners have the same status. Moreover, the founders of a crypto network may not even own a share in this network, or they can sell their share, if they have one (like Charlie Lee, the founder of the Litecoin network, who recently sold all his Litecoins).

3. Bitcoin is a bubble

Another common criticism is that Bitcoin and the other cryptocurrencies are a bubble [4, 6, 8]. This claim is not a very informative one. What does it mean? Does it mean that the Bitcoin price is too high? In a free market, the price is always right. If there is something “wrong” with the price, then it means that the market is not really free. When there is a housing bubble, it does not mean that there is something wrong with the houses, or that the sellers are greedier than they usually are, but it does mean that the government manipulates the interest rate and subsidizes bad mortgages, etc.

Therefore, any “bubble” claim is actually not a criticism against Bitcoin, but a claim against something external to its network—probably against governments. If everyone buys cryptocurrencies, it is probably because the public has no other investment channels. The banking interest is practically zero; the stock market is too high after 10 consecutive years of rising prices; and the housing market is recovering from the latest collapse. The fact that Bitcoin is in a state of a bubble, whatever that means, cannot be used as evidence to the argument that Bitcoin is worthless.

As Ludwig Wittgenstein wrote, “For whenever we test anything, we are already presupposing something that is not tested.” Similarly, when one believes the price of Bitcoin is too high, he presupposes that Bitcoin has *some* value.

4. Bitcoin yields no return

Another repeating argument is that Bitcoin is not a real asset in the sense that it does not yield any return. Unlike stocks or real estates, which yield dividends and rents, Bitcoin does not “yield” anything. People purchase Bitcoin only to sell it later.

But this is a strange argument, since, after all, money never yields return. A one-dollar note does not yield a return. It will be worth 1\$ forever. Nevertheless, people “purchase” dollars only to “sell” them later for goods. This is exactly the function of money and the same applies to Bitcoin.

5. The Bitcoin’s volatility

One very common attack on Bitcoin is that it must be useless as money (or currency) since it has very high volatility [12, 13].

Clearly, if an asset's value is very volatile, then it is less likely to be adopted as a unit of account, which is one of the properties of money. However, it should not considerably affect its prospects to be used as a *medium of exchange*. Even today, most Bitcoin transactions are quantified in US dollars, that is, in these transactions, Bitcoin is used as a medium of exchange, while the US dollar is used as a unit of account. However, it should be stressed that in these transactions, the dollar takes no role. Bitcoin is currently exploring a new territory, in which it is used as a medium of exchange, but yet to be used as a unit of account (on this discrepancy see Ref. [15]).

Moreover, the usage of the volatility criterion is useful only in close-to-equilibrium's markets. In the case of Bitcoin, the price increases exponentially, which is a clear sign of a nonequilibrium scenario. Exponential rise is an indication of a constant amplification process, which cannot occur in the vicinity of equilibria. In this case, it is clear that the volatility will increase exponentially as well. Therefore, there could be two options: (A) the approximately constant amplification process is close to its end, in which case the market will converge to a semiequilibrium state, and the volatility will decrease dramatically. (B) The constant amplification process is going to last for some time, in which case the value of Bitcoin will continue to rise dramatically.

Therefore, in both cases, the attractiveness of Bitcoin will increase, and in any case, the high volatility in an exponentially growing process cannot be used as an argument for the claim that Bitcoin is worthless. It is only a sign that the crypto market is in its infancy stages.

In an exponentially growing economy, the volatility should be evaluated in logarithmic scale, and in this scale, the Bitcoins' volatility actually declines.

6. The hoarding dilemma

Another important claim is that Bitcoin is worthless as a medium of exchange because most people, who purchased it, hoard the coins [12, 13]. Since most people regard Bitcoin as a store of value and "Hodl" (the crypto nickname for hold) the coins, how can it be used as a medium of exchange? This claim is often heard even in the crypto community, where the holders are encouraged to exchange their coins with goods, that is, to sell and buy the coins repeatedly (e.g., Ivan Liljeqvist and Rick Falkvinge). However, the two properties of money are tightly linked. A good cannot be a store of value unless it is a medium of exchange and vice versa. How can an object be valuable, without the option of exchanging it for something else? How can something be a medium of exchange, unless it is valuable?

Moreover, hoarding takes place only when people expect that the coins' price will rise in the future. In this case, fewer coins are used in circulation and, as a consequence, their price increases. This is the mechanism that persuades the hoarders to part with their coins.

7. A deflationary economy

The hoarding dilemma is a very important point because it is related to another criticism: how can Bitcoin be used as a medium of exchange while being a deflationary currency? In a deflationary

monetary economy, the argument continues, prices decrease perpetually, and therefore people have no incentive to buy anything, for they know that they will probably get it for less money in the future. In such an economy, consumption decreases, and the economy stagnates.

There are several problems with this argument. First, there is a problem of definition. Bitcoin is an inflationary currency, not a deflationary one since the number of coins increases gradually. It is true, however, that its rate decreases, and eventually the total number of coins is limited (around 21 million). Consequently, in a progressing economy, which is based on Bitcoin, eventually, the Bitcoin inflation will be lower than the economy's growth rate. In such an economy, the products' prices will eventually decrease. This state is wrongly termed "deflationary" [16, 17]. However, and this brings us to the second misconception, there is nothing wrong with rising prices. In fact, the economic sectors, which experience decreasing prices, are the sectors with the highest growth rate. The computer industry belongs to this category. Computer prices perpetually decline for decades, while the industry is growing. Not only that people did not stop from buying computers, but computers' sales are gradually increasing.

People have needs, and as economists explain, they have a time preference, that is, they do not like to postpone gratifications [16–18]. If they need a computer, they will eventually buy it, and decreasing prices is a good incentive to make the purchase. Eventually, they will buy the computer.

The third misconception is that saving is worse than spending and therefore people should be encouraged to spend their money. In fact, unlike the Keynesian thinking, over consumption is the enemy of economic growth. Clearly, people have to buy to encourage production; however, the economy cannot grow unless there is enough savings and investments. That is, as was explained by Hayek (in "the paradox of savings" [19]), when people save their money, they only *postpone* their consumption; they do not stop consumption altogether. Saving is a crucial ingredient in any economic growth, and therefore, there is nothing harmful in an economy with rising prices. In fact, at the end of the nineteenth century, when the American economy was based on the gold standard, the US experienced one of its best economic eras during a deflationary period [20, 21].

Evidence shows that any economy will gain from a "deflationary" currency, such as Bitcoin (or even gold, for that matter). However, if, in the future, it will be clear that there are some benefits to inflationary currency, then there are many other coins, in which inflation is part of their algorithm, for which case there is no upper limit to the number of coins. Let the market decide on the best inflationary/deflationary algorithm.

8. Bitcoin and the government

There is a claim that governments may create a competitive coin to Bitcoin, and simultaneously, the governments can outlaw Bitcoin. Indeed, the government can create a token of its own, and it seems that some governments seriously think about such an enterprise [22–24]. However, it is not clear what would be their motives. If these governments intend to create simply a true decentralized competitor to Bitcoin, then they would face two problems: (1) a

government would never be able to compete against the decentralization level of Bitcoin and (2) with a decentralized coin, the government would lose all its benefits of controlling the national currency, that is, by replacing fiat currency with cryptocurrency, the government literally kills the goose that lays golden eggs.

If the government plans on creating a centralized coin (i.e., government-controlled currency), then it could not rely on the good reputation of decentralized coins. In this case, the government would encounter a great difficulty to sell the coin to the Bitcoin community (see what happens with the new Venezuela's Petro).

Governments can confront the problem differently, and it can try to ban Bitcoin. This is evidently possible *de jure* but not *de facto*. The more the government manipulates the currency, the more the people need cryptocurrencies (see, e.g., the case of Zimbabwe, India, and Venezuela).

9. Technology-based money

There is a good question regarding Bitcoin's longevity. Bitcoin, the claim argues, is a technological invention. In principle, there is no reason that it would not be defeated by competing technologies. Unlike gold, which would exist forever, Bitcoin is a technology that changes in time. This is an interesting argument; however, in fact, this argument only emphasizes the similarities between gold and Bitcoin. Gold is here to stay, but so does Bitcoin. Actually, due to its decentralization, it would be extremely difficult to eliminate the entire Bitcoin blockchain. To achieve that, every copy of the blockchain should be erased. The chances of that are extremely low. Clearly, the value of the blockchain can decline substantially, but this is equivalent to a decline in the price of gold due to a lack of (technological or financial) interest. Therefore, gold is not better money than Bitcoin due to the fact that "while Bitcoin can be overthrown by competitive technologies, gold will exist forever." In fact, they both will probably survive for a very long time, and both may lose their value due to competitive technologies, because, in its essence, gold is also a monetary technology.

Having said that, it must be emphasized that a replacement of a monetary technology is a very challenging task. Financial markets are very conservative.

Gold has no clear chemical advantage over (for example) platinum, palladium, or iridium, and the main reason that gold is preferred over these precious metals is its early adoption as a medium of exchange (possibly due to its unique yellowish color). It may be instructive to note that there have been several attempts in the history to replace gold with other metals (iron in Sparta, copper in Rome, and even silver in the US); however, these attempts did not affect the gold's hegemony worldwide.

The same thing applies to Bitcoin. Bitcoin enjoys the network effect due to its early adoption. The gold's unique color and its plasticity made it relatively resistant to counterfeiting. However, gold counterfeiting is still possible (e.g., by covering tungsten with a layer of gold, because tungsten and gold have almost the same density), while Bitcoin cannot be counterfeited.

10. Genuine scarcity

This brings us to a well-known argument, that says that Bitcoin, like any other digital asset, is not scarce, and therefore can be repeatedly reproduced. The knowledgeable Bitcoin's opponent, which uses this argument, does not mean that the number of Bitcoins can be increased ad infinitum. He means that the algorithm can be copied and an infinite amount of rival crypto networks can be created. In fact, during the writing of these lines, there are literally thousands of cryptocurrencies networks: Bitcoins, Ethereum, Ripple, Bitcoin Cash, Cardano, Litecoin, Stellar, NEO, EOS, and IOTA to mention only the first 10 within the highest market cap list. Moreover, each one of these coins can be forked to other coins. The original Bitcoin network was forked many times to Bitcoin cash, Bitcoin gold, Bitcoin diamond, Bitcoin segwit2x, etc.

The argument is, therefore, that digital assets, like cryptocurrencies, can be even worse than fiat currencies, for while fiat currencies' inflation is regulated by central banks, and the number of cryptocurrencies can be inflated uncontrollably. However, Bitcoin is not only an algorithm. Indeed, the cost of copying the algorithm is negligible. But Bitcoin is also a very secure network. Every new Bitcoin-clone does not benefit from the same level of security. The more computational power is invested in the network; the more secure the network is, and the more people would find it safe to invest their money in it.

Bitcoin may lose its hegemony in the crypto sphere; however, as was explained above, it would be very difficult for new networks to pose a real threat to Bitcoin due to its proven high security and reliability.

11. Bitcoin transactions are too slow and too expensive

Recently, the Bitcoin adversaries took advantage of the heavy load on the Bitcoin network, which caused slow and high fee transactions, to claim that the Bitcoin does not deliver its promises—Bitcoin transactions are too slow and too expensive. Soon, they predict, the Bitcoin network will be so cumbersome, that transactions will become unfeasible, and the Bitcoin project will be abandoned. This is indeed a problem. But this is a technological problem and not a fundamental one. It may explain why the Bitcoin market dominance declines, but it can never be used to explain why Bitcoin should be worthless. Clearly, the Bitcoin developers are aware of these problems and work constantly to mitigate the harmful effects of the network load.

Several technological improvements have been suggested and implemented (SegWit, lightning network, atomic swap, and even raising block size in a forked versions of Bitcoin).

Moreover, there are countless other currencies, whose transactions are much quicker and cheaper, and yet their value is considerably lower than the value of the Bitcoin network. Despite the fact that the technology is yet in its infancy stages, and there are still numerous technological challenges, the value of Bitcoin keeps on growing.

Therefore, these facts should be an argument for Bitcoin and not against it, because these problems show that the need for reliable decentralized currency in the modern markets is so high, that people keep purchasing it despite the high transaction costs (and despite the fact that there are low cost but less proven alternatives).

12. Currencies backed by nothing

A very popular argument against cryptocurrencies is that they are backed by nothing: “They are neither backed by gold nor are they backed by governments.”

Clearly, these are two different arguments. President Nixon, in 1971, was responsible to complete the monetary experiment that began at 1944 with the Bretton Woods system. Since then, there is not a single fiat currency in the entire globe, which is backed by gold or by any other commodity. Hence, a commodity backup is not a crucial ingredient in the making of money. As for the second argument, what does it mean that the currency is backed by the government?

Clearly, if the government backs its currency by forbidding the usage of other currencies (in its geographical territory), then it enforces a certain minimum value for the currency. However, not all governments can or do that. In most countries, the population can make economic transactions with many currencies. Most governments back their currencies by enforcing tax payment with them. Similarly, the governments pay their employees with the national currency. However, these conducts are equivalent to the presence of a rich man in a market, who declares that any economic transaction with him can take place only with a certain currency. As richer this man is, the higher will be the value of this currency. Clearly, a government is equivalent to a very rich man, but the differences are quantitative rather than qualitative ones.

One of the most instructive examples in this regard is the Swiss dinars in northern Iraq during the gulf war [25]. This is a very interesting example, which vividly illustrates the fact that paper money can be used as a medium of exchange, despite the fact that it is backed neither by any commodity nor by any government.

13. Dependence on the current monetary system

An argument against Bitcoin, which was very common in its early years, is that Bitcoin is not a real medium of exchange because most traders, which accept Bitcoin, convert them to fiat currency almost immediately after the transaction.

Nowadays, this argument is heard less since many sellers prefer Bitcoin over fiat money. They prefer spending their fiat money and receive and keep their cryptos. Moreover, nowadays many employees are paid in cryptocurrency.

However, it is important to stress that whether the users of Bitcoin prefer to make an additional transaction after selling a product, that is, to convert the crypto to fiat, is irrelevant to the validity of Bitcoin as a medium of exchange. First, there is no praxeological difference between the exchange of Bitcoin with fiat and the exchange of Bitcoin with other goods. If a

seller prefers to convert Bitcoin into fiat currencies, it only means that he had decided to use Bitcoin as a medium of exchange to purchase the fiat currencies. Moreover, one should not ignore the fact that the main reason that sellers prefer to convert their cryptos back into fiat is due to government regulations (mainly taxation) and has nothing to do with the fundamental monetary properties of Bitcoin.

14. Bitcoin and economic calculations

Some Austrian economists used the volatility problem and the last argument to claim that Bitcoin cannot be used for economic calculations. Since economic calculations are essential to any modern economy [16], it is futile, according to them, to replace the current fiat currency with Bitcoin. However, economic calculations can be made with any commodity. When a businessman has four bottles of wines, and he needs to choose between two production alternatives: one alternative that will eventually yield three additional bottles and a second one that will eventually yield five bottles, he will choose the latter. The same thing applies to Bitcoin. Crypto traders already practice this kind of economic calculations using Bitcoin.

However, volatility is indeed a problem (mainly in intra-temporal calculations, i.e., interest rates), which prevents wide adoption. Nevertheless, as was explained above, the volatility gradually declines, and it is one of the infancy problems of Bitcoin, and it is not a fundamental one.

15. Bitcoin and the division of labor

Division of labor cannot exist in a nonmonetary economy. The presence of money drives people to specialize and increases their productivity beyond their personal needs. They can trade the surplus of their production in order to pursue higher gratifications (for the analysis of production in the presence of specialization, see Ref. [26]).

Therefore, any adoption of Bitcoin as a medium of exchange should be accompanied by an upgrade of the division of labor. Is there any evidence for this?

The problem is that it is almost impossible to attribute scientifically a specific improvement in the division of labor to a specific cause. However, it is clear that if a person prefers using Bitcoin than other currency, then he must have found it useful and more efficient for him. Therefore, this individual can spend the surplus time in further specialization.

Consequently, in a free market, any unregulated usage of Bitcoin (or anything else for that matter) is a circumstantial evidence for upgrading the division of labor.

16. Bitcoin and property rights

Property rights are subtle issues. There is a fundamental claim that intangible objects, like digital assets or ideas, cannot be owned. The claim is based on the presumption that property

rights and private ownership are essential to manage scarce resources in the real world. Thus, according to this view, only scarce resources (like, land, houses, gold, etc.) can be owned, while resources that are not scarce (like, ideas, patents, text, digital pictures, etc.) and that can be easily reproduced cannot be owned [27]. Bitcoin is a chimera, in that regard, since it is both digital, that is, intangible, and scarce. In fact, the essence of the blockchain technology is the creation of scarce digital assets. That is, the blockchain creates artificial scarcity.

Therefore, despite the complex philosophical issue, I believe there is a consensus that Bitcoins can be owned, and property rights can and should be applied to it.

There is a claim, however, that Bitcoin advocates ignore traditional property rights, contracts, and traditional legal systems, which were developed and refined for millennia [12].

It is true that currently, it is easier to evade law enforcement using cryptocurrencies than using most bank transactions. The facts that there is nothing tangible in the Bitcoin network and that digital transactions can take place without the regulated banking system complicate law enforcement. However, on the one hand, it can be regarded as a technical difficulty, which may be solved using artificial intelligence technologies, and on the other hand, one may argue that these properties of the Bitcoin network only strengthen property rights, because they prevent government confiscation of private property (private money).

Not only aren't crypto networks against contracts, but also smart contracts are an integral part of these networks. The most well-known is the Ethereum network, but there are many more cryptocurrencies with this property (like Neo, EOS, Cardano, etc.), and even the Bitcoin network can support smart contracts (Mastercoin, Rootstock, Particl, etc.).

Therefore, the blockchain technology eliminates the need for (external) law enforcement in some cases, because the contracts are enforced within the blockchain itself.

In general, cryptocurrencies strengthen private property and property rights. They do not weaken them.

17. Bitcoin and crime

Some politicians and economists believe that Bitcoin and other cryptocurrencies have no value to society since most of their users are outlaws and criminals [28].

For one thing, one has to make a distinction between the different cryptocurrencies. Most of the criminal activity was transferred from the Bitcoin network to the more private cryptos (such as Monero, Zcash, Verge, etc.) since transactions in the Bitcoin network can be traced.

Moreover, most of the illegal trade that takes place on the Internet belongs to the category of victimless crimes (like drugs, gambling, and tax evasion), whose prohibition is disputed.

In any case, the illegal activities that take place on the network only emphasize the fact that the crypto networks are valuable for at least some of the people, and in a market economy, when a commodity is valuable for some of the people, then it is valuable to the entire economy.

18. Bitcoin and egalitarianism

There is a claim that a Bitcoin-based economy would increase wealth inequality. This argument is based on the fact that most of the Bitcoin wealth is concentrated in a minuscule amount of Bitcoin addresses [29]. But clearly, wallets and addresses are not persons. Almost every user holds several wallets, and a wallet can and does generate multiple addresses mainly for privacy reasons.

This argument suffers from an additional fallacy: the distribution of money in a population does not determine the distribution of wealth. Quite the contrary, the distribution of wealth determines the distribution of money. In a free economy, people are paid for creating wealth. Since Bitcoin economy has a higher resemblance to a free economy than our current fiat economy, it seems that in a Bitcoin-based economy, the money distribution will be fairer than the current one.

19. The value of Bitcoin

There is a claim that Bitcoin is worthless, because it answers no real need and solves no real problem. This claim can easily be refuted.

Bitcoin is a global, decentralized, highly liquid, and pseudo-anonymous asset. Therefore, in any transaction, which requires all these properties, the benefits of using Bitcoin over other currencies are clear. Moreover, that is exactly the reason that most people do not appreciate these properties. First, most people are unaware of the damage caused by centralized monetary systems. Second, only rarely do they perform international financial transactions in large volumes. Third, most people are against anonymous transactions.

However, the benefits of Bitcoin are widely recognized in the following cases:

(1) Where the centralized monetary system completely collapses (e.g., Venezuela and Zimbabwe). (2) Where the government confiscates its own citizen's assets (e.g., Cyprus and Saudi Arabia). (3) Among populations, which are excluded from the financial and banking systems (e.g., bankrupted citizens and minors). (4) Among outcasted populations (e.g., drug users and gamblers). (5) Among people who are keener on their privacy (e.g., tax evaders and porn users). (6) Among frequent travelers/flyers.

In general, it is clear that the Bitcoin technology has a clear value wherever censorship-resistance is required. Money is one example, social media is another (e.g., Steem, LBRY, Memo).

As was mentioned above, in a market economy, when an asset is valuable to some people, then it is valuable to the entire economy. Consequently, people who do not belong to any of these populations can still regard Bitcoin as a safe haven for their money.

However, the fact that Bitcoin is valuable only increases the mystery as for the *origin* of its value. In the previous sections, we have presented the problems in arguments, which claim

that Bitcoin should be worthless. Before we present the last argument, which will lead us to the *origin* of the Bitcoin's value, it is instructive to discuss incorrect explanations, from which we will learn what *cannot* explain the origin of the value of Bitcoin.

20. Backed by energy

It is repeatedly mentioned by crypto advocates that Bitcoin is backed by proof-of-work, or, that it is backed by energy or by the mining's electricity.

In particular, such an explanation was used by John McAfee to justify his prediction of the Bitcoin price at the end of 2020 [30]. The argument goes like that: currently, it costs several million dollars to mine 1800 BTC (the current daily yield). Within few decades, the mining rate will decrease substantially, while there is no reason to assume that the cost will decline (more plausible that it will rise). Therefore, one may conclude that because Bitcoin's mining cost will rise, its price must rise as well.

This is a very common error that is based on the classical economists' theory of value—the labor theory of value. This theory, which was developed by Smith, Ricardo and their followers (including Marx), was based on the premises that the labor is the source of value. This theory helped them to explain the water-diamond paradox, namely, why the value of diamonds is higher than the value of water, while clearly water is much more useful than diamonds. The classical economists would reply that it costs more to mine and to shape diamonds than to pump water from a nearby well. The subjectivist schools of economics, in general, and the Austrian school, in particular, would strongly disagree. Bohm-Bawerk, the well-known economist, would argue that it may be very costly to prepare a mud pie, nevertheless, the mud pie is still worthless. The Austrian economists would argue that the classical economists made it all wrong. It is the price of the product that determines its cost and not the vice-versa. That is, if a producer evaluates that he can sell a product for 1000\$, he will be willing to pay production costs, which are lower than 1000\$. Clearly, the competition enforces the producer to lower the product's price until it is close to the product's cost. However, had he not known that he could sell the product at a price higher than the cost he would not have produced it.

The same thing applies to any product, and mining is not an exception. As long as the market price of gold is higher than the cost of mining, then mining will continue, otherwise, the miners would stop the mining process. That is, the market cost of gold (approximately 1200\$/ounce today) determines the maximum cost of mining. In the case of Bitcoin, the mining process cannot stop. In fact, since every 10 min a new block is added to the blockchain, then the algorithm keeps adjusting the mining difficulty to maintain a constant rate of block production. Therefore, the algorithm makes sure that the mining cost would remain below the market price so that mining would never stop.

21. Too costly to mine

A similar reasoning appears in a different argument against Bitcoin: the Bitcoin mining costs are extremely high, and even now, its electricity consumption is equal to that of a small

country (like Ireland). Within several years, the costs would be gigantic, and it would be unprofitable to mine additional coins.

Again, this is a complete misunderstanding of the mining process. As was explained above, unlike gold mining, there is no given external cost for mining Bitcoin. The causality between cost and prices works in the opposite direction—Bitcoin prices determine the cost of mining. Therefore, at any given time, the users of the Bitcoin network are the ones who determine the amount of money they are willing to invest in the network security. That is, first, the mining cost cannot increase beyond the amount the users are willing to pay, and second, the electricity cost is not a wasted investment; it is a measure of the network security. The more people trust the Bitcoin network, the more they are willing to invest in it. Consequently, the Bitcoin price increases, and so does, as a byproduct, the mining cost, which measures the network computation power. That is, the more secure the network is, the more trustworthy it becomes in practice via the price mechanism. This is a positive feedback, which strengthens the network. However, there is a limit to the cost of security, which people are willing to pay in any financial transaction. This limit determines the mining cost.

It is interesting that a similar argument was put against the gold standard. Followers of the monetary school of economics argued that unlike fiat money, gold mining is a waste of useful resources, which can be directed to other useful industrial sectors. The answer of the Austrian school was that it is a small price to pay to prevent the government from inflating the amount of money [31]. The Austrian economists have a nice analogy: why so many resources are invested in steel locks? Wouldn't it be smarter had we replaced them with paper locks and allocate the steel to better uses? This is clearly a rhetorical question. Security is a costly business. We pay for security and safety.

This is an important point. In a stationary economy, or, in the Austrian school terminology, the Evenly Rotating Economy (ERE), the future is already known, and there are neither surprises nor risks. Consequently, there is no need for money. In the ERE, money has no function. People need money only in states of uncertainty. Money helps relieve the sense of uncertainty. However, counterfeiting is a source of concern. Fiat money is susceptible to the whims of the government. Governments can (and do) inflate the money supply indefinitely.

The supply of gold, on the other hand, is regulated by the market, since gold counterfeiting is extremely difficult. Only when the market price exceeds the mining cost, new gold is generated by mining.

The same reasoning applies to Bitcoin. However, there are some very important differences: as was explained above, it is more difficult to counterfeit Bitcoin than gold, let alone fiat currency. Moreover, the ability to counterfeit fiat currency and gold is independent of their value. Therefore, as their value rises, additional counterfeiting attempts are made.

The opposite is true for Bitcoin. The difficulty to attack the Bitcoin network is proportional to the Hash power of the Bitcoin mining; however, the cost of this power is proportional to the price of Bitcoin (since most of the Bitcoins have already been mined). Therefore, unlike fiat money and unlike gold, as the price of Bitcoin rises, it becomes more difficult to attack the network (Bitcoin's equivalent of counterfeiting).

To summarize this point, the high mining cost is not a waste—it is a security investment.

22. Scarcity and value

Another misconception about the origin of the value of Bitcoin is that unlike fiat money, which is created “out of thin air,” the number of Bitcoins is fixed and cannot be changed, and this inherent scarcity is the source of its value.

First, as was explained above, Bitcoin is also inflationary. In fact, the important characteristic of the decentralized crypto coins is not that coins cannot be created “out of thin air,” but that their creation is fully determined by the well-known protocol and cannot be manipulated by a central entity (i.e., governments). Therefore, the users can take account of the inflation parameters into their future financial contracts. This property of cryptocurrencies is a clear advantage they have over fiat currencies. In fact, this is a major advantage even over commodities backed currencies, such as gold, since the future mining rate of gold is unknown, while cryptocurrencies are created in a predetermined manner.

Second, scarcity, by itself, cannot be the source of value. Using Bohm-Bawerk example, the fact that a certain mud pie cannot be reproduced is, in itself, an insufficient demand to make it valuable. Scarcity is a necessary but insufficient condition for value creation.

23. The regression theorem and the *origin* of value

It was Karl Helfferich who formulated in 1903 the vicious circle of money [32]. The marginal value theory of Menger, the forefather of the Austrians school, can explain why a handful of diamond worth considerably more than the buckets of water, despite the fact that water is clearly more essential to human existence than diamonds are [33]; however, it could not explain why a seemingly worthless object like pieces of papers can have a high value. In other words, it cannot explain why people would be willing to exchange them with commodities, which have a clear intrinsic value. It was clear that if people, for some reason, attribute value to money, then it would be a logical behavior for the individual to attribute value for money, even if he does not find it useful to himself. However, how did money gain its value in the first place, or, in others word, it is a vicious circle to say that people want money simply because people want money [32].

Mises, apparently, solved this conundrum. He said that people want money today because they anticipate that other people would want it tomorrow since they wanted it yesterday, that is, money has value today because it has value yesterday. By introducing time schedule into the description of the process, Mises circumvented the vicious circle. But he did it with a cost. This logic leads to the unavoidable conclusion that any money had, prior to its use as a medium of exchange, an intrinsic value [34].

Thus, there is an argument that Bitcoin cannot be money since it never had an intrinsic value, that is, while the US fiat dollar is valuable today since it was based on the original value of the gold dollar, which was based for millennia on the currency value of gold, which was based somewhere in the past on the commodity value of gold, they claim that Bitcoin does not have such a chain of events. One cannot find any intrinsic value in the Bitcoin genesis. While gold

has an extensive commodity use in its premonetary era, Bitcoin, according to them, had no nonmonetary history and therefore cannot evolve into money.

This claim has several flaws. First, they turn Mises' argument on its head—Mises used his argument to explain how apparently worthless object can be used as a medium of exchange. Bitcoin is already a medium of exchange, which means that there are only two options, either Mises argument is erroneous or that they are missing something about Bitcoin. In fact, *Mises was not entirely accurate and Bitcoin does have a nonmonetary value.*

I would like to harness a physical analogy to explain this point—the laser.

When a laser is connected to a power supply, it emits coherent light almost instantaneously. Nowadays, lasers are very common and there is nothing special about this; however, a laser is not a light bulb, the origin of light in a laser can be regarded as a similar mystery. A laser consists of two basic elements: a light amplifier and a resonator, which is actually a feedback mechanism. Hence, a laser is a giant amplifying machine. Using the feedback, the laser keeps on amplifying the light. But wait! Where did the light originally come from? The laser has no element that generates the “original” light (i.e., the primordial photons), it only amplifies it. So where did the light originally come from? Well, actually, this is quite a mystery that nobody really knows. The source can be thermal noise, scattered light, or maybe the zero point energy. While academically it may be an interesting question, it is practically irrelevant to the laser operation. Moreover, it teaches us an important lesson—in the presence of a highly efficient amplifying process, the increase is exponential, and therefore the initial trigger is practically irrelevant. It doesn't matter whether the process started from a single photon, ten photons or a hundred, the changes in the time till it reaches equilibrium (the time, in which it grows exponentially) is negligible.

The same goes for Bitcoin. It was proven to be a rapidly accelerating phenomenon. In fact, just like the laser intensity or any other phenomenon with an approximately constant rate increase, the value of Bitcoin grew exponentially: within about 4 years it increased by a factor of a million! The technology was proven so successful that the initial value, people attributed to Bitcoin, is unimportant.

The legendary pizza transaction, which allegedly determined its initial market value (in which a couple of pizzas were sold for 10,000 BTC), could be totally different. It could have been sold for 1000 or 100,000 BTCs, and the final outcome would be almost the same and it would be determined by the equilibrium value. In fact, the entire process can start from a whim of a handful of strange geeks (see, for example [35]). That is totally sufficient, exactly like the amplifying process in a laser, which can start, for all we know, from a single photon, which accidentally was present in the laser's cavity.

In the previous paragraphs, it was explained why one does not have to prove that Bitcoin currently has an intrinsic use value in order to show that its exchange value, that is, its value as a medium of exchange, does not contradict Mises' regression theorem; nevertheless, *Bitcoin had and still has an intrinsic use value.*

Clearly, even prior to the Pizza transaction, the initial miner group attributed value to Bitcoin since they spent their time and the energy consumption of their computers to generate these Bitcoins.

Bitcoin is not the only thing that can be sent via the blockchain, in fact, almost any kind of information can be sent via the transactions, and this is an irreversible process, since any such information will remain in the blockchain for eternity, and everyone in the network will have an access to this information. Bitcoins are the cost of perpetuating the information. In other words, Bitcoins can be regarded as the “real estate” of the blockchain. The more Bitcoins a person has, the more information he can send on the blockchain. There are all kinds of data encapsulated on the blockchain: poems, prayers, political statements, commercials, and even photos [36]. In fact, it is amazing how many kinds of information can be found there. It is not difficult to find many applications for this kind of information retention.

One of the special applications is the announcement of contracts. Such contracts will be confirmed by the blockchain. Or another important application is a decentralized registrar of real estate (or any other type of property). With the Bitcoin network, one can announce ownership of objects, the information will be available instantaneously, and since it is not centralized, then there is no fear of losing this information.

The important thing is to realize that there is no direct connection between this information and the value of Bitcoin. The relation is indirect. The value of these announcements is directly related to the number of nodes in the network. The more people are connected to the Bitcoin network, the more valuable this information is. Therefore, if the network is large enough, then people will like to use it by sending and announcing information. However, it is clear that when the network grows, sending information becomes more valuable, and therefore the value of the network’s coin, which controls it, increases as well. The more coins a person owns, the more he controls the network. Again we see that owning Bitcoin is like owning real estate on the blockchain.

Clearly, at its inception, when the Bitcoin network was small, the value of publishing data over it was low, but then the Bitcoin’s value was accordingly small. In fact, in its genesis, the Bitcoin’s value could have been only the subjective value of the first few geeks, who mined it (including Satoshi himself). When the network grows, the Bitcoin value increases exponentially, just like the laser power.

Nowadays, the fees of sending information over the blockchain are quite high, and therefore people seldom use the blockchain for broadcasting information. As a consequence, they tend to forget that the Bitcoin network has a clear nonmonetary use, and therefore it has a subjective use value. In any case, the fact that Bitcoin has a nonzero value does not and cannot contradict Mises’ regression theorem.

24. Conclusions

Bitcoin has many enemies, and, as a consequence, there are many arguments, which allegedly explains, why Bitcoin should be worthless or should be banned. The truth is that Bitcoin is extremely valuable and is here to stay because it cannot be banned. On the other hand, Bitcoin has many advocates, which use inaccurate arguments to justify the origin of its value.

The fact that these arguments were presented by renowned economists shows us that our understanding about the origin of money did not change much during the last century. The mysterious Satoshi Nakamoto gave us the opportunity to revive these century-old conundrums.

The main conclusions are:

- Bitcoin is not a scheme; it is a great monetary invention, which has a clear economic value.
- It cannot and should not be banned by governments. In fact, any government's manipulation and regulation emphasize and increase the need for cryptocurrencies.
- Criminals are not the only ones who see the benefits in using cryptocurrencies. In the third world (e.g., Venezuela and Zimbabwe), cryptos are lifesavers. In general, cryptos are extremely valuable wherever censorship resistance is required, and in a global market economy, that fact creates value for everyone.
- Bitcoin does suffer from infancy problems (high volatility and high transaction costs); however, these issues are not fundamental and will be resolved eventually (we already see many signs for that). The fact that the crypto market exceeded 800B\$, despite these issues, only emphasizes the need of the markets in them.
- The energy which is spent in crypto mining is not a wasted energy. It is the source of the network's security which increases the trust in the system, and in a market economy trust is a very valuable commodity.
- The easiness in the creation of new coins is not equivalent to fiat money inflation. Fiat inflation is a counterfeiting process, while the creation of new cryptos is equivalent to the creation of a new invention, which may be better, but it has to surmount the former coins' network effect.
- Bitcoin does not contradict any economical law. In particular, it does not contradict Mises' regression theorem for two grounds: first, Bitcoin was valuable for the first miners even before it was used as a medium of exchange, and the regression process can be kindled by any subjective whim; second, even now Bitcoin has a nonmonetary value (just like gold) as a "real-estate" on the Bitcoin network.

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