Bitcoin: A worldwide currency?

Bachelor Thesis

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Introduction

In November 2008 Satoshi Nakamoto published the white paper for Bitcoin called 'Bitcoin: A Peer-to-Peer Electronic Cash System' (Nakamoto, 2008). In this paper Nakamoto introduces and describes an electronic payment system called Bitcoin. It achieves what many had tried and failed to create before. The paper describes a protocol for a peer-to-peer payment system with a solution to the infamous double spending problem. Bitcoin is a decentralized system that operates without the intermediation of central authorities. Instead, it relies on cryptographic proof-of-work, which is created with computational power. This cryptographic proof-of-work makes it practically impossible to interfere or disrupt the protocol. Nakamoto referred to Bitcoin as an electronic payment system, but many now call it a cryptocurrency due to its currency like characteristics.

As Bitcoin is the first cryptocurrency in the world, it received a lot of media attention. This attention was quickly followed up by adoption from consumers and speculators. This adoption made the price of one bitcoin very volatile, which was $1 dollar per bitcoin on the 14th of April 2011 and $1242 on the 4th of December 2013. After this increase the price fell to current levels of $250 per bitcoin (Coindesk, 2015). However, the massive increase in adoption is a relative term, as the market capitalization of Bitcoin is only $3.3 Billion Dollar (Blockchain.info, 2015). This market capitalization is very small compared to the US dollar monetary base of 4 trillion dollar (Federal Reserve, 2015).

Since the creation of Bitcoin, many argued that Bitcoin could be the first global currency ever existed. However, many labeled bitcoin as a hype and a gimmick, which in the near future would have no value left. One who thinks of the latter is Paul Krugman, a professor at Princeton University and named 2nd most important economist of 2015 (The Economist, 2015). Krugman wrote an article in the New York Times called 'Bitcoin is evil' where he argues that Bitcoin could never be successful (Krugman, 2013). Despite many who think that Bitcoin could never be successful, the adoption and attention prove that a lot of people believe in the possibilities of Bitcoin becoming a worldwide currency, or at least, a widely used medium of exchange.

The purpose of this thesis is to investigate if Bitcoin can be seen as money and if it could function as a currency. This will on the one hand be done from the point of view of the Austrian economic school of thought. On the other hand, practical implications of the technical differences between Bitcoin and fiat money will be discussed. This leads to the following research question:

Can Bitcoin function as a monetary system?

To answer this research question, an in-depth understanding of Bitcoin is required. An analysis of the Bitcoin network will be given in section 1. Section 1 will contain an introduction to Bitcoin, describe its design and major differences with fiat currencies. Section 2 will describe the Austrian view on money, and compare this view to the characteristics of Bitcoin. In section 3 the practical implications of a Bitcoin monetary system will be discussed. Finally, a conclusion will be given as well as an answer to the research question.

For the sake of clarity, Bitcoin with a capital B refers to the Bitcoin protocol. When bitcoin is written with a lower case b, this will refer to the unit of account.

Section 1: What is Bitcoin?

Bitcoin (BTC) is an internet based crypto currency which was invented in 2008 by Satoshi Nakamoto and released in 2009 as open source. The system is peer-to-peer and therefore allows users to directly exchange bitcoins with each other. Each transaction that occurs within the Bitcoin network is recorded on a public ledger; the block chain. This public ledger is updated by miners which, as compensation, receive transaction fees and newly minted bitcoins. In this section the Bitcoin protocol will be briefly described, and there will be elaborated on the main differences between Bitcoin and fiat currencies.

Design of the Bitcoin network

Every bitcoin transaction is recorded on the block chain. The block chain is a public ledger which has no single entity that governs it. It is governed and updated by a network of communicating nodes. These nodes can validate transactions and send an updated version of the block chain to the other nodes (Nakamoto, 2008).

Every 10 minutes these new transactions are secured, also known as hashed, into a new block. This block is then added to the block chain. Hashing blocks is done by miners. A miner is a computer or a group of computers that hash blocks in search for a reward. The miner that hashes the block the quickest gets a 25 bitcoin reward plus the transaction fees of all the transactions in that block. As the miners equipment becomes more technologically advanced, the difficulty of hashing a block is automatically increased to ensure the arbitrary 10 minutes time interval between each block (Khan, 2014).

The units of account in the Bitcoin network are called bitcoins. Symbols used to abbreviate a bitcoin are BTC and XBT. A bitcoin is divisible in many small amounts of bitcoin. One bitcoin can be devised into one hundred million 'Satoshis' named after the founder. One Satoshi represents 0.00000001 bitcoin.

Bitcoins are held in a wallet, a wallet is a file that contains a public and private key. A public key can be seen as the number to a checking account. The information one would need to send money to another. The private key can be seen as the password to access the bitcoins.

However, the public key is derived from the private key through a cryptographic protocol and therefore cannot be changed. Once a private key is lost, the bitcoins assigned to that private key are lost (Reid & Harrigan, 2012).

Differences with fiat currencies

There are some fundamental differences between bitcoin and fiat currencies. A lot of different views exist on these differences. The major differences between fiat currencies and bitcoin will be discussed in this section.

Transaction fees

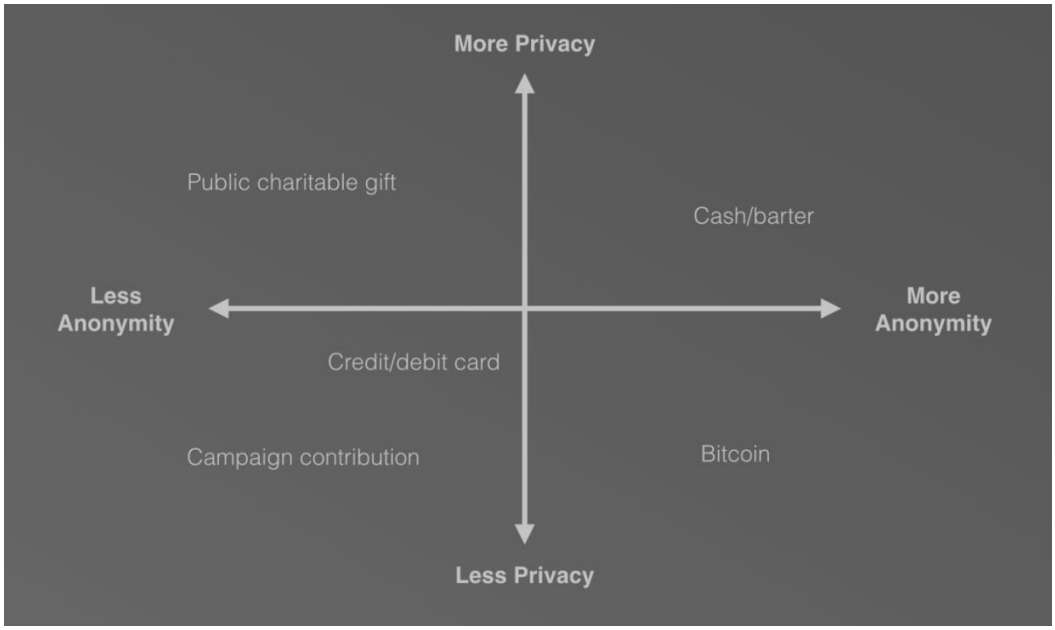
With fiat currencies it is possible to transact with others directly and without transaction fees. However, this is only possible when done physically. One would have to go to the other party and hand over the bills or coins in person. Since this is highly impractical and imposes opportunity costs, a common way of transacting money is via the internet. Fiat currencies require intermediaries for this type of transactions. These intermediaries may charge costs for this service. These fees may increase if the transactions happen between different banks and other countries/currencies (Kim, 2015).

Within the Bitcoin network all the transactions are directly to the other party. For a transaction to take place, it is only necessary that this transaction gets confirmed and adopted in a block. To incentivize miners to adopt a transaction in a block, a transaction fee is optional. One could choose to include a fee with their transaction to accelerate the transaction as miners are able to select transactions to adopt in their block. A transaction with a transaction fee is far more likely to be adopted in the block chain then a transaction without one. (Grimbergen, 2011) The Bitcoin community has agreed upon a standard transaction fee of 0.0001 BTC which as of May 2015 is approximately $0.002 (Andresen, 2013). This makes Bitcoin transactions significantly less expensive than online transactions with fiat currencies. For example in the US the average transaction fee that is paid to wire money to a domestic bank account is $27.50 and to a foreign bank account $47.50 (Kim, 2015). If the same amounts of money are sent in bitcoin this transaction fee would be $0.002 no matter where and which amount of money.

Pseudonimity

Many make the assertion that Bitcoin is completely anonymous. This is not true, Bitcoin is a pseudonymous network where every user operates under one or many pseudonyms. This pseudonym is the public key (Reid & Harrigan, 2012). This makes Bitcoin more anonymous than credit or debit cards, but makes it less private. This privacy is compromised due to the publicity of the block chain. Everybody can see every transaction in the block chain, so if a pseudonym is linked to a real person, each and every transaction that person made with that pseudonym is public. There are several services like dark wallet that create a new pseudonym for every transaction made in bitcoin. Without this service, Bitcoin falls somewhere between the extremes of credit and debit cards, and hand to hand cash transactions which are completely anonymous and private (Coindesk, 2015). In Figure 1 a graphical representation is shown which shows where Bitcoin falls between cash, public charitable gifts and credit and debit cards. This figure shows that cash and barter are the most private and anonymous method of transferring funds. It can be seen that Bitcoin is just as anonymous as Cash, but less private. Credit and debit cards fall in the category of less anonymous and less privacy.

Figure 1: Privacy and Anonymity of Bitcoin and comparables



I think that the increase in anonymity is an improvement for online payments. Not only that, it is an improvement towards the fundamental human rights; the right to privacy. However, it poses many challenges towards regulation and taxation, discussed in the following section.

Regulation and taxation

It is impossible to regulate the Bitcoin protocol itself as it is a peer to peer network where the government can't interfere. In addition, the pseudonimity makes it impossible to determine which person makes which transaction. These characteristics of Bitcoin make bitcoins a popular medium of exchange for illegal activity. Bitcoin facilitated the anonymous market place the 'Silk Road' which was used to exchange illegal contraband for bitcoins. Until closure, in excess of 1.2 million dollar in bitcoins was changed hands on this marketplace (Christin, 2012). After its closure in 2013, many other anonymous marketplaces came in existence to facilitate illegal activity. Furthermore, the pseudonymous nature of Bitcoin allows it to be used to for money laundering.

Bitcoin has been banned from Iceland, Bolivia, and Ecuador for these reasons (Bitlegal, 2015). However, the argument that Bitcoin should be banned due to these reasons is highly questionable as fiat currencies are used on a much larger scale for these types of activity (Havocscope, 2015). Most developed democracies are open to Bitcoin and developing regulations and laws for the use of cryptocurrencies. Less open minded countries like China and Russia have contentious view on the use of Bitcoin (Bitlegal, 2015).

Taxation is another problem for governments. Bitcoin offers the possibility to evade taxation due to its pseudonymous nature (Marian, 2013). In many countries there are no clear tax laws on cryptocurrencies. Some governments have made tax regulations for cryptocurrencies, however, the assets have to be voluntarily reported by the tax payer. For example, in 2015 the Dutch government added an option to declare assets in 'virtual currencies' (Belastingdienst, 2015). With a small chance of being caught for tax evasion when not reporting these assets, it is very likely that many people chose not to report these assets.

A possible way to regulate and tax Bitcoin would be to identify the persons behind each public key. This could be done by regulating the companies that provide services for Bitcoin users (Gruber, 2013). A first step towards this type of regulation has been done in the US. In

2014 the Department of Financial Services from the state of New York proposed a license named 'BitLicense'. A proposed license that every company should have if it wants to engage in any 'Virtual currency business activity'. The aim of this license is to regulate all the businesses that want to service in virtual currencies (Department of Financial services, 2014).

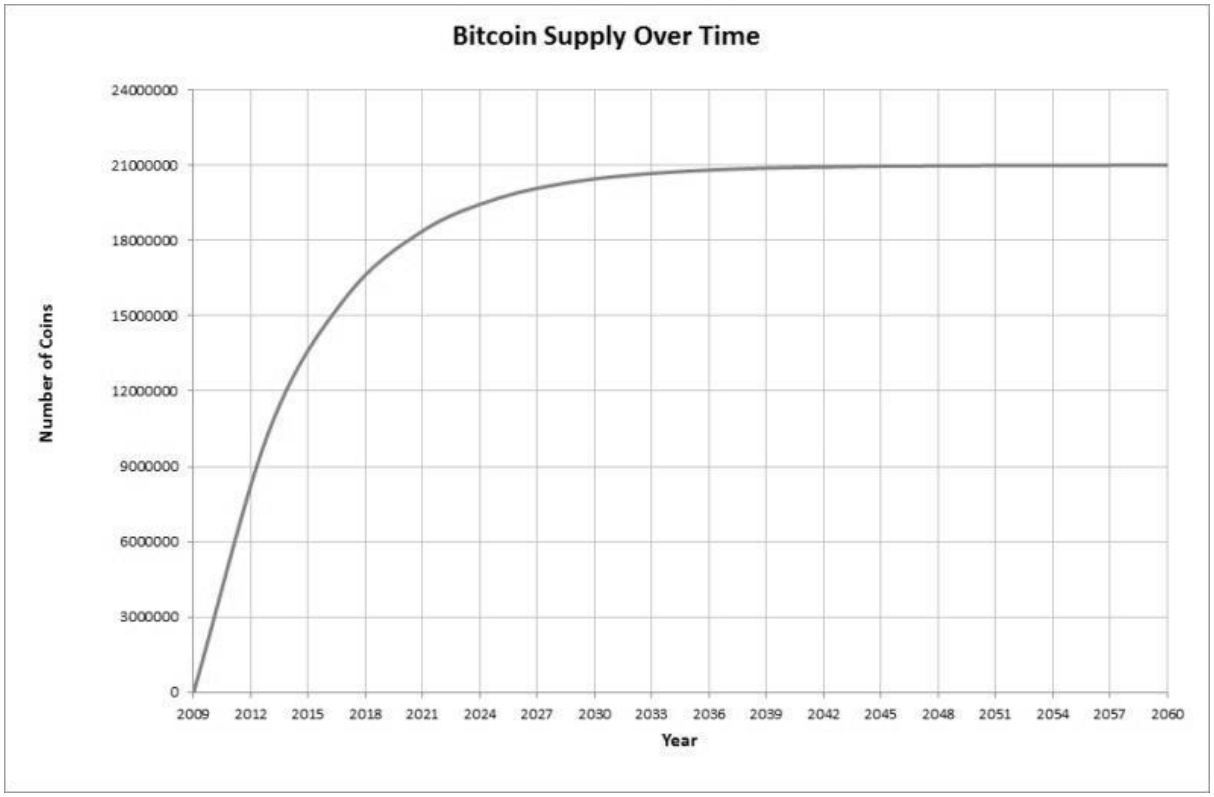
The BitLicense has gotten major resistance from the Bitcoin community, namely because of privacy reasons. Companies that obtain a BitLicense could be forced to collect identifying data on account holders and end users including full name and physical address (Department of Financial services, 2014). The aim of the regulators is to have information on the company to prevent any illegal activity. But as a result of this, the regulators will have all transaction history of every user of that company even if these transactions had no connection with this company. This is due to the full transparency of the block chain.

My belief is that Regulation and taxation may be a major point of resistance towards full adoption as a currency. I think the biggest problem is that there is no real mid-way concerning privacy. The design of the block chain is such that if the users behind the pseudonyms become known that all privacy is lost. Governments want full transparency while users of Bitcoin want privacy. This conflict of interest may be very hard to solve.

Money supply

In a centralized monetary system the money supply is regulated by the central banks like the European Central Bank and the Federal Reserve. With this monetary policy they can achieve certain goals as price stability, economic growth and interest rate stability (Woodford, 2005). In a decentralized system, the supply policy has to be fixed in advance. With Bitcoin, the supply of bitcoins is regulated and fixed by the software and executed by the miners which receive new bitcoins as a reward for the hashing of transactions (Nakamoto, 2008). The finite supply of Bitcoin is fixed to 21 million bitcoins. The first block was mined in 2009 by Satoshi Nakamoto and contained 50 bitcoins. Since then, approximately every 10 minutes a block has been mined. The Bitcoin protocol is hard coded to halve its bitcoin reward per block every 4 years. Currently (2015) the reward is 25 bitcoins per block and set to halve in 2017. This preset supply creates a curve shown in figure 2. The last bitcoin is set to be mined in 2140. Satoshi Nakamoto created this curve to recreate the supply of commodities like gold.

Figure 2: Bitcoin supply over time



Long before the creation of Bitcoin there has been a lot of discussion about the advantages and disadvantages of a fixed money supply. Many free market supporters like Milton Friedman support a fixed money supply (Friedman, 1984). In addition, supporters of the gold standard are supporters of a supply curve like Bitcoin has. However a great deal of economists supports government intervention within a monetary policy. Further implications and different opinions of a fixed money supply will be given in section 3.

Section 2: An Austrian view on Bitcoin

Origin of Money

To understand bitcoin as potential money, a further understanding is needed on the origin of money. Money can emerge in two different means. The first mean is via state force, where a state forces its people to accept a state created currency. These types of currencies are called fiat money and are typical for modern days. Every country in the world uses this type of money. If a country does not have its own currency, it uses a currency from another country. Fiat currencies are held in place and given value by means of military power and public confidence. These are needed as a consequence of the money having no other significant intrinsic value (Lerner, 1947).

A second type of emergence of money is via market forces. A currency created by supply and demand. Menger proposed and described a currency created by these market forces (Menger, 1892). An example of the emergence of money via market forces would be an owner of a specialized type of equipment. This owner needs to eat and wants to trade its equipment for food. However, since this equipment is very specialized, he is having a hard time getting a good price for it. A person with gold instead of equipment will have a significantly less hard time to find someone to trade with. As a result, the more saleable good will be the most liquid. If this principle is being practiced over longer periods of time, the most saleable good will emerge as a universally accepted medium of exchange.

Since it is very unlikely that a government will announce Bitcoin as its currency, the most likely way that bitcoin will emerge as a currency will be through the way of market forces. The Austrian school of economic thought agrees with Menger on this topic, arguing that the emergence of money is a catallactic process. A catallactic process is a process where the strongest form of money arises and becomes a universally accepted one (Hoppe, 1990).

Is Bitcoin money?

As mentioned earlier, the aim of this thesis is to research if Bitcoin could function as a currency. However, to get to this analysis, there has to be determined if Bitcoin can be seen as money.

Money is often defined by the functions it performs. Jevons was in 1875 one of the first to describe these functions of money. He defined money in four functions, as a medium of exchange, unit of account, standard of deferred payment and a store of value (Jevons, 1875). This definition of money is widely used as a base for defining money. However, the Austrian school of economic thought describes money to have only one primary function, which is a medium of exchange (Mises, 1912). Mises argues that all other functions of money arise from this function.

To qualify Bitcoin as a candidate for money from an Austrian point of view, we need to answer the question if Bitcoin is a medium of exchange. Satoshi Nakamoto designed Bitcoin to be a medium of exchange, where users could exchange directly with each other. So, theoretically yes, Bitcoin is a medium of exchange. In addition, Bitcoin has a growing ecosystem and an increasing amount of retailers and stores are accepting Bitcoin in exchange for goods and services. Next to the theoretical function of Bitcoin as a medium of exchange, Bitcoin also practically serves as a medium of exchange.

Generally accepted medium of exchange

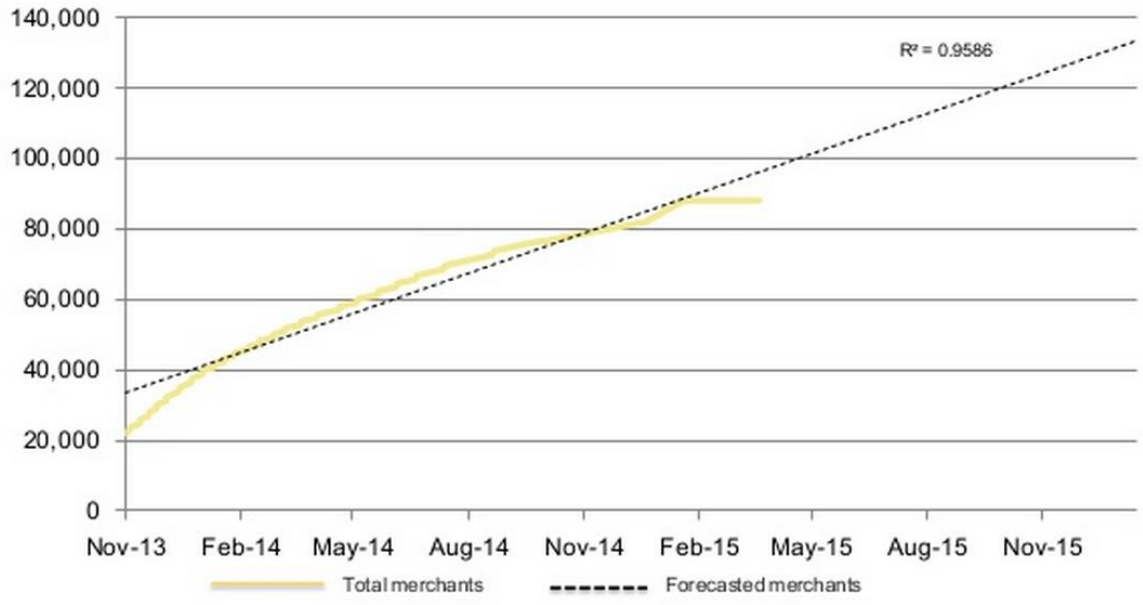
In complement to Mises statement that moneys primary function should be a medium of exchange, Menger argues that money should be a generally accepted medium of exchange (Menger, 1892). By adding this subjective element, the definition of money becomes a lot less clear. However, in the case of Bitcoin it is not difficult to answer the question if Bitcoin is generally accepted. Bitcoin would be generally accepted if a significant percentage of merchants are accepting Bitcoin. This is not the case as approximately 88,000 merchants are accepting bitcoin for their goods and services as of March 2015 (Coindesk, 2015). This is only a fraction of all the merchants. Merchants that accept Bitcoin are mostly small to mid-size

companies (Coinmap, 2015). This is a sign that large companies are hesitant to adopt Bitcoin. Furthermore, if a company accepts Bitcoin, in most cases the prices are still denominated in a fiat currency. At the checkout this fiat amount will be converted in bitcoins. The need for customers to see the prices in their own currency represents the lack in acceptance. It can be safely said that Bitcoin is not a generally accepted medium of exchange at this stage. According to the Austrian school of economic thought Bitcoin is not money (Surda, 2012).

Future general acceptance

The fact that Bitcoin is not generally accepted at this stage does not take away that Bitcoin can become a generally accepted medium of exchange in the future. Bitcoin is growing in many aspects. The key adoption metrics about Bitcoin can be found in figure 6. The most important metric according to Mises theory is the merchant adoption. In Figure 3 and 6 this merchant adoption can be found. It can be seen that merchant adoption is growing steadily on a yearly basis. It is expected that at the end of 2015 120.000 merchants will accept Bitcoin as a method of payment (Coindesk, 2015). Next to the Small to mid-sized companies, a limited amount of big companies are accepting Bitcoin in 2015. These companies are Microsoft, Overstock, Amazon and Tesla (Chokun, 2014).

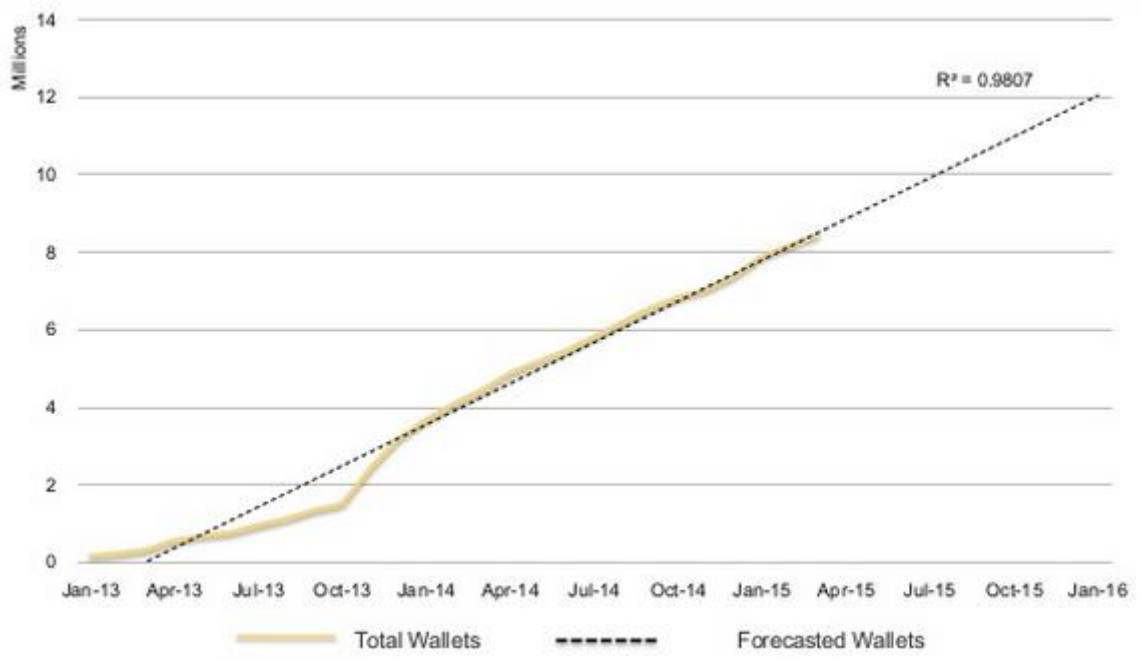
Figure 3: Actual and Forecasted Bitcoin accepting merchants



However, general acceptance can not only be derived from merchant adoption. A currency is accepted if it is not only backed by merchants but also by users, investors and media. Since

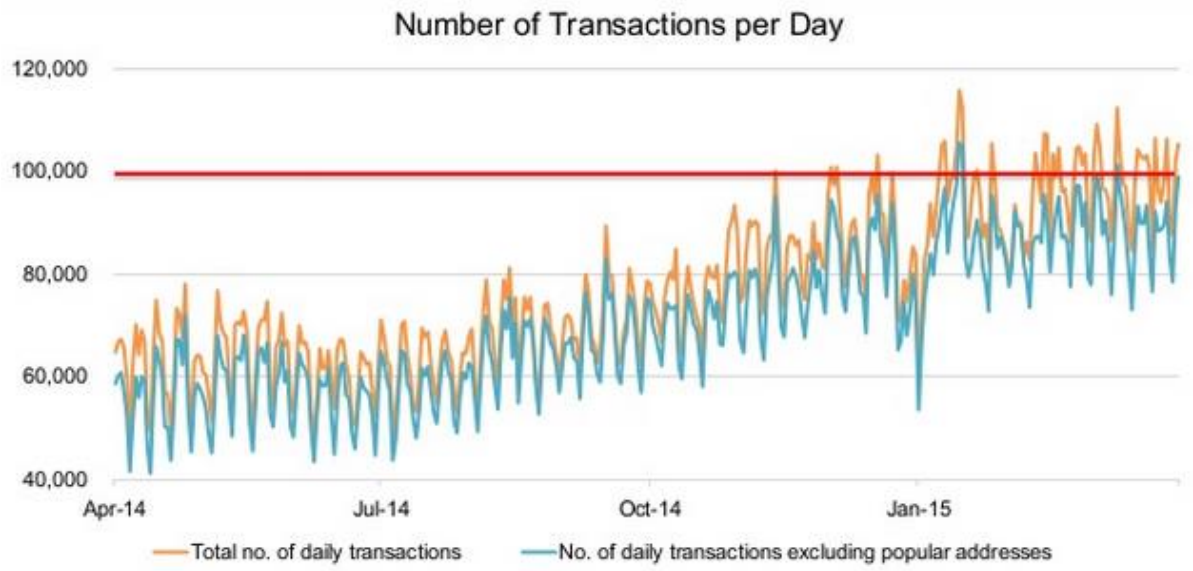
the number of users cannot be exactly measured, we look at the number of wallets to determine the growth in users of Bitcoin. The number of wallets is expected to correlate strongly with the number of users of Bitcoin. The number of total wallets has grown with 14% between December 2014 and March 2015, and a yearly growth of almost 100%. This brings the total number of wallets to 8,457,207 as of March 2015.

Figure 4: Actual and forecasted total amount of Bitcoin wallets



Another metric that could indicate the number of users is the number of transactions per day. In figure 5 there can be seen that from April 2014 to January 2015 there was a steady increase in transactions per day. This indicates that the use of Bitcoin increases, and it is very likely that the amount of users increased. However there is no way to prove this.

Figure 5: Number of Bitcoin Transactions per day



There are no Bitcoin companies publicly available on a stock exchange, therefore, to measure the amount of investments in Bitcoin companies we have to look at investments from venture capital. In Figure 3 there can be seen that the all-time venture capital investments went up from 164 million dollar in March 2014 to 676 million dollar in March 2015. This is an increase of more than 400%, a clear indication that investors believe in the potential growth of Bitcoin.

Media attention about Bitcoin is often related to the price, this is the reason that mainstream media attention in Bitcoin has steadily been going down since the price bubble of December 2013. Between March 2014 and March 2015 the number of mentions of Bitcoin in the media has decreased with 82%. The fact that media mostly mentions price movements depicts the way the general public looks at Bitcoin, as a speculative and risky investment vehicle rather than a currency or method of payment.

Figure 6: Worldwide Bitcoin key adoption metrics

	Quarterly			Last 12 Months	
	Mar-15	Dec-14	Q/Q Δ	Mar-14	Δ
Commerce					
Wallets	8,457,207	7,396,772	14%	4,448,142	2x
Merchants	88,000	82,000	7%	52,704	2x
Merchants' annual revenue ($bn)	180	180	0%	2	78x
ATMs	374	342	9%	47	8x
Unique bitcoin addresses	203,189	157,377	29%	137,342	1x
Industry					
All-time VC investment ($m)	$676	$447	51%	$164	4x
Number of VC-backed startups	103	89	16%	47	2x
Media					
Mainstream media mentions	458	580	-10%	2,594	-82%
Technology					
Network hash rate (billion/second)	346,028,956	313,142,289	11%	41,813,922	8x
Github no. of updated repositories	27,857	23,249	20%	9,915	3x
Valuation					
Bitcoin market capitalization ($bn)	$3.4	$4.3	-21%	$5.3	-36%

To summarize, two things can be concluded. First, Bitcoin cannot be seen as money from an Austrian school of economic thought point of view. Bitcoin is not generally accepted as a method of payment or medium of exchange. Second, as Bitcoin is not generally accepted in this point of time, it cannot be excluded that this will happen in the future. Bitcoin is not money now but it is still able to become money.

Mises Regression Theorem

A common critique on Bitcoin regarding Bitcoin becoming money is that Bitcoin does not satisfy the regression theorem created by Mises. In this section the regression theorem by Mises will be explained. Thereafter an explanation will be given on how Bitcoin dissatisfies the regression theorem and what the implications are for Bitcoin. I will also elaborate my view on this topic.

Menger explained in 1892 how commodities emerge as money due to their salability and marketability. What Menger fails to explain is how this money is given its valuation. In 1912 Ludwig von Mises attempts to explain how non-fiat money acquires its price (Mises, 1912). Prior to the theorem, economists explained the valuation of non-fiat money through its marginal utility. This marginal utility creates circularity where the value of non-fiat money is explained by its marginal utility, derived from its own purchasing power. Mises solved this circularity by developing the regression theorem (Murphy, 2003). Mises applied the subjective theory of value to the objective exchange value of money, also known as the purchasing power of money. The subjective theory of value was created by Jevons, Walras and Menger of the Austrian school of economic thought. However, this theorem values goods by their use value or consumer value. For this reason the subjective theory of value could not be directly applied on money. Mises solved this problem by tracing the value of money back step by step, until the point where it emerged as money from a barter good. At that point, the purchasing power of this money can be explained in the same way as the exchange value of a commodity is explained. To simplify the regression theorem, non-fiat money should have had use value before it became money.

To illustrate the regression theorem, the example of gold can be used. Until 1857 the United States of America used gold and silver as its legal medium of exchange. Because of the inefficiency of carrying gold around, the government issued bank notes which represented a certain amount of gold. These bank notes could also be exchanged back to gold, this way one could trace the value of the bank note back to the underlying value of gold used for other purposes like jewelry and industrial purposes.

As many critics argue, Bitcoin has no intrinsic value outside the use of it as a medium of exchange. It has no use next to the monetary functions it performs. Therefore it does not satisfy the regression theorem. According to the Austrian school of economic thought, this would mean that Bitcoin is not money and cannot function as a medium of exchange (Surda, 2012). This leads to a contradiction. On the one hand, we can see Bitcoin performing as a medium of exchange, and on the other hand it cannot be one according to the Austrian school of economic thought. This leads to think of two possible scenarios; either Bitcoin is evidence of the regression theorem being incorrect, or Bitcoin has an unrecognized use value next to its existence as a medium of exchange. Both scenarios will be discussed to come to a conclusion.

To investigate if the regression theorem is incorrect, a deeper understanding of the background and the time of formation of the regression theorem is needed. Ludwig von Mises publicized his first version of 'The Theory of Money and Credit' in 1912. In this book he explains the origin of money along with the regression theorem. This time period was a period where no personal computers or internet existed. These technologies emerged in 1977 and the 1990's respectively for consumer use (Computer History, 2015). It very likely to think that Mises could not have imagined a technology like Bitcoin at the time that the book was published. For this reason he could not have seen intrinsic value in network like Bitcoin. It is most likely that the regression theorem, in the way that Mises formed it, does not fit a technology like Bitcoin. The initial statement that the regression theorem is incorrect cannot be confirmed, however it can be stated that the regression theorem needs to be altered to fit a technology like Bitcoin.

This makes the scenario that Bitcoin has unrecognized use value in addition to its existence as a medium of exchange a more likely situation. Therefore it is necessary to analyze the demand for bitcoins. As Bitcoin is an intangible good, the use or consumption value has to be sought in the psychological and sociological type of value of which the demand originates. I broke the demand of Bitcoin down in three categories:

- Technological demand
- Ideological demand
- Speculative demand

Technological demand

For many years people tried to create a cryptocurrency that prevented double spending and was self-sustaining. Double spending is the phenomenon where it is possible to spend a digital token multiple times at the same time without the receivers knowing that it received a token that was already spent somewhere else. With traditional cash transfers a trusted third party was needed to verify if a token already had been spent. Bitcoin was the first decentralized cryptocurrency that mitigated this double spending problem (Androulaki & Capkun, 2012). This created a demand for Bitcoin as this technology was the first to achieve this.

The block chain technology is often mentioned as a network that facilitates the transfer of Bitcoin transactions. However, as Bitcoin is essentially cryptographically signed data, the block chain could also be seen as a distributed data network. In this light many different applications could be built upon the block chain. For example, NASDAQ announced a plan to build an equity management system upon the block chain. This will increase transparency, audit ability, governance and transfer of ownership capabilities (NASDAQ, 2015). If followed by more financial institutions, transparency will increase dramatically. This is only one example of an application that can be built upon the block chain other applications include (safe) electronic voting, patent storage, decentralized data storage and contract hosting (Blatchford, 2015).

Ideological demand

Satoshi Nakamoto released the first version of Bitcoin on the 3th of January, 2009 with a 500 word essay. In this essay he suggests that the motive for creating Bitcoin was anger at the financial crisis. A section of this essay is: "The root problem with conventional currencies is all the trust that's required to make it work. The central bank must be trusted not to debase the currency, but the history of fiat currencies is full of breaches of that trust." (P2P Foundation, 2009). After the financial crisis in 2008 there was an increasing opposition against banking and central authorities. Many claimed the banks and government to be the cause of the financial crises. The timing of the launch of bitcoin couldn't be better as many early adopters adopted Bitcoin from an ideological standpoint. With buying Bitcoins one

could make a statement against the current monetary system and world of banking. In addition to these bank opposing people, libertarians are large supporters of bitcoin (Feuer, 2013).

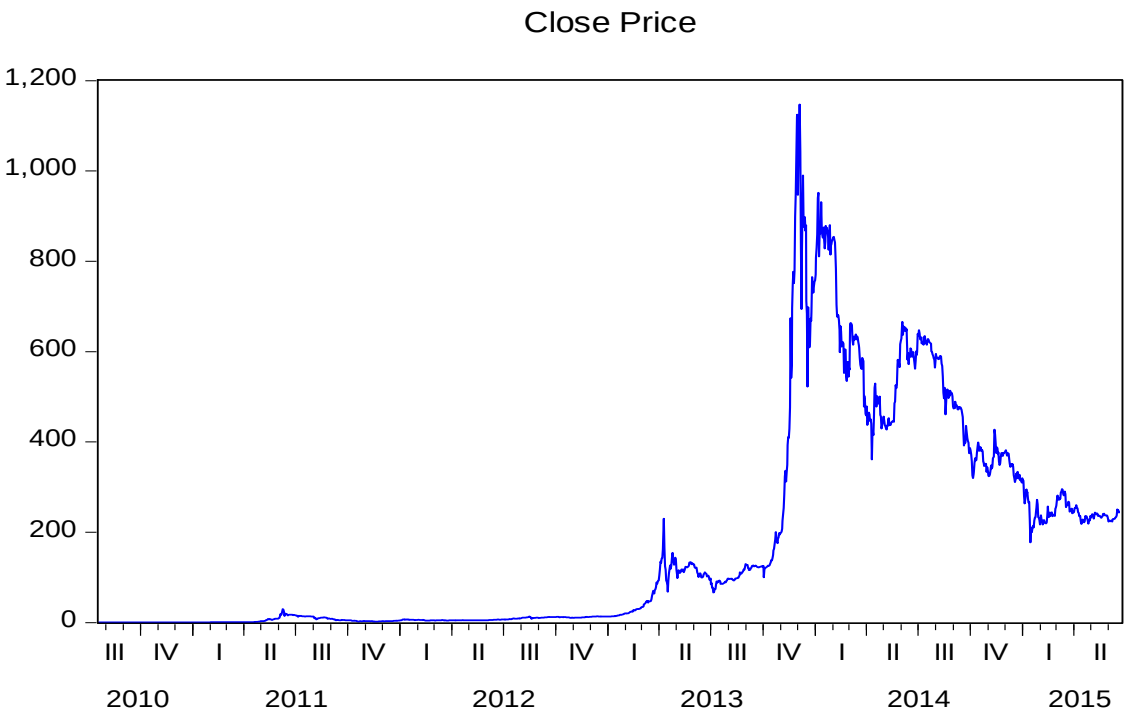
Another ideological reasoning to buy bitcoins is the right to privacy. The current banking system demands their users to reveal a great amount of personal information. Although many countries have a bank secrecy act in place, this secrecy may be violated in many cases and under vague conditions. For example, banks in the United States of America are required to keep records of all transactions, and file reports to the governments of transactions larger than 10,000 dollar. They are also required to report any suspicious activity that might indicate criminal activities (FinCEN, 2011). Another strengthening of this ideological reasoning was the reveal of many classified documents by whistleblower Edward Snowden. This revealed that the NSA is infringing on many people's privacy (The Guardian, 2013).

Speculative Demand

The final factor I believe to generate demand for Bitcoin is the use for Bitcoin as a speculative vehicle. Although Bitcoin is just a string of codes and data and has no physical representation, the fact that Bitcoin has a non-zero chance to emerge as a generally accepted medium of exchange generates demand for it. The fact that people think that Bitcoin has a non-zero chance on becoming a generally accepted medium of exchange is due to the advantages that Bitcoin offer with reference to traditional fiat currency.

In addition, speculative demand may come from the volatile price history that Bitcoin has. In figure 7 in the appendix can be seen that in September 2010 the price of one bitcoin was $0.06 and on its peak on December 4th 2013 the price of one bitcoin was 1242 (Coindesk, 2015). This rapid increase caught the attention to a big community, many saw it as a 'get rich quick' scheme. Since its peak the price has fallen but many believe that a price rise like in 2013 is still possible reaching even higher levels.

Figure 7: Coindesk Bitcoin Price index



Conclusion

Mises regression theorem led me to two possible conclusions. The first possible conclusion contained the possibility of the regression theorem being incorrect or incomplete. The second possible conclusion was that Bitcoin has unrecognized use value next to its function as a medium of exchange. From my research and logical reasoning I cannot reject any of the two possible conclusions. However, the two conclusions are closely linked with each other. Because of the time period in which the regression theorem was formed, it is very likely that Ludwig von Mises was not able to anticipate an innovation like Bitcoin. As a result of this Mises or other economists from the Austrian school of economics could not have thought of use value next to physical use value. In that light, the second conclusion I want to make is that Bitcoin has value next to its value as a medium of exchange. This value is psychological and sociological and can be categorized in technological value, ideological value and speculative value. Because of this value I conclude that Bitcoin satisfies the regression theorem and can function as a medium of exchange according to it.

Conclusion Section 2

In section 2 an Austrian analysis was given to make conclusive statements if Bitcoin could theoretically function as money. This was done through the origin and functions of money described by Mises and Menger.

Mises described that for a commodity to be seen as money, it needs to function according to only one purpose; as a medium of exchange. I concluded that Bitcoin serves this purpose as can be observed in daily life. Millions of transactions have taken place where Bitcoin serves as the medium of exchange. However, Menger argues that for a commodity to be money, it should be generally accepted. After an extensive research on the acceptance of Bitcoin I can conclude that Bitcoin is not generally accepted. It only serves a very small portions of all transaction made on earth. From this standpoint I concluded that Bitcoin cannot be seen as money at this stage of time. Further research however did show that as Bitcoin is not generally accepted now, it could be in the future. Many metrics show that Bitcoin is still growing in the aspects of transaction volume, users, merchant adoption and investments.

Mises further described the regression theorem for commodity money. A theorem that argues that for commodity money to function as a medium of exchange it needs to possess use value next to its value as a medium of exchange. Strictly seen Bitcoin possesses no use value next to its function as a medium of exchange. However, my analysis on the demand of Bitcoin shows that there is demand for Bitcoin which shows there is value. Therefore my conclusion is that Bitcoin does satisfy the regression theorem. It satisfies it in a way that Mises could have never thought of when formulating it.

A general conclusion I want to make on this section is that Bitcoin definitely cannot be seen as money now but it cannot be excluded that it will in the future.

Section 3: Implications of a Bitcoin monetary system

The major differences between Bitcoin and fiat money can implicate major changes if Bitcoin becomes a widely used monetary system. In this section I will discuss some of the major implications of a Bitcoin monetary system.

Finite money supply and deflation

As discussed in section 1 Bitcoin has a finite money supply. Over time the rate of growth of the monetary base will slow down asymptotically to zero. From 2021 onwards the rate of growth will be so slow that the supply of bitcoins can be seen as constant. Eventually the total stock of Bitcoins will be inelastic and capped at 21 million. An implication of this finite money supply is that Bitcoin will be deflationary in nature.

A deflationary versus inflationary monetary system is a long running argument between different types of economists. However, an inflationary monetary system is supported by the majority of economists. This inflationary system is also supported by central banks around the world. The chairman of the Federal Reserve Bernard Bernanke said the following: "Sustained deflation can be highly destructive to a modern economy and should be strongly resisted." (Bernanke, 2002). Governments have a Keynesian inspired preference towards positive albeit low inflation rates. They believe that deflation leads to a deflationary spiral as illustrated in figure 8.

Figue 8: Deflationary spiral

It states that expecting inflation, consumers will delay spending on goods under the knowledge that prices will fall in the future, hoarding currency and creating a negative shock to aggregate demand. Producers respond to this negative shock in demand and are forced to drop prices further. This drop in prices combined with falling demand will lead to debt defaults, which as a result will lead to bankruptcies. When companies are going bankrupt, the GDP drops and demand will fall further (Hildi, 2013).

Debt and lending

A currency with a deflationary nature would change the debt and lending markets tremendously. Funds paid back in the future are more valuable in terms of purchasing power than those borrowed in the past. This can be explained with Fischer's equation where r is the real interest rate, i the nominal interest rate and π the inflation rate:

$$r = i - \pi$$

A negative inflation (deflation) increases the real interest rate within an economy. As a result, in a deflationary economy lenders must offer negative interest rates to incentivize borrowing. In this case, lenders would gain more from holding funds for themselves and would choose not to lend.

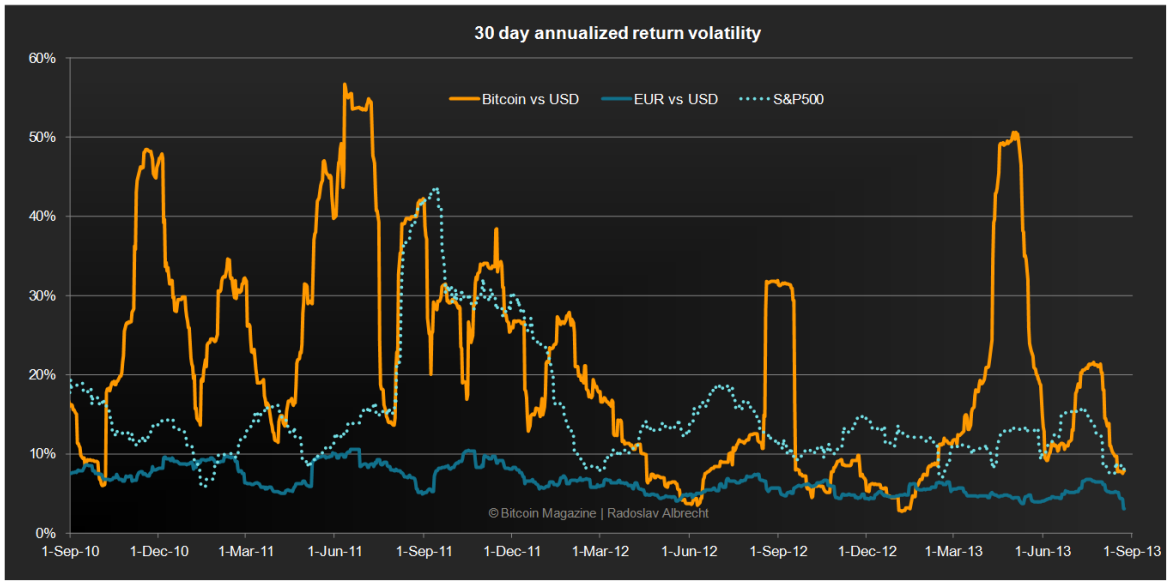
A deflationary economy would demand a demand an entirely different structure. The current structure of fractional reserve credit and debt would have to change to an economy that would be based on saving and investments (Hulsmann, 2008)

Volatility

The bitcoin price has very high number of volatility. As can be seen in Figure 9 the volatility of Bitcoin against the Dollar is much higher than the Dollar against the Euro (Albrecht, 2013). Bitcoin is very popular amongst speculators and investors because of its high volatility. However, speculators are risk loving in nature whereas regular consumers are risk averse. People want some kind of security that their money is worth approximately the same amount of money tomorrow as it is today. With the steep drops in price, Bitcoin is not a very steady currency to keep wealth in.

However, it is expected that the volatility of Bitcoin will drop as the market capitalization increases. The small market capitalization causes Bitcoin to be very sensitive towards price swings. One big investor can cause a major drop in price if he decides to pull out his money. One individual cannot influence the price of one bitcoin if the market capitalization is at much higher numbers than at current levels. As a conclusion, volatility is now a problem for users, but in case of a Bitcoin monetary system this would not be a problem.

Figure 9: 30 day annualized return volatility Bitcoin, EUR, S&P500



Practical usability

One recurrent problem I have identified in the making of this thesis and during my personal experience with Bitcoin is the problem of practical usability. Purchasing and using Bitcoin does not always feel safe and often requires a lot of steps. For example the public key, similar to a bank account number is 1KgMCMkMiwCCK9PsRpfVQ8s9nXQg2Bcuz4 and the private key (password) is 5JV9LwtmVzbspfE3bFuDoQ7SeAgSc9VwNMBw62vJW4VJb2hbAHb. These strings of letters and numbers are very complex in comparison to traditional account numbers and passwords. This is one of many practical usability problems Bitcoin has in this stage of time. Many companies are working on these problems to make Bitcoin a more pleasant experience to work with and if Bitcoin grows bigger, more companies will help in this process. My personal beliefs are that these usability problems can be solved in the future.

Conclusion Section 3

In section 3 I discussed what I believed to be the major practical implications of a Bitcoin monetary system. As Bitcoin is very different than any other currency, Bitcoin will have many more practical implications as it grows. However to investigate them all is outside the scope of this thesis.

First I discussed an implication of a finite money supply. This implication of a finite money supply holds that it gives Bitcoin a deflationary nature. This deflationary nature is in contrast with the current inflationary monetary system. It also contrasts the economic theories of most mainstream economists. These economists argue that a deflationary monetary system will cause the economy to fall into a deflationary spiral where the economy spirals down into less demand and a lower gross domestic product.

Another implication of the deflationary nature of Bitcoin is that it disincentives Debt and lending. With Fischer's equation it becomes clear that lenders have to ask negative interest rates incentivize lending. In this case, it is more profitable to not lend out the money. A Bitcoin monetary system would have to change the current system of debt en lending into a system of saving and investments.

A major hurdle for Bitcoin is the problem of high numbers of volatility. It causes risk averse consumers to be hesitant to use Bitcoin for wealth storage. I think this volatility is in line with the small market capitalization of Bitcoin and it will lower if Bitcoin grows.

The last problem I identified was the problem of practical usability. Bitcoin often requires a lot of steps to buy trade or transact a bitcoin. In comparison with internet banking it is not attractive for consumers to use Bitcoin over fiat currencies.

I believe that the problems of volatility and practical usability are temporary and will solve itself as Bitcoin grows. However, the implications of a deflationary monetary system will always be present. These implications do not withhold Bitcoin from becoming a widely used currency, but it requires a drastic change to the current system.

Conclusion

The aim of this thesis is to answer the research question formed in the introduction. The research question states: *Can Bitcoin function as a monetary system?* To give an answer to this question I analyzed Bitcoin extensively and compared it with other currencies. Thereafter I answered the question if Bitcoin can be seen as money and finally I discussed some of the major implications of a Bitcoin monetary system.

In section 2 I discussed if Bitcoin can be seen as money from an Austrian school of economics point of view. Mises argues that for a commodity to be money, it only needs to perform in one function; as a medium of exchange. A function Bitcoin definitely performs. However, Menger argues that for a commodity to be money, it needs to be generally accepted. From this point of view, I need to reject the hypothesis that Bitcoin is money. Bitcoin is not generally accepted; however Bitcoin adoption metrics show that this is possible in the future.

Thereafter I addressed the critique that Bitcoin does not satisfy the regression theorem formulated by Mises. This regression theorem states that commodity money cannot function as a medium of exchange if it has no intrinsic value. As Bitcoin has no physical use value next to its monetary functions, it should not be able to function as a medium of exchange. However I argue that the regression theorem is incomplete and does not recognize psychological and sociological use value and therefore does satisfy the regression theorem.

Practical implications might be the biggest hurdle towards a Bitcoin monetary system. I discussed the implications of a finite money supply, debt and lending markets, volatility and practical usability. I found that the problems of volatility and practical usability can be solved in line with the growth of Bitcoin. However, the implications of a finite money supply and the consequence of deflations will always be present and demand major changes in the current monetary system.

This thesis finds no definitive answer to its research question. Bitcoin is extremely different than any other currency widely used now. A theoretical switch to a Bitcoin monetary system would have a countless number of implications of which only a few are covered by this thesis. The only way to answer this research question would be to introduce Bitcoin as a monetary system and observe the implications it would have on society.

Bibliography

Albrecht, R. (2013, August 27). Bitcoin Volatility – The 4 perspectives.

Andresen, G. (2013, May 13). *Bitcointalk.org*. Retrieved May 21, 2015, from https://bitcointalk.org/index.php?topic=219504.0

Androulaki, E., & Capkun, S. (2012). Double-spending fast payments in bitcoin. *Proceedings of the 2012 ACM conference on Computer and communications security*, 906-917.

Belastingdienst. (2015). *Belasting op overige bezitten.* Retrieved May 21, 2015, from Belastingdienst.nl: http://www.belastingdienst.nl/wps/wcm/connect/bldcontentnl/belastingdienst/prive/vermogen_en_aanmerkelijk_belang/vermogen/wat_zijn_uw_bezittingen_en_schulden/uw_bezittingen/overige_bezittingen/

Bernanke, B. (2002). "Deflation: Making sure it doesn't happen here" Remarks by Governor Ben S. Bernanke Before the National Economist Club. Washington DC: The federal reserve board.

Bitlegal. (2015, May 21). *Bitlegal*. Retrieved from Bitlegal.io: http://www.bitlegal.io

Blatchford, J. (2015, March 28). *4 ways Blockchain technology will change the world*. Retrieved June 20, 2015, from venturebeat.com: http://venturebeat.com/2015/03/28/4-ways-blockchain-technology-will-change-the-world/

Blockchain.info. (2015). *Blockchain.info Market Cap*. Retrieved May 21, 2015, from Blockchain.info: https://blockchain.info/charts/market-cap

Chokun, J. (2014). *Who Accepts Bitcoins As Payment? List of Companies, Stores, Shops*. Retrieved June 20, 2015, from Bitcoinvalues.net: http://www.bitcoinvalues.net/who-accepts-bitcoins-payment-companies-stores-take-bitcoins.html

Christin, N. (2012, May 4). *Traveling the Silk Road: A measurement analysis.* Retrieved May 21, 2015, from https://www.andrew.cmu.edu/user/nicolasc/publications/TR-CMU-CyLab-12-018.pdf

Coindesk. (2015, May 21). *Coindesk Price index*. Retrieved May 17, 2015, from Coindesk.com: http://www.coindesk.com/price/

Coindesk. (2015, Januari 25). *How Anonymous is Bitcoin? A Backgrounder for Policymakers*. Retrieved May 21, 2015, from Coindesk.com: http://www.coindesk.com/anonymous-bitcoin-backgrounder-policymakers/

Coindesk. (2015, April 10). *State of Bitcoin Q1 2015*. Retrieved June 20, 2015, from Coindesk: http://www.coindesk.com/research/state-of-bitcoin-q1-2015/

Coinmap. (2015). Retrieved June 21, 2015, from Coinmap.org: https://coinmap.org/

Computer History. (2015). *Computer History Timeline*. Retrieved June 21, 2015, from http://www.computerhistory.org/timeline/?category=cmptr

Department of Financial services. (2014). *BitLicense .* Retrieved May 21, 2015, from http://www.dfs.ny.gov/: http://www.dfs.ny.gov/about/press2014/pr1407171-vc.pdf

Federal Reserve. (2015 , April). *Aggregate Reserves of Depository Institutions and the Monetary Base - H.3*. Retrieved May 21, 2015, from Federalreserve.gov: http://www.federalreserve.gov/releases/H3/Current/#t2tg1link

Feuer, A. (2013, December 14). *The Bitcoin Ideology*. Retrieved June 20, 2015, from NY Times: http://www.nytimes.com/2013/12/15/sunday-review/the-bitcoin-ideology.html?_r=1

FinCEN. (2011, March 11). *Bank Secrecy Act*. Retrieved June 22, 2015, from Financial Crimes Enforcement Network: http://www.fincen.gov/statutes_regs/bsa/

Friedman, M. (1984). Monetary Policy for the 1980's.

Graf, K. (2013, Februari 28). *Bitcoin, the regression theorem and that curious but unthreatening empirical world*. Retrieved June 20, 2015, from Mises Circle Features: http://themisescircle.org/features/bitcoin-the-regression-theorem-and-that-curious-but-unthreatening-empirical-world/

Grimbergen, R. (2011, November 11). Bitcoin: An Innovative Alternative Digital Currency. *Hastings science & technology law Journal*.

Gruber, S. (2013). *Trust, identity, and disclosure: Are Bitcoin exchanges the next virtual havens for money loaundering and tax evasion?* Retrieved May 21, 2015, from http://www.quinnipiac.edu/: http://www.quinnipiac.edu/prebuilt/pdf/SchoolLaw/LawReviewLibrary/Vol32_Issue1_2013_Gruber.pdf

Havocscope. (2015). *Havocscope Global Black Market Value*. Retrieved May 21, 2015, from Havocscope: http://www.havocscope.com/market-value/

Hildi. (2013, Januari 11). *Irvin Fisher's Deflationary Spiral*. Retrieved Juli 6, 6, from http://snbchf.com/: http://snbchf.com/economic-theory/deflationary-spiral/

Hoppe, H. H. (1990). Banking, Nation States, and International Politics: A Sociological Reconstruction of the Present Economic Order. *The Review of Austrian Economics* , 55-87.

Hulsmann, J. G. (2008). Deflation and liberty. Auburn, Alabama: Ludwig von Mises institute.

Jevons, W. S. (1875). *Money and the Mechanism of Exchange.* New York: Appleton and Co.

Khan, M. (2014, June 1). *Bitcoin: The White Paper Explained. Part-1*. Retrieved May 21, 2015, from Mashariqkhan.com: https://www.mashariqkhan.com/blog/2014/01/06/bitcoin-the-white-paper-explained-part-1

Kim, T. (2015, March 25). *Comparing Wire Transfer Fees at the Top 10 U.S. Banks*. Retrieved May 21, 2015, from Mybanktracker.com: http://www.mybanktracker.com/news/wire-transfer-fee-comparison-top-10-us-banks

Krugman, P. (2013, December 28). *Bitcoin is evil*. Retrieved May 21, 2015, from New York Times: http://krugman.blogs.nytimes.com/2013/12/28/bitcoin-is-evil/?_r=1

Lerner, A. P. (1947). Money as a Creature of the State. *The American Economic Review*, 312-317.

Marian, O. Y. (2013, October). *Are Cryptocurrencies 'Super' Tax Havens?* Retrieved May 21, 2015, from http://scholarship.law.ufl.edu/cgi/viewcontent.cgi?article=1365&context=facultypub

Menger, C. (1892). On the Origin of Money. *Economic Journal 2*, 239-255.

Mises, L. v. (1912). *The Theory of Money and Credit.* Austria: Jonathan Cape.

Murphy, R. (2003). *The Origin of Money and its Value*. Retrieved June 21, 2015, from Mises Institute: https://mises.org/library/origin-money-and-its-value

Nakamoto, S. (2008, November). Bitcoin: A Peer-to-Peer Electronic Cash System.

NASDAQ. (2015, March 11). *NASDAQ Launches Enterprise-Wide Blockchain Technology Initiative*. Retrieved June 20, 2015, from Nasdaq.com: http://www.nasdaq.com/press-release/nasdaq-launches-enterprisewide-blockchain-technology-initiative-20150511-00485

P2P Foundation. (2009). *A new open source P2P e-cash system, originally developed by Satoshi Nakamoto*. Retrieved from P2PFoundation: http://p2pfoundation.net/Bitcoin

Reid, F., & Harrigan, M. (2012, May 7). *An Analysis of Anonymity in the Bitcoin System*. University College Dublin.

Rothbard, M. N. (2005, July 20). *What Has Government Done to Our Money?* Retrieved June 20, 2015, from Mises Institute: https://mises.org/library/what-has-government-done-our-money

Surda, P. (2012). Economics of Bitcoin: is Bitcoin an alternative to fiat currencies and gold? WU Vienna University of Economics and Business .

The Economist. (2015, Januari 2). *Influential economists: That ranking*. Retrieved May 21, 2015, from Economist.com: http://www.economist.com/blogs/freeexchange/2015/01/influential-economists

The Guardian. (2013). *The NSA Files*. Retrieved June 22, 2015, from The Guardian: http://www.theguardian.com/us-news/the-nsa-files

Woodford, M. (2005). *Interest and prices: Foundations of a theory of monetary policy.* Retrieved May 21, 2015, from Press.princeton.edu: http://press.princeton.edu/chapters/s7603.pdf