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The Economics of Bitcoin

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Executive Summary

This dissertation investigates the crypto-currency known as Bitcoin and provides an appraisal of a Bitcoin based currency system in the context of theoretical Austrian economics.

Are Bitcoins money? Does the emergence of Bitcoin violate Mises regression theorem? Is deflation a problem for a theoretical Bitcoin economic system? This paper builds upon both modern works on crypto-economics and theories of the Austrian school to understand and answer these critiques of the Bitcoin system. Furthermore this paper goes on to analyse the areas of future growth of the Bitcoin system in conjunction with its limitations and risks.

It finds that Bitcoin cannot be classified as money but remains a medium of exchange that the market may choose to adopt at a later stage. It also identifies a failure of modern Austrian economics in appreciating a subjective valuation approach to the regression theorem and concludes that Bitcoins emergence does not violate it. In analysing the deflationary property of Bitcoin it highlights a great divide in theoretical economics and concludes that it is possible to imagine a working deflationary economic system based upon the Bitcoin currency, one that has a vastly different structure to the systems we are familiar with and observe in the world today.

Finally, it concludes that whilst it is unlikely that Bitcoin will ever become money, the protocol represents an innovative technological breakthrough and has the potential to revolutionise remittance and payment solutions markets.

Executive Summary	2
List Of Figures.....	5
Chapter 1 – Introduction	7
1.1 Alternative currency schemes	7
1.2 The Bitcoin System	9
1.3 Methodological approach.....	10
Chapter 2 – Are Bitcoins Money?	12
2.1 – “General acceptance”	13
2.2 – Competitive Currency	14
2.3 – Conclusion.....	15
Chapter 3 – Bitcoin and the Regression Theorem.....	16
3.1 – Implications of the Regression Theorem for Bitcoin.....	17
3.2 – Previous attempts to solve the problem	18
3.3 – My analysis	19
3.3.1 – Supply Side.....	19
3.3.2 – Demand Side	20
3.4 – Conclusion.....	22
Chapter 4 – A Bitcoin Monetary System	23
4.1 – Differing attitudes to the money supply.....	23
4.2 – The money supply of Bitcoin.....	24
4.3 – Implications of an inelastic money supply.....	25
4.4 – Automated vs. managed currency systems	25
4.5 – Austrian Business Cycle Theory	26
4.6 – Conclusion.....	27
Chapter 5 – Is Deflation A Problem Within A Theoretical Bitcoin System?	28
5.1 – Differing attitudes to deflation	28
5.2 – Usability	30
5.3 – Deflation Spiral Theory	30
5.4 – Debt markets and lending.....	31
5.5 – Case Study – Iraqi Swiss Dinar	33
5.6 – Conclusion.....	34

Chapter 6 – The Future of Bitcoin	35
6.1 – Speculative Bubble or Hyper monetisation	35
6.2 – Growth prospects of Bitcoin	37
6.2.1 - Explaining Bitcoins rapid growth	37
6.2.2 - Bitcoin as a payment mechanism	38
6.2.3 – The remittance industry	40
6.3 – Limitations and risks for Bitcoin.....	41
6.3.1 – Regulatory risk	41
6.3.2 – Practical usability problems	42
6.3.3 – The protocol is absolute	42
6.3.4 – What would replace Bitcoin?.....	43
6.4 – Conclusion.....	44
Chapter 7 – Conclusion	45
Bibliography	47

List Of Figures

Figure 5.1 – Iraqi Swiss Dinar/\$ against time (King, 2004).....	33
Figure 6.1 – Bitcoin USD market price against time (blockchain.info, 2013).....	35

Chapter 1 – Introduction

In 2009 an anonymous programmer with the alias Satoshi Nakamoto published the technical basis for a protocol that succeeded where cryptography had previously failed, a protocol that solved the infamous double spending problem of online currencies. Since then, the decentralised currency system known as Bitcoin has seen massive increases in adoption along with spectacular bubble-like price behaviour. From a close price on the 14th of April 2011 of \$1 per Bitcoin, the exchange rate reached an all-time high of \$1242 in December 2013.

Awareness of Bitcoin rapidly proliferated through online communities, media and academia. It has since spurred heavily polarised debate between opposing economic schools of thought. The purpose of this dissertation is to build upon the current theoretical framework of Austrian economics whilst providing a critical analysis of a hypothetical Bitcoin currency system and evaluating its future growth potential and risks.

1.1 Alternative currency schemes

“Money is a social institution: a tool created and marked by society’s evolution, which has exhibited a great capacity to evolve and adapt to the character of the times. It is not surprising that money has been affected by recent technological developments and especially by the widespread use of the Internet.” (ECB, 2012 p.10)

Classical economics could not have envisaged the exponential growth of technology that occurred at the end of the 20th century and the resulting innovations in credit, money and finance. Between the end of the year 2000 and the second quarter of 2012, the number of Internet users in the world grew from 361 million to 2405 million, currently 34.3% of the global population (Internetworldstats.com as of June 2012). This represents a massive “structural change in social behaviour, affecting the way people live, interact with each other, gather information and, of course, the way they pay.” (ECB, 2012 p.11)

The distinction of what constitutes a currency, or money, has become less clear. The Economist (2005) estimated that the total value of all frequent-flier miles in the world was over \$700 billion, exceeding the number of physical dollars in circulation at the time. Additionally they argued that these were a form of money, they existed as a means of exchange and a store of value; from a legal perspective they highlighted the monetary value placed upon these frequent flier miles in the resolution of divorce settlements. Indeed Paul Krugman (2010), citing innovations in credit cards, electronic money and repo, has stated that it is ambiguous that any single number can be called 'the' money supply.

Companies such as Amazon and Facebook have launched their own respective virtual currency schemes (VCS), known as Amazon Coin and Facebook Credits. The emergence of VCS can also be seen in the media. In an article for the Harvard Business Review Bonchek and Cornfield (2013) coined the term the 'Branded Currency Revolution', whilst Bloomberg has implemented a Bitcoin price ticker on its terminals.

Paul Kemp-Robertson's (2013) recent Ted talk from Ted Edinburgh titled 'Bitcoin. Sweat. Tide. Meet the future of branded currency' exceeded half a million views in three months. Within the talk he highlights several examples of alternative currencies, such as the fact that 30% of U.S. Starbucks purchases are made not with dollars but with Starbucks 'Star Points'. He also highlighted the curious phenomenon in which Tide detergent was found being used across America in lieu of dollars to purchase illegal drugs, attributing this strange behaviour to the trust placed in the product due to strong brand loyalty (a 2009 survey ranked Tide detergent in the top 3 brand names that consumers at all income levels were least likely to give up regardless of recession).

There has been a recent emergence of academic literature on the subject of alternative currency systems. In 2012 the European Central Bank (ECB) acknowledged the proliferation of virtual communities and laid out a preliminary basis for academic discussion. The ECB defined virtual currency as "A type of unregulated, digital money, which is issued and usually controlled by its developers, and used and accepted among the members of a specific virtual community", going on to acknowledge that virtual currencies can satisfy the functions of money as mediums of exchange and as a unit of account.

1.2 The Bitcoin System

In an interview Milton Friedman (1999) predicted the emergence of an Internet based currency, prophesising that in the future some form of e-cash would develop on the Internet and would allow the anonymous transfer of funds. Interestingly Friedman noted that its emergence would be due in part by the desire to evade government taxation. Some years later Nakamoto (2009) published plans for a purely peer-to-peer version of electronic cash, with the ability to allow online payments between parties without going through a third party institution - Bitcoin.

“What is needed is an electronic payment system based on cryptographic proof instead of trust” (Nakamoto, 2009 p.1)

Nakamoto stated the necessity of such a system in order to bypass the weaknesses of the current internet commerce model, in which there exists the problem of high transaction costs and the inability to conduct non reversible transactions; problems resulting from reliance on a third party trust based model.

The technicalities of the protocol are beyond the scope of this dissertation however the important features are as follows. Bitcoin is a “decentralised system where no central monetary authority is involved” (ECB, 2012 p.24). The money supply is exogenous of any monetary body, but rather comes into existence over time through a production process known as *mining*; competing users employ technological hardware and power in order to solve a computational algorithm. Miners are compensated for their efforts in the form of newly minted Bitcoins and transaction fees.

As the number of miners increases, along with innovations in hardware to gain faster speeds, the difficulty parameter is increased such that the rate of Bitcoin creation is approximately constant over time, one every ten minutes. It is estimated the last Bitcoin will be mined around the year 2140.

Bitcoin is different from other virtual currency schemes such as the Amazon Coin as it is decentralised and independent of political, economic and geographic borders. Amazon Coin has unidirectional flow (cannot convert from Amazon coin to fiat) whilst Bitcoin has

bidirectional flow (both Bitcoin to fiat and fiat to Bitcoin are possible). This has particular theoretical implications. In a hypothetical world denominated in Amazon Coin, Amazon would have complete discretionary control over the money supply, highlighted by their gifting of 500 free coins to all Kindle Fire owners; Bitcoin replaces discretion with an open source mathematical protocol.

Just as Tide detergent has been observed in lieu of money due to trust and fiat currencies are based upon a trust in the central authority; Bitcoin replaces trust with a mathematical proof. This splits the theoretical economic debate surrounding Bitcoin, with Austrian economists tending to view these decentralised features positively whilst Keynesians hold a much more negative view (Surda, 2012a).

1.3 Methodological approach

Since Bitcoin has emerged as a media of exchange through market forces alone it seems only justified analysing it in the context of the Austrian school of economics, ideas that discuss the competitive issue of currency and hold a laissez faire attitude towards monetary policy. The ECB (2012) identified that the theoretical roots of Bitcoin lie heavily within this school and its criticism of both fiat money and government interventions in the money market. Surda (2012a) stresses that any analysis of Bitcoin must ultimately centre around Austrian theories, as every other economic school appeals to the state and neglects the concept of money introduced and chosen by free market forces.

“Bitcoin should change the landscape of Austrian literature forever, and open a wide spectrum of possibilities for research and our understanding of money.” (Surda, 2013)

Whether the Bitcoin currency will ever replace fiat currencies is an empirical problem. Bitcoin has undoubtedly reopened a largely closed discussion surrounding the origins of money and free market monetary systems; theories which have perhaps been neglected in the post-Keynesian economic era.

This work will analyse Bitcoin through the lens of these less mainstream theories. I anticipate there will be numerous times in which the conclusion reached would depend

entirely on the economic school upon which analysis is based; in these positions I shall appreciate the full range of views before attempting to tackle the arguments using the works of Austrian economics and empirical evidence.

I aim to answer key theoretical questions surrounding Bitcoin and understand how well the system conforms to the writings of prominent Austrian economists. Note that not all Austrian school economists are pro Bitcoin, with arguments surrounding violation of the regression theorem and the lack of intrinsic use value (Matonis, 2011). I will isolate and address these new Austrian criticisms in this piece.

Chapter 2 – Are Bitcoins Money?

Before analysing Bitcoin as a monetary system it is important to classify it in the context of the definition of money.

Commonly money has been defined in terms of the functions that it performs (Rothbard, 2008). Much of today's characterisation is based upon Jevons (1875) where he analysed money in terms of four functions, a medium of exchange, unit of account, standard of deferred payment and a store of value. The Austrian school does not share this classic viewpoint, instead it views money with one primary function, the others are "simply corollaries of the one great function: the medium of exchange." (Rothbard, 2008 p.17)

"The function of money is to facilitate the business of the market by acting as a common medium of exchange" (Mises, 1953 p.29)

In The Theory of Money and Credit, Mises (1953, p.34) deems money to have one sole function. He sarcastically mocks other academics who "do not think that due regard has been paid to the significance of money until they have enumerated half a dozen further 'functions'". Going on to quip, "as if, in an economic order founded on the exchange of goods, there could be a more important function than that of the common medium of exchange." Other functions such as the use of money as a price index are attributed by Mises to being the result of money's employment as a medium of exchange, which in turn facilitates its other uses.

In light of this understanding, I have to answer the simpler question – are Bitcoins a medium of exchange? Well, empirically, yes. Whilst small, the Bitcoin ecosystem has a growing number of companies, projects and facilities in which Bitcoins are being used in lieu of fiat currency for satisfying indirect exchange (examples of which can be found in chapter 6.2.2).

2.1 – “General acceptance”

“Bitcoin is not a universally accepted medium of exchange, therefore, from an Austrian viewpoint, it is not money.” (Surda, 2012a)

This result that Bitcoins are a medium of exchange comes with a caveat. Functioning as a medium of exchange is a necessary but not sufficient condition for Bitcoin to be classed as money. A more consistent definition of money is as a “*generally* acceptable medium of exchange” (Menger, 2009; Gertchev, 2013). By adding a subjective element, the necessity for ‘general acceptance’, it is clear that whereas the concept of ‘medium of exchange’ is precise, the concept of ‘money’ is less so (Rothbard, 2008).

Putting this in context of Bitcoin, I argue there are clear limits to the general acceptance of Bitcoin as a medium of exchange. This is apparent when looking at retail websites that serve the Bitcoin ecosystem such as the “Silk Road” drugs marketplace and Bitmit, an auction site. These websites, although primarily Bitcoin denominated, have popular options to automatically translate all Bitcoin prices into local fiat currency prices (Graf, 2013a). The need for consumers to view prices of goods in their own fiat currencies represents this lack of general acceptance within the economy and leads to the conclusion that whilst Bitcoin certainly satisfies the condition of a medium of exchange, it does not have enough widespread usage to be classified as money.

As confidence in the currency grows and if we see increases in both liquidity and exchange rate stability then it is conceivable that Bitcoins may eventually satisfy this condition of general acceptance. Indeed Tony Gallippi co-founder and CEO of BitPay, a Bitcoin payment solutions company, has commented on an increasing trend in number of customers holding proportions of payments in Bitcoins as opposed to converting the whole sum to fiat upon receipt of payment (Matonis, 2013); similar observations surrounding the increasing ‘money-ness’ of Bitcoin have been made by Tucker (2013).

2.2 – Competitive Currency

The importance of the free market is at the heart of Austrian economics, it can be seen clearly when discussing how media of exchange compete to become increasingly accepted and eventually become money.

“Man will always prefer a more general, and if possible, a universal medium of exchange to a less general or non-universal one” (Hoppe, 1990 p.56)

Hans-Hermann Hoppe (1990) argues that there is a tendency for a single commodity to emerge as money due to its preference as a more saleable good. Tucker (2013) echoes this by saying that “money begins with speculation and goes through a period of gradual adoption until it is universal”. The fact that Bitcoin is not the single universal medium of exchange is not the reason that it is not money. Hoppe’s argument that there is a social tendency towards a single universal currency ignores the legal restrictions and transaction costs that exist in world.

Some critics may be tempted to compare Bitcoin to a system by which banks are permitted to issue their own currency so long they hold reserves to back money in circulation, perhaps citing the failure of Scottish banks in the 18th century who consistently over issued money (Ayr Bank and Banking Company of Aberdeen to name two). Such a comparison is a misunderstanding of the protocol. In the Scottish case there was still the reliance in trusting the banks not to issue excess, in Bitcoin this trust is replaced by unbreakable mathematical proof (the supply side is discussed further in chapter 3). I would also stress that attempting to critique a new technology by attempting to draw upon failures of vaguely related past experience is problematic at best. Such an approach will be prone to not appreciate the creative differences and technology that distinguish the innovative new system.

2.3 – Conclusion

Bitcoin exists within a pool of media of exchange, a pool from which the market selects the most saleable and marketable goods to be generally accepted as money. The usage of Bitcoin within the world is not yet widespread enough to earn it the classification as money. However unlikely it may be, it is possible to suggest that following massive Bitcoin acceptance growth the system could reach levels of general acceptance in exchange which allow it to gain this classification; granted this is speculative and an empirical rather than theoretical problem.

Chapter 3 – Bitcoin and the Regression Theorem

Since establishing that Bitcoin is a medium of exchange and a potential candidate to be considered “money” in the Austrian sense, I wish to address a common critique that some contemporary Austrian economists have for Bitcoin – it does not adhere to the regression theorem.

“The regression theorem is a temporal-sequential explanation of the initial emergence of indirect exchange value” (Graf, 2013a).

The regression theorem postulated by Mises (1953) is a praxeological statement that ties together a comprehensive theory of the origination, formation and development of modern day money. Prior to the theorem, economists explained the valuation of money through marginal utility analysis and the quantity theory, creating a circularity in which the exchange value of money was explained by its marginal utility, derived from its own purchasing power (Murphy, 2003).

Mises solved this circularity through the regression theorem by building upon works of Bohm-Bawerk and Menger before him with emphasis on the subjectivist approach to valuations. Mises acknowledged that the value of money is the result of the marginal utility of goods for which it can be exchanged; its expected purchasing power. Following this he identifies that people expect future purchasing power based upon current and previous observed purchasing powers. In his own words, “Objective exchange value... today is derived from yesterday’s under the influence of subjective valuations of individuals frequenting the market” (Mises, 1953 p.121).

The theorem shows that it is possible to regress to a point in time where the objective exchange value of money has no component based upon its function as a medium of exchange, but that its value at this time is only based on its use in some other form (i.e. for consumption/production). It is at this point in time where people first emerged from a state of barter; Mises states that this is an observable “phenomenon of economic history” and not merely an abstraction.

The theorem ties together at this moment in history with Menger's origin of money (Murphy, 2003). Menger argues that money formed organically, similar to language, as the natural result of traders overcoming inefficiencies in a barter economy; inefficiencies stemming from the difficulty satisfying the double co-incidence of wants. Traders would trade indirectly for other goods, even if they gain no use value for the goods received, so long as the acquired goods had a higher 'marketability' than the goods they forfeit. This process would continue until there would be an

“Inevitable tendency for the less marketable of the series of goods used as media of exchange to be one by one rejected until at last only a single commodity remained, which was universally employed as a medium of exchange” (Mises, 1953 p.32)

It attributes the prevailing of gold and silver as early media of exchange to their divisibility, identifiability and durability, all of which contributed to their high marketability.

3.1 – Implications of the Regression Theorem for Bitcoin

In Mises own words,

“Before an economic good begins to function as money it must already possess exchange-value based on some other cause than its monetary function.” (Mises, 1953 p.111)

Austrian critics of Bitcoin argue that it has no intrinsic value outside of its use as a medium of exchange. They go on to argue that since Bitcoin lacks a pre-existing price framework based upon a non-monetary function, it therefore contradicts the regression theorem (Kramer, 2011).

“According to the Austrian school, a medium of exchange not adhering to the regression theorem isn't unsustainable, rather it cannot exist.” (Surda, 2012a p.41)

This seems to create a paradox. It is possible to observe Bitcoin used as a medium of exchange and yet through application of the regression theorem, we are led to the result that it cannot be one. I was drawn to two possible conclusions; either Bitcoin is evidence that the regression theorem is wrong or misinterpreted, or Bitcoin does in fact satisfy the

theorem and has an intrinsic value that numerous academics and critics have failed to observe.

The former is unsettling and thankfully, on inspection, not possible. Although named a theorem according to the Austrian school the regression theorem is a praxeological statement, a study of human action and hence an observable fact that is not in need of testing (Graf, 2013a). The question when analysing Bitcoin through the lens of the regression theorem should not be “do Bitcoins have a prior direct-use value?” but rather “what is it?”

3.2 – Previous attempts to solve the problem

A user of <https://bitcointalk.org> with the alias ‘XC’ provided an early construction of why Bitcoin did not violate the regression theorem. His argument was that in order for Bitcoin to serve as a medium of exchange without a commodity value there must be an observable history of prices. The first observable businesses in the Bitcoin ecosystem were exchanges, which filled this institutional and informational void for prospective users. He considered Bitcoin to be a mere extension of the regression theorem, in that just as we moved from monetised silver and gold to fiat-based currencies, the same process led to the movement towards Bitcoin.

Graf (2013a) cautiously praised this approach and I have to agree with his analysis that whilst it did attempt to explain Bitcoins emergence in exchange, it still failed to give sufficient insight into a prior direct-use value and hence did not solve the core problem. From an Austrian perspective it appreciates the importance of a free market innovation to satisfy a void but fails to identify specific supply and demand factors behind the establishment of a price.

Surda (2012a) approached the problem in a different way. He analysed the emergence of price by breaking down the supply and demand of Bitcoins prior to their use in exchange and argued that there existed factors in such a way as to establish a non-exchange use value for Bitcoin. Once established, Bitcoin emerged as a medium of exchange in line with the

regression theorem due to its marketability derived from the properties of the system. Surda's methodological approach is particularly good as it begins from a microeconomic level and gives due appreciation of subjectivism in valuation. I will attempt to build upon this framework and update it in line with recent literature.

3.3 – My analysis

My task is to understand and establish the forces that drove the supply and demand for Bitcoins prior to their use as a medium of exchange. Whilst Bitcoin does not have an absolute use value in production their emergence as a medium of exchange implies that from an Austrian perspective they must have had a subjective use value at least in consumption or ownership.

3.3.1 – Supply Side

“While the idea of attempting to get rid of the bankster monopoly on creating money out of thin air is commendable, Bitcoin is also money created out of thin air.” (Kramer, 2011)

An elementary critique on the supply side of Bitcoin is that they are simply an abstraction. By attempting to find an alternative to “unbacked fiat currencies” all that has occurred is a substitution to a differently named unbacked currency (Kramer, 2011). This approach fails to see Bitcoins in terms of objects of human action (Graf, 2013a). They are not spawned at will but created via a capital and labour intensive production process, a process which has been designed to replicate the competitive production of a scarce good, with free entry to mining and decreasing returns (Gerchev, 2013). Güring and Grigg (2011) identify that the supply of Bitcoins is based upon very standard economic theory. They note that for aggregate mining activities to be profitable the below inequality must apply.

$$\begin{aligned} & \textit{Number of miners} * \textit{average power cost per 10 minutes} \\ & < \textit{Number of Bitcoins awarded} * \textit{Market Price} \end{aligned}$$

As a result of this production process, the supply side of Bitcoin closely resembles the process of gold extraction from the ground.

Surda (2012a) observed that the first trade between Bitcoin and USD occurred on the 5th of October 2009. A miner with the alias 'NewLibertyStandard' set an exchange rate at 1309.03 Bitcoins for \$1. They calculated this figure by dividing \$1 by the average electricity to run a computer with high computational power for a year, 1331.5kWh, multiplied by the average residential cost of electricity in the USA of the previous year, \$0.1136, divided by 12 months and divided by the number of Bitcoins the user mined over the past 30 days. I find it interesting that the miner did not seek to profit on the Bitcoin transaction. This could be explained due to the competitive market; since difficulty of mining was low any price set above variable cost would be undercut. However, I would argue there is a simpler explanation. As 'NewLibertyStandard' ignored all sunk costs on hardware and costs of labour, it is apparent they did not undertake Bitcoin mining for economic benefit but for some other hobby or perhaps ideological purpose; in doing so they wished to establish a price that was simply fair reward for their expense and no more.

3.3.2 – Demand Side

(Direct use values) “do not have to be recognized by anyone other than those in a given sub culture actually doing the valuing”. (Graf, 2013a)

In the same way I proposed that NewLibertyStandard gained subjective value from involvement in the mining process, this subjectivist approach can be applied equally to the demand that existed prior to any use as a medium of exchange. Graf (2013a) makes an important observation about this in the above quote. While much of the Austrian criticism of Bitcoin rested in the lack of direct use value, the irony is that these economists failed to look at Bitcoin through the very philosophies that the early Austrian theories were based. Subjective value theory and methodological individualism underpin the works of Menger, Mises and the Austrian economists that followed. In attempting to understand early Bitcoin demand we too must appreciate the existence of subjective inherent direct-consumption value that may be “psychological or sociological in character” (Graf, 2013a).

Gertchev (2013) acknowledges this importance; he observes that Bitcoins were first created and held within the “crypto-punk” community and that they originally served a purpose of conveying a specific anti-establishment worldview, similar to an artistic medium of expression. This element could be known as its ideological bias, a bias that has perhaps been further strengthened in the post 07/08 financial crisis period due to increased opposition to banking systems and a growing anti-establishment sentiment, particularly in countries such as Greece and Cyprus.

Secondly, prior to Bitcoin no virtual currency system had ever managed to successfully solve the double spending problem. The importance of such a solution was profound within cryptography communities and, similar to how gold’s original direct value in consumption was the beauty seen by the beholder, so too did individuals involved in these communities see the Bitcoin protocol as a thing of beauty or at the very least a potentially useful technological breakthrough.

The third and final factor I believe contributed to Bitcoins direct-use value was as a speculative vehicle, even though a unique cryptographic hash has no representation in physical space and whilst Bitcoin had zero value as a medium of exchange, the properties of the protocol instilled Bitcoin with a positive non zero chance that it may have a potential value as a medium of exchange in the future. Individuals saw the potential of Bitcoin as a medium of exchange that results from its marketability and low transaction costs, demanding them based upon this speculative value. In addition, speculative demand may be driven in part by curiosity of external onlookers (such as myself) who had no prior vested interest in the cryptography or libertarian literature but saw the qualities of the system and the debate surrounding the currency to be fascinating.

In summary, analysis of the direct-use value of Bitcoin on the demand side through the lens of subjective value theory can deconstruct the demand into three main areas:

- Ideological demand
- Hobby demand
- Speculative or curiosity demand

3.4 – Conclusion

“Rational expectations of the potential utility of Bitcoin for the potential buyers exceeded the price demanded by the producers, and trade emerged.” (Surda, 2012a p.42)

In the case of gold, its price is composed of its direct-use value and its value as a medium of exchange. Similarly, the price of Bitcoin is currently the aggregation of these two sources of value. Prior to Bitcoin having any indirect value as a medium of exchange it still had direct-use value as a result of the market intersection of supply and demand within the relevant technological, cryptography and libertarian circles. This led to the establishment of a price based solely on these subjective direct-use values.

A good example is the trade on the 22nd of May 2010. This trade was the first example of Bitcoin being used as payment for real world goods; ‘bitcointalk’ user with the alias ‘Laszlo’ traded 10,000 Bitcoins for pizza. It is possible to argue that this transaction was not indirect exchange, but in fact a direct barter exchange. The receiver of these coins made a subjective valuation of Bitcoin based on a combination of the three sources of demand I have outlined and determined an exchange ratio between Bitcoin and a physical good with monetary value.

It is from these early barter type valuations that allowed Bitcoin to fit within the scope of the regression theorem. Similar to how direct exchange for gold allowed for a path of historical prices and facilitated its use in indirect exchange (Rothbard, 2008), the establishment of direct use value in Bitcoin has acted as a seed for expected purchasing power and facilitated its function as a medium of exchange.

A further implication is that it allowed for the formation of organised markets. The first Bitcoin exchange began on the 6th of February 2010 and by allowing interested potential participants to observe a formal record of historical prices and enter the Bitcoin ecosystem, liquidity and depth of the market increased.

Chapter 4 – A Bitcoin Monetary System

Another area of contention surrounding the theoretical viability of Bitcoin is its property of a finite money supply. Over time the rate of growth of monetary base will slow down asymptotically to zero (Gobry, 2013) with the rate of growth being so low in 2021 that to approximation the money supply will be constant (Salmon, 2013). Eventually the total stock of Bitcoins will be inelastic and capped at 21 million.

In this chapter I shall investigate the properties of the money supply and also critically analyse how well a hypothetical Bitcoin based economic system would fit within the Austrian Business Cycle Theory works and literature surrounding automated currency systems.

4.1 – Differing attitudes to the money supply

At the heart of the debate on the money supply are the opposing economic schools of thought and their differing attitudes to monetary policy and deflation. Keynesian economics favours government intervention and believes money supply inflation is essential to growth whereas the Austrian school's view ranges from favouring deflationary systems to abhorring both inflationary and deflationary periods altogether.

Austrians are much stricter when defining the money supply than mainstream economists (Surda, 2012a). Austrians define the money supply as circulating money in the narrow sense or money substitutes of zero maturity that are readily convertible for use in exchange. Money substitutes are claims to a definite amount that are redeemable on demand, with perfect certainty that they can be exchanged at every instance against money (Mises, 1996).

4.2 – The money supply of Bitcoin

The money supply can be broken down into two areas. The first is commodity credit, which is the commodity in circulation (in Bitcoin's case this is unequivocally fixed at 21 million) and the second is circulation credit, additional money which results from credit expansions in a fractional reserve banking system (FRB) where banks issue credit in excess of their own funds. To determine the true elasticity of the Bitcoin money supply it is important to understand whether innovations in circulation credit and FRB are possible or likely in the future.

For Bitcoin to gain circulation credit it must see the emergence of money substitutes, which currently do not exist. Money substitutes exist as a result of the competitive advantage they have over money, such as bank accounts being used to economise on storage and transacting costs (Hoppe, 1994). Surda (2012a) argues that the possibility of such substitutes arising is unlikely. He shows that the base currency of Bitcoin already has intrinsic features that are conventionally provided by money substitutes and this reduces the likelihood that substitutes can emerge from competition; for example they could not compete on transaction costs.

Surda (2013) also postulates that future innovations in the ecosystem could satisfy the demand for properties, reducing the need for substitutes further; an example of this is increased security from facilities such as multi-signature transactions (allowing the control of a balance to be split in 2 or more parts, potentially held by security or an escrow service).

Finally, Bitcoin has no lender of last resort system. The absence of such a system decreases the probability that a fractional reserve banking system will emerge as a result of the insolvency risk due to a potential bank run scenario. In order to avoid the insolvency risk I believe it is more likely that should a banking system arise it would likely be one of 100% reserve banking, nevertheless it is still difficult to understand why an individual would choose to place their coins in a bank as opposed to holding funds themselves.

The probability of credit expansion emerging in the Bitcoin economy is low and therefore the money supply can be expected to be largely consistent and equal to the stock of commodity credit within the economy, which will eventually be perfectly inelastic.

4.3 – Implications of an inelastic money supply

The frozen monetary base of Bitcoin shows resemblance to the proposal of Friedman (1984) to freeze the rate of high-powered money growth in the U.S. (Selgin, 2013). The proposal was to eliminate the role of the US Federal Reserve in determining the quantity of money by setting the quantity of high-powered money to be fixed.

Friedman considered whether zero high-powered money growth would be workable and healthy in an economy. He postulated that in the long run if financial innovations kept pace and the money multiplier rose at the same rate of output, then prices would be stable. However, if financial innovations ceased (such as what Surda (2012a, 2013) suggests in the Bitcoin case) then prices would tend to fall at a magnitude equal to the rate of output growth in the economy. In conclusion he stated that if all was known, anticipated and output growth was relatively stable then this system of built in deflation would cause “no problems and indeed would have some advantages.”

The most important implication from the inelastic money supply is that if generally used as a medium of exchange it would have an inbuilt and anticipated deflation rate.

4.4 – Automated vs. managed currency systems

A lecture I attended held by Kevin Dowd (2013) on free market money touched upon an interesting point. The assumption that money has to be controlled by the state or a central bank has been taken for granted in recent years and whilst both Friedman and Hayek held these views, both conceded this position near the ends of their works.

Dowd also pointed out that the fundamental problem of fiat currency systems is that of controlling the supply; incentive systems are created in order to solve problems related to the inflation bias that results from the temptation of central bankers to deviate from expectations in order to manipulate the position of the economy and in essence to trick price and wage setters.

Selgin (2013) argues that whilst a money commodity such as Bitcoin might be regarded as nothing more than a rule-bound fiat, it is not clear if monetary bodies have ever been practically subject to “any meaningful enforcement at all”. The incentives that rule-bound central bankers face and the imperfections in monetary rules inevitably tempt them to interfere with the monetary stock.

A Bitcoin currency system does not leave management to a rule bound central banker, nor does it leave it to the operation of blind forces. Such a system establishes an automated monetary system as defined by Buchanan (1962), which fixes the monetary supply to be absolute without discretion. An automated monetary system could be likened to Friedman’s k-percent rule, which provided for a constant growth rate of the monetary base. Friedman commented that such a rule might as well be implemented by a computer (Selgin, 2013).

Bitcoin is such a protocol, it is the first attempt at establishing an automated monetary system that is decentralised of human control and hence does not require trust in central bankers or the state; instead replacing faith with an absolute mathematical proof (Nakamoto, 2009).

4.5 – Austrian Business Cycle Theory

The Austrian school argues that business cycles are an inevitable consequence of monetary interventions. Excessive expansions in credit as a result of the fractional reserve banking system lead to artificially low interest rates (Hollenbeck, 2013). Low rates impair economic calculation of entrepreneurs and shift resources into unsustainable investment projects that do not match consumers’ optimal inter-temporal consumption preferences. Once these imbalances can no longer be sustained, a painful restructuring process occurs to bring the market back in line with its optimal allocations (Rothbard, 2009; ECB, 2012).

Whilst mainstream economists view the boom as positive and bust as negative, Austrians view the boom as equally negative and argue that an inelastic money supply and suppression of fractional reserve banking are required to prevent such business cycles.

I have already concluded that the probability of credit expansion occurring within a Bitcoin economy would be low due to the lack of need for money substitutes. Since Bitcoin leaves monetary forces and valuations to the free market, decentralised of human control, it satisfies the conditions that Austrian Business Cycle theorists argue are required to avoid recurring business cycles.

4.6 – Conclusion

In this chapter I have shown that a Bitcoin monetary system would have a perfectly inelastic supply schedule, which is equivalent to an automated currency system with zero growth of the monetary base.

It is important to remember that since the Bitcoin monetary base is fixed and does not adjust to changes in demand, Bitcoin will be required to increase in value significantly should adoption rates increase. This may lead to its usage as a speculative investment vehicle over a currency (discussed further in section 6.1).

Finally, perhaps the most important implication of this chapter is that if Bitcoin were to be used as money it would be an inherently deflationary system.

Chapter 5 – Is Deflation A Problem Within A Theoretical Bitcoin System?

It is first and foremost imperative to appreciate that the argument surrounding deflation is not a Bitcoin problem. It is a long running argument between two starkly contrasting theories of economics; the prevailing school of thought against the less mainstream Austrian school.

I will begin by considering the opposing attitudes to deflation before analysing the common arguments against deflationary currencies in the context of Bitcoin. I intend to conclude by deciding whether the inbuilt deflation of Bitcoin would make it theoretically unviable from an Austrian perspective.

5.1 – Differing attitudes to deflation

“Sustained deflation can be highly destructive to a modern economy and should be strongly resisted.” (Bernanke, 2002)

Deflation defined by Bernanke (2002) is a “general decline in prices”. Mainstream economics and world governments have a Keynesian inspired preference towards positive albeit low inflation rates and encourage the manipulation of the money supply by central banks through open market operations to influence the inflation rate and short term employment. Perhaps born of the fears of post Great Depression, the mainstream consensus has been absolute avoidance of deflation at all costs, for fear of a deflation spiral.

“There is absolutely no reason to be concerned about the economic effects of deflation— unless one equates the welfare of the nation with the welfare of its false elites.”
(Hülsmann, 2008 p.43)

On the other side of the debate lie academics such as Friedman (1984) who proposed a system of anticipated inbuilt deflation and saw no economic reasons why such a system would not be successful. Other academics have praised the benefits of deflation and chastised the modern consensus. Hülsmann (2008) argued that deflation has become the

scapegoat of the economics profession; the case against it so apparently clear it has not been given fair analysis and is simply derided.

Aristotle, Hume and Smith have all noted in some form that changes in the money supply do not create real aggregate wealth changes in the economy. Hülsmann argues instead that both deflation and inflation are implicitly zero sum games that do not produce real aggregate changes in an economy but rather radically modify the ownership structure and distribution of resources.

Hülsmann goes on to attribute the opposition to such structural change as the reason why there exists a vehement fight against deflation. That entrenched political and economic elites who are reliant on the current debt based system understand that deflation would bring about a personally unfavourable redistribution and wish to avoid such change at all costs. He nicknames deflation as the “harbinger of liberty,” praising that it would abolish the advantage that inflation based debt enjoys over savings based equity finance at the margin and would in turn encourage the foundation of an economic system built upon saving as opposed to debt.

“Falling prices through increased production is a wonderful long-run tendency of untrammelled capitalism.” (Rothbard, 2006 p.251)

Rothbard, a leading figure in the modern libertarian movement, posed a starkly positive view of deflation relative to Bernanke’s view on its destructive nature. His argument follows that deflation arising from productivity increases, such as in the industrial revolution, is a positive economic force.

The magnitude of the theoretical divide highlights the difficulty in adequately analysing Bitcoin’s deflationary nature; the conclusion reached depends on the ideological and theoretical bias of the analyser. From the onset of this dissertation I have centred on Austrian economics and as such I will attempt to evaluate the theoretical viability of a hypothetical Bitcoin currency system and challenge the deflationary critique in the context of the Austrian school.

5.2 – Usability

The first argument proposed against deflation is that there exists a problem of usability. Since most modern currencies have a minimum unit, as economies grow and minted coins are lost, in the existence of a fixed money supply this could lead to a situation whereby prices of objects within the economy fall below the minimum physical unit. Whilst Bitcoins may fall out of existence through loss of accounts similar to how the Iraqi Swiss Dinar (section 5.5) suffered from physical deterioration, this would not be a problem with Bitcoin; Bitcoin is divisible by up to 8 decimal places, lending to a possible 2.1 quadrillion units in circulation.

Theoretically the deflationary nature of Bitcoin should not be a problem for its widespread usability.

5.3 – Deflation Spiral Theory

The most common critique of deflation is the deflation spiral argument; it states that expecting deflation, 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, partially as a result of purchasing inputs in the previous period under the expectation of higher demand, which creates a self-sustaining deflation spiral.

Surda (2013) refutes the hoarding argument on the basis that it ignores consumer's time preference or need for goods. Supporting evidence can be found looking at the markets for technology or automobiles, it is widely anticipated that prices in these markets are falling over time yet investments in innovation and sales figures are doing quite the opposite. Since January 1998, PC prices have fallen 93% yet consumer outlays have increased by over 2700% (Shostak, 2010).

There is significant empirical evidence that challenges the deflation spiral argument.

Atkeson & Kehoe (2004) tested 180 years of data for 17 countries and concluded there was

no evidence of a relationship between deflation and depressions outside of the Great Depression. They also highlighted that a greater number of episodes of depression occurred with periods of inflation than with deflation. Another instance of non-harmful deflation was the industrial revolution, Steil and Hinds (2010) investigated the second phase of the US industrial revolution between 1870 and 1896, noting that prices fell 32% over the period whilst real income soared 110% amid robust economic growth and technological innovation. Rothbard (2006) also cited the industrial revolution as a positive deflationary period in which there was observed steadily rising real wages.

I believe an important aspect of the Bitcoin protocol that deflation spiral proponents fail to appreciate is that deflation would be both anticipated by all agents and it would be low and stable in magnitude. In a Bitcoin based economy with sustained deflation, a hoarder would implicitly gain an interest rate equal to the deflation rate. Using Friedman's analysis we can understand this deflation rate to be equal to the rate of output growth, likely to be a small yet positive number in a healthy economy (perhaps equal to the rate of technological growth at the Solow long run steady state).

It follows that the choice a consumer at a given time would have is whether to spend on current consumption in the present or save by holding funds in Bitcoin to yield a small yet positive annual return. I'd like to draw the similarity to a consumer in our current inflationary system that is offered a similar choice due to the existence of several potential investment vehicles; the existence of inflation beating investment possibilities would not eliminate all present consumer spending. Rather than being implausible we simply expect an economic system structured drastically different to our current one.

5.4 – Debt markets and lending

It is undeniable that deflation creates a disincentive to borrowing. Funds paid back in the future are more valuable in terms of purchasing power than those borrowed in the past. For those with current fixed borrowings such as mortgages the real burden of their debt would increase in accordance to the Fisher equation on the following page, where r is the real interest rate, i the nominal interest rate and π the inflation rate.

$$r = i - \pi$$

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

I agree that introducing deflation in our current economic system built upon the circulation of fractional reserve credit and debts would be unambiguously detrimental as a result of standing fixed repayments within the economy. It is important to understand that a deflationary Bitcoin based economy would have an entirely different structure; the structure that Hülsmann (2008) argues would be based entirely on saving and investment as opposed to debt.

A hypothetical Bitcoin economy could still have lending, just as institutions charge a premium on interest to account for inflation, lenders could offer a discount to account for the deflation rate. Whilst this would lower nominal lending rates it does not necessarily require them to be negative so long as the deflation rate is of a low order of magnitude as expected. Alternatively it is plausible to suggest a shift to crowd based funding models such as Kickstarter, which grew 238% in 2012 (Popper, 2013). A similar innovation already exists within the Bitcoin economy; BTCjam is an exchange platform in which prospective borrowers lay out terms and users selectively choose favourable projects in which they are interested in investing.

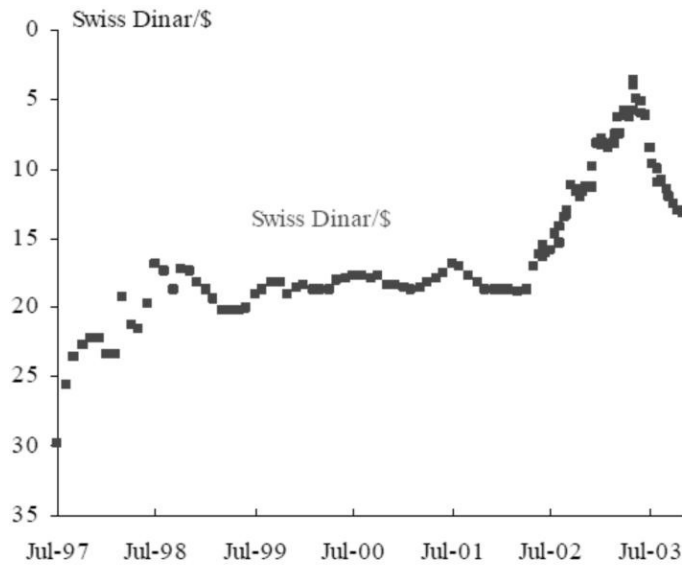


Figure 5.1 – Iraqi Swiss Dinar/\$ against time (King, 2004)

5.5 – Case Study – Iraqi Swiss Dinar

“Synthetic commodity money is not just a hypothetical possibility” (Selgin, 2013 p.13)

Selgin argues that due to Bitcoin’s lack of non-monetary use value and absolute scarcity, it could be classified as synthetic commodity money. An unplanned instance of the establishment of such money, similar to Bitcoin, was the Iraqi Swiss Dinar. Prior to the 1990s paper dinars were the currency of Iraq produced with Swiss engraved plates. Following sanctions on import restrictions the Iraqi government chose to replace the now fixed supply of Swiss Dinar in favour of new Saddam Dinars.

Saddam Dinars suffered from heavy depreciation due to oversupply and ease of counterfeiting. As a result Swiss Dinars continued to circulate in the Kurdish regions and held a stable purchasing power and exchange rate relative to the U.S. Dollar, as seen in figure 5.1 above (Selgin, 2013).

King (2004) noted that the circulation of Swiss Dinars was a market-based solution to create a medium of exchange in the absence of a government with the ability to issue currency. It is an example that intrinsically useless currency can continue to function as money even though its use is not recognised by legal tender (Selgin, 2013).

Comparing the Swiss Dinar to Bitcoin, the dinar suffered from the problem of physical deterioration, a problem which the Bitcoin currency also may have; wallets holding account balances may be lost over time and hence it could be seen that the money supply may, albeit very slowly, shrink. This would also contribute further to the effect of deflation within the Bitcoin economy. I argue that facilities such as the ability to back up Bitcoin wallets will become standard procedure and will largely eliminate this problem.

An important reason why the Swiss Dinar held purchasing power versus the dollar was that Northern Kurdish regions did not have a sophisticated banking system. Similarly, in section 4.2 I argued that it was unlikely for Bitcoin denominated money substitutes to emerge within the Bitcoin system and therefore the case of the Iraqi Swiss Dinar is evidence that a fixed monetary base system can work not just from a theoretical Austrian perspective but also in practice under certain conditions.

5.6 – Conclusion

I am in no position to conclude the debate as to whether or not deflation should be praised or derided within an economic system; this is far outside of the scope of this dissertation and my own knowledge. What I am able to say with certainty is that Bitcoin could be considered the first real attempt at establishing a deflationary system that conforms to the theories of Friedman, Hülsmann and other proponents of the Austrian Business Cycle Theory. The Iraqi case provides some empirical evidence to suggest that such a deflationary system can operate in particular instances.

I believe it is possible to envisage a successful Bitcoin based economic system with anticipated deflation in the absence of fractional reserve credit expansions. Imposing such a drastically different economic system upon our current debt based society is certainly empirically unfeasible, but as a theoretical abstraction through the Austrian lens there is no reason why such a system would not work.

Chapter 6 – The future of Bitcoin

6.1 – Speculative Bubble or Hyper monetisation



Figure 6.1 – Bitcoin USD market price against time (blockchain.info, 2013) [Accessed 9/12/2013]

The rapid price increase of Bitcoin represents increased demand for Bitcoin holdings. Critics of the Bitcoin system such as Casey (2011) argue that the main value of Bitcoin is as a speculative vehicle and as such, due to lacking intrinsic value, it is a merely a speculative ‘bubble’. Dutch central banker Nout Wellink described Bitcoin as worse than the classic Dutch Tulip bubble of the 17th century in that at least with Tulip Mania “you got a tulip at the end” (Hern, 2013a).

Nobel laureate Robert Shiller (2012) describes a speculative bubble as “a social epidemic whose contagion is mediated by price movements.” He further defines a mechanism of market excitement and exuberance luring more and more people in and fuelling further price behaviour; a type of successive feedback loop as the bubble grows. Surda (2012a) found through regression analysis a strong positive correlation between the price of Bitcoin and public interest in Bitcoin (measured in terms of Google searches). He suggested a dual direction of causation that both public interest drove price action further and the news surrounding price action motivated peoples interest in Bitcoin further. I would argue that

combining Shiller's definition and Surda's empirical work Bitcoin does appear to show characteristics of a speculative bubble.

Graf (2013b) makes an important distinction; there is a difference between dismissing Bitcoin to be a bubble and deeming it to be a medium of exchange that is susceptible to bubble like price behaviours. In typical asset bubbles, the use value of the underlying asset does not change no matter how great the price becomes. In Bitcoin, as more people enter the market and its price rises it gains positive network effects just like language or social networks. As a result the practical value of the system increases for everybody using it as the number of stakeholders and market depth increases.

Speculation is not the only reason the price of Bitcoin can rise, increased demand can also arise as a result of increased monetisation, where more people demand Bitcoins for exchange transactions. Empirical analysis from Ron and Shamir (2012) concluded that 76% of all Bitcoins were being hoarded. The same analysis repeated using 2013 data by Meiklejohn (2013) found a 12% reduction in the number of coins being hoarded. The increase in exchange usage of Bitcoins over the past year will have contributed some part of the increases in Bitcoins price. This increasing trend within the Bitcoin ecosystem is further evidenced by payment processor BitPay, who saw a 6260% increase in 2013 'Black Friday' sales against figures from the previous year (Wong, 2013).

In the previous chapter I concluded hoarding would not be problem for a theoretical Bitcoin economy where it was the sole medium of exchange. In practice what we are seeing is hoarding behaviour (albeit falling) as a result of Bitcoin being used in parallel with other domestic currencies. Users foresee fixed repayments in fiat denominated terms and see little incentive to purchase goods and services in Bitcoin; instead holding as an investment vehicle in the hope that its value will rise.

The price behaviour of Bitcoin is the combination of increasing usage of Bitcoins for indirect exchange purposes and more dominant usage as an investment vehicle for users. As Dowd (2013) points out, Bitcoin is not currently a working currency market and the volatility that arises from speculative behaviour is extremely detrimental to Bitcoin's usage as a store of value.

The positive for Bitcoin is that the trend of hoarding is falling whilst its usage in exchange is increasing and should be likely to continue increasing so long as models such as BitPay protect retailers against exchange rate volatility and hence drive merchant adoption.

6.2 – Growth prospects of Bitcoin

6.2.1 - Explaining Bitcoins rapid growth

Before analysing the future prospects for Bitcoin as a legitimate form of money or an innovative payment system it is important to understand why the market demanded and adopted an alternative to the current forms of money.

Bitcoin was set up like many ventures before it as an innovation in response to a market problem. In Bitcoins case the problem was the reliance electronic transactions placed on trusted third party models, which creates significant transaction costs. Bitcoin was set up to economise on these costs.

In its five years of existence it has achieved a market penetration that exceeds all other forms of non-state digital currency before it. Users holding the currency represent a number of different interests including technological early adopters, privacy and cryptography enthusiasts, libertarian thinkers, government mistrusting ‘gold bugs’, criminals and speculators.

The system has a number of unique properties that provide Bitcoin with value to its users. Such as:

- Decentralised monetary mechanism; independent of political, economic and geographic borders.
- Anonymity in transaction.
- Low relative transaction costs.
- Facilitation of micropayments.
- Similarity to gold in production.

Herpel (2011) analysed why people switch to digital currencies as an alternative to the current system and concluded that demand for digital rises where there is an unavailability of banking, local currency instabilities (such as in developing nations) and where the average incomes are low. He cites that the growth of the Webmoney system that emerged in the late 1990s was in part due to the 1998 collapse of the Russian banking sector.

“There is no doubt that Bitcoin is a spontaneous answer to the monetary instability that we see in the world today.” (Korda, 2013)

A poll of 82 users on bitcointalk.org (2011) found that 19.3% of responding users felt that the distrust of central banks was the ‘best reason to describe why they use Bitcoin’. Whilst this is not an academic source it does highlight that some proportion of early Bitcoins adoption was driven by anti-establishment sentiment or ideological bias.

On trust, the Edelman Trust Barometer (Edelman, 2013) found that 61% of people trusted a person ‘like themselves’, 43% trusted CEOs and 38% trusted government officials. The reason for recent decline is perhaps due to the emergence of information through WikiLeaks cables and Edward Snowden’s whistleblowing on the mass spying capabilities of the PRISM surveillance program. Individuals in society have gained awareness to these privacy infringements and this in part will have driven interest to alternative systems such as Bitcoin.

6.2.2 - Bitcoin as a payment mechanism

The likelihood is that Bitcoin will not replace fiat currency in the world. Bitcoin’s unique properties do lend it to be a useful payment system, with low transaction costs and chargeback protection. This allows Bitcoin to act as an alternative to conventional payment networks such as Visa, Paypal and Western Union (Lee, 2013a).

Merchants do not need to hold any Bitcoin nor be exposed to volatility (Andreessen, 2014) should they adopt the BitPay or Coinbase model. BitPay facilitates over 14,000 merchants to accept Bitcoins and eliminates potential exchange rate risk by allowing them to receive fiat

denominated funds. The system processed over \$100m of transactions in 2013 (Jahosky, 2013). On the Bitpay website (Bitpay.com) the company explains that it allows vendors to reduce chargeback risk (many merchants are ecommerce businesses who are more likely to get targeted by criminals using stolen credit cards) and also monetise new international markets via a unified digital currency.

In reference to virtual currencies, U.S. Federal Reserve Chairman Ben Bernanke said

“...there are also areas in which they may hold long-term promise, particularly if the innovations promote a faster, more secure and more efficient payment system.”

(Bernanke, 2013 p.10)

The Montreal Economic Institute (2014) has also identified its potential to revolutionise payment systems, particularly in developing nations.

So far 2014 has been the year of merchant adoption. Google is working to incorporate Bitcoin into its payment solutions (Greenberg, 2014) whilst media streaming service Netflix are rumoured to implement Bitcoin; facilitating micro-transactions by allowing consumers to purchase individual episodes or films at a low price, a proposal previously unfeasible with higher transaction fees. Major electronic retailers Overstock and Tiger Direct have begun to accept Bitcoin, with Tiger Direct processing over \$250,000 worth of Bitcoin transactions within the first 17 hours post announcement (Josic.com, 2014). Founder of Australian electronics firm Millenius, Pierre Boutros, noted that Bitcoin customers are spending more in dollar terms than any other payment method and praised that the system allowed the firm to negotiate fraud to 0% whilst expanding its global audience (Cryptocoinsnews.com, 2014). This trend of merchant adoption can be expected to continue as merchants are realising the financial benefits for their businesses.

Finally Bitcoin could see potential as a payment system in developing markets. In Kenya 70% of adults do not have access to a formal bank account whilst at the same time 70% have access to a mobile phone with the majority using a mobile money service known as M-Pesa to transfer money. (Smith, 2013). It is possible to imagine Bitcoin based innovations created that satisfy this developing market demand for accessible mobile banking and money transfers.

Digital processing now makes it possible to pay for a dollar denominated product from an alternatively denominated credit card whilst a foreign exchange transaction occurs in the background (Surda, 2013). This is precisely the direction I predict Bitcoin usage heading, all advantages of economising on transaction costs and security, whilst eliminating volatility risk from its exuberant price behaviour.

6.2.3 – The remittance industry

The low transaction costs of Bitcoin also allow for growth in the global remittance industry. The World Bank (2013) remittance prices analysis found that for the \$514 billion remittance funds transferred annually the average cost of remittance is 8.85% per year.

Whilst it is extremely early in the Bitcoin ecosystem's development, innovative start-ups have already sprung up in order to gain a share of this lucrative market. One such start-up is BitPesa Ltd, which targets remittances to the Kenyan market whose remittance industry is worth \$1.2 billion per year (Ombok, 2013). BitPesa is competing with commercial banks that handle half of remittance transactions along with services such as Western Union that hold 31% of the business (World Bank, 2010). Whilst services such as BitPesa have an initial struggle to gain credibility and widespread adoption as an alternative to bank transfers, the 3% rate on overseas transfers plus same day arrival of funds will be sure to attract some users away from standard means of transfer.

Bitcoin does not have to become widely accepted as a medium of exchange in order to achieve market penetration in the global remittance industry, nor does it have to reduce in exchange rate volatility; it is possible to imagine funds denominated in Bitcoin for very short periods of time and converted into the domestic currency, similar to the BitPay model.

6.3 – Limitations and risks for Bitcoin

There are significant potential risks and limitations that Bitcoin faces, some of which were outlined in a 2013 Bank of America report (Jeffries, 2013). The bank identified its potential as a major means of payment for ecommerce but highlighted problems such as price volatility, legal status and exchange reliability. This section will briefly cover the risks and limitations I believe to be important in the future of Bitcoin growth.

6.3.1 – Regulatory risk

With digital currencies being an entirely new class of products, governments have struggled in deciding how to classify, tax and regulate them.

Until its closure, Bitcoin facilitated the anonymous drugs marketplace the “Silk Road” which generated monthly sales revenue in excess of \$1.2m per month (Christin, 2012). The argument that Bitcoin should be stopped because of its involvement in illegal activities is highly questionable; dollars are used daily for drugs transactions with the absence of a public ledger to record the transfers (unlike Bitcoin). Additionally, Meiklejohn et al. (2013) pointed out that using Bitcoin to launder money is not particularly attractive due to exchanges acting as chokepoints of the Bitcoin economy; exchanges that can be scrutinised and regulated by policymakers.

Its classification varies across the world, with the Swiss parliament recently signing a postulate asking for it to be treated as a foreign currency whilst the governments of Norway and Sweden are treating it as an asset subject to capital gains tax (Moran, 2014). In the UK HM Revenue & Customs has said it would not charge the 20% VAT tax on Bitcoin trades (Wild et al., 2014) implicitly this treats Bitcoin as a currency and may incentivise future growth of Bitcoin start-ups within the UK. The Bitcoin Foundation is already looking to make the move to London, attracted by a favourable regulatory environment.

Governments do have the potential to limit the Bitcoin market, not by private usage but instead by controlling the exchange mechanism. A staggering 50% price drop was observed

overnight when Chinese exchange BTC China said it could no longer accept payments in Chinese currency due to a regulatory change (Hern, 2013b) although this has subsequently been reversed (Spaven, 2014). Comments from Bernanke, the ECB's (2012) neutral stance and Germany's classification of Bitcoin as private money hint that the risk of governments taking an active role in limiting the proliferation of Bitcoin is significantly lower than when the protocol first began.

6.3.2 – Practical usability problems

One recurrent problem I have identified over the course of this work is a limitation for adoption in the form of knowledge and technological hardware. The action of purchasing and trading Bitcoin is often not simple and does not always feel secure. Additionally I found significant difficulties in explaining the protocol and beneficial properties of the system to people with little knowledge of technology. Until big businesses get behind and push Bitcoin either as a currency or more likely as an alternative internet payment mechanism it will still be viewed by the majority as somewhat of a speculative gimmick, lacking purpose.

It is unlikely Bitcoin will emerge as money in the sense that debts, wages and prices will be denominated on a massive scale in Bitcoin because it is inherently reliant on both technological hardware and the connectivity of the internet. These limitations lend further weight to the idea of Bitcoin developing as payment mechanism.

6.3.3 – The protocol is absolute

Dowd (2013) emphasised this problem in his lecture; the properties and workings of the protocol are set in stone. Due to fixed supply any mass adoption will be surely accompanied by hyper-deflation, lending Bitcoin to attract users of a purely speculative nature as opposed to those who value its other properties.

The absolute nature of the protocol could also have severe implications for Bitcoin should technical issues be discovered that have not yet been identified. A bug known as transaction

malleability has been an issue in the protocol since 2011. In simple terms it is possible to change the unique ID of a Bitcoin transaction before the network has confirmed it. Ultimately this means that it is possible to pretend that the transaction did not happen and request the transfer a second time. This bug has severely affected the world's largest Bitcoin exchange MtGox, who filed for bankruptcy protection in February 2014 (BBC, 2014). It is important to note MtGox's crippling misplacement of an estimated 850,000 Bitcoins, at a value (as of 02/03/2014) of \$476 million dollars, was an avoidable error made by the exchange. It is possible to argue that the fault lies with companies such as MtGox who should have known to watch for the non-malleable payment details of the transaction, rather than the malleable transaction ID (Bradbury, 2014).

Irrespective of who is at fault, MtGox's failure to account for this known bug unavoidably reflects badly on the Bitcoin protocol as a whole. Bitcoin is still young and the worry surrounding transaction malleability begs the question as to what other significant problems or bugs exist in the protocol. For example, Bahack (2013) postulated the possibility of theoretical Bitcoin attack with less than the conventional 50% computational power. As of today (02/03/2014) there is no reason to believe that the core protocol has any crippling flaws but that doesn't provide comfort to the possibility that such flaws may be discovered in the future.

6.3.4 – What would replace Bitcoin?

Should people stop using Bitcoin as a medium of exchange it must be because they switched to another due to some sort of competitive advantage (Surda, 2012a). Whilst unlikely to be beaten on transaction costs by fiat money or gold, there are numerous alternative digital currencies which have been created such as Freicoin, Peercoin, Litecoin and Altcoin to name a few. Some of these are Bitcoin based whilst others operate on a different protocol, for example Freicoin introduces a demurrage fee in order to disincentivise hoarding.

Alternatively, it is possible to envisage a successful alternative currency supported by governments and organisations such as PayPal, which could leverage its current popularity to create liquidity in the market (Surda, 2012b). Irrespective of whether Bitcoin ultimately

loses in the competitive battleground with other alternative currencies it has surely been the pioneer in the digital currencies market and opened up a previously closed debate surrounding Austrian based monetary systems.

6.4 – Conclusion

The trend for the future of Bitcoin is largely positive with its increasing usage as a medium of exchange and a payment mechanism. Nevertheless a large proportion of Bitcoin holders are speculative investors who seek to capitalise on the knowledge that Bitcoin is still in its early phases and who know that increasing acceptance will undoubtedly be accompanied by hyper deflation as a result of its fixed supply.

From a regulatory standpoint, although some governments are choosing not to class Bitcoin as a currency it seems extremely unlikely in the majority of countries that any intervention will occur in order to block Bitcoin transactions and exchanges, China being perhaps the exception.

There are still limitations for adoption in the form of knowledge, technology and price volatility, in addition to the ever-present risk that Bitcoin has some underlying flaw in the protocol that has not yet been discovered. As such, it is unlikely to be trusted as a store of value without significant technological research into the protocol combined with a fall in volatility. Until then it is more likely to develop as a payment mechanism through systems such as BitPay and within the global remittance market.

Chapter 7 – Conclusion

This dissertation has found that contrary to the critique of some modern Austrian and libertarian thinkers it is possible to justify Bitcoin's existence as conforming to Mises's regression theorem. It is my opinion that the failure to observe the intrinsic value of Bitcoin in early literature represents an overtly narrow approach to its valuation. In trying to critique through the regression theorem, critics lost sight of the core philosophies that underpin the theorem itself. I would therefore argue that the prior critique has been too rigid in its application, with a distinct lack of emphasis on the importance of subjective valuations that are at the core of Austrian economics.

Whilst Menger and Mises could not envisage the existence of such a mathematical backed digital currency I argue they would appreciate the subjectivism associated with early price valuations and would have understood as such that Bitcoin can not and does not violate the praxeological statement that is the regression theorem. The emergence of Bitcoin as a medium of exchange is plausible both as a theoretical abstraction and an observable phenomenon, such as the emergence of gold. The biggest difference is the rapid speed that Bitcoin emerged, attributed to the speed of technological and informational proliferation across the world today. The market can identify, value and adopt a new medium of exchange at a much faster rate.

From a methodological perspective, the underlying assumption throughout this dissertation has been that the Austrian perspective is correct and under this I have found no reason to suggest why a drastically different Bitcoin based economic system would be unsustainable. It is possible this assumption is wrong however in my investigation I have no reason to doubt it and I have found the literature both intellectually compelling and unique.

A recurring problem I experienced was the availability of academic research, particularly empirical. I had originally intended to test a link between Bitcoin price and other stores of value, however on inspection the volatile bubble-like behaviour of Bitcoin clouds the validity of any empirical results and hence causations that can be drawn from them. Future literature could analyse the volatility changes of Bitcoin over time to see the effect increased merchant adoption and market depth has had on its usage as a store of value.

Expansion of Surda (2012a) could also be done in attempt to model the price action of Bitcoin whilst including the influence of speculative behaviour, a proxy of which may be search engine popularity.

Bitcoin is unlikely to emerge as a general medium of exchange. Instead, as with many revolutionary technologies, usage and innovation can expand into originally unexpected areas. The Bitcoin protocol represents a gigantic technical breakthrough and could provide the basis and infrastructure for remittance and payment solutions markets in the same way that the Internet facilitates innovations in cloud storage and email protocols. By competing with incumbent monopolies in these areas, any improvements it brings in either speed or decreased transaction costs will ultimately mean that Bitcoin will have had a positive impact on global social welfare.

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