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Bitcoin in Venezuela: a Future Currency or a Technology of Last Resort?

Abstract

This study assesses the impact of Bitcoin in Venezuela in response to the social, political and economic crisis that is currently facing Venezuelans as a result of poor policies implemented by their socialist government. The study addresses the analysis by asking two questions; Firstly, the study examines whether or not Bitcoin is performing as a currency in Venezuela. Secondly, the study asks the question as to whether Bitcoin is perhaps not necessarily a currency but rather a technology that has manifested into a currency as a last resort to struggling Venezuelans. In answering these questions, the study posits findings from an economic analysis into the performance of the Venezuelan Bolivar against Bitcoin and the US Dollar concluding that while Bitcoin is a better economic alternative to the Bolivar in its current state, it is still a currency that is wrought with economic issues. Furthermore, in answering the second question, the study posits a socio-technical analysis of Bitcoins currency in so far as explaining that while Bitcoin may not suffice as a currency per se, it still represents a technology imbued with many socio-technical assemblages that ask far deeper questions around the value society attributes to technology in the form of money. The paper concludes with proposals into future areas of research in the field of cryptocurrencies.

Tables of Contents

Chapter 1: Introduction	1
1.1 Background to Study	1
1.2 Context and Scope of Study	4
1.3 Chapter Roadmap	5
Chapter 2: What is Bitcoin?	6
2.1 History of Bitcoin	6
2.2 The Technology behind Bitcoin	8
2.3 Advantages and Disadvantages of Bitcoin Technology	11
Chapter 3: Literature Review	13
3.1 Political	14
3.2 Security and Regulation	18
3.3 Economic	22
3.4 Environmental	28
3.5 Conclusion to Literature	30
Chapter 4: Methodology	32
4.1 Bitcoin as a Currency in Venezuela	34
4.2 Socio - Technical Analysis	41
Chapter 5: Conclusion	45
References	48
Appendix 1	53

Tables and Graphs

Image 1: Distribution around bell curve.	36
Table 1: Findings and Analysis.	37
Graph 1: Euro to Dollar Exchange Rate.	38
Graph 2: Euro to Bitcoin Exchange Rate.	39
Graph 3: Euro to Bolivar Exchange Rate.	39
Graph 4: Weekly Bitcoin and Petro Trading Volume.	40

Chapter 1: Introduction

1.1 Background to Study

Payments, and more fundamentally money, is an industry going through profound change. The digitisation of money has played a pivotal role in this evolution which has been driven by innovations in mobile technology, artificial intelligence, technology start-ups and distributed ledger systems such as the blockchain. All of these areas of innovation offer new avenues of access to money for people all over the world.

Cryptocurrencies have also entered into the realm of innovation in finance offering a new opportunity for their users. They offer an opportunity for people to use a new kind of money that has never been used before - one that enables a new kind of financial independence. Crypto enthusiasts have the luxury of accessing a digital currency, and all that is required is access to a mobile phone and the internet.

Cryptocurrencies have created many challenges and opportunities. Critics of the cryptocurrency industry argue that it has evolved to provide as a facilitator of criminal activity. Furthermore, the lack of regulation around the industry has resulted in the ecosystem surrounding cryptocurrencies falling victim to cyber-attacks. The currencies are also subject to extreme volatility making their value extremely unreliable for their customers.

In contrast, cryptocurrencies have offered the world an opportunity to subscribe to a new kind of money that is created and managed by each of the participants of the cryptocurrency network. There are no requirements to entry. Customers can come and go as they please accessing new markets that would otherwise be not possible. They also offer anonymity providing users with more independence to purchase goods as they wish.

However, cryptocurrencies also create a new set of questions such as: What is money? Do cryptocurrencies constitute money, a technology or both? What role does technology have in the money system?

Money, in so far as it has provided as a form of currency, represents one of the earliest examples of an information system that exists to this very day. It has also had a huge influence of how people have interacted with each other over time. According to Robertson (2007) *“Over the centuries, money has reflected changes in politics and government, in economic life and power, in science and technology, in religious and other cultural beliefs, in family and neighbourhood life, and in other aspects of how we live. And it has not just reflected those changes; it has also helped to bring them about”* (pp.1).

Currencies have experienced many iterations of innovation for many years. According to Robertson (2007), it was the 6th century BC where the first set of coins were created by the Greeks under the rule of King Midas. Coins spread throughout the states of Greece stamped with emblems of their cities and were seen as a more innovative means of exchange to traditional bartering of animals and livestock. When the Roman empire took control of Greece, they developed a sophisticated banking system introducing the concept of tax collection: *“Although ancient Greece and ancient Rome were very different, they both show that in most societies there is a tendency for a powerful minority to take control of most of the money and land”* (Robertson, 2007, pp.5).

Paper bills were first used by the Chinese as a means to improve the practicality of trading so as to avoid the inconveniences of merchants carrying bags of coinage (Szczepanski, 2018). 500 years later, Marco Polo would discover these bills on his travels to China and introduced the concept of paper money to Europe in his book *Travels of Marco Polo* which would go on to encourage European bankers to use paper money (Robertson, 2007). Bankers would offer notes in exchange for gold and silver coins and for several centuries banknotes were linked to the value of gold and silver.

Robertson (2007) notes how it was in 1694 that a new milestone took place in the evolution of money through a war fought between King Louis XIV of France against England, when the King of England needed money to finance the war and the English Parliament would not increase taxes to fund it. In response, the Bank of England was created to finance the war and insisted that loans did not need to be repaid as long as the government continued to meet the interest payments on the loans. According to Robertson (2007), for the next two and half centuries, the Bank of England developed from a commercial bank into an agency of the state until it was nationalised in 1946. This nationalisation of commercial banks has evolved throughout the world with the European Central Bank representing the state agency bank for Europe (Robertson, 2007).

The nationalisation of banks has led to many boom and busts of state financed institutions leading up to the Wall Street crash in 1929 and more recently the financial crash of 2008. While the history of money is mainly financial in nature, it does raise many questions around the nature of money and how its creation and value is political in nature. This study is not concerned with the history of money per se. However, it is important to understand the history of money in so far as to understand the impact current technology is having on money and how the questions underlying cryptocurrencies are just as much political as they are technological.

The digitisation of money has resulted in advances of banking to some of the worlds most underdeveloped countries. The M-Pesa system in Kenya (discussed in chapter 3) represents a hugely successful example of utilising mobile technology to create a scalable banking system in a developing country. According to a recent study by Findex (2017), 52 percent of the adult population recorded having made or received at least one digital payment using their account in the past year. Furthermore, the share of adults making or receiving digital payments increased by 11 percentage points between 2014 and 2017. However, notwithstanding recent advances in mobile money technology, access to a money system still remains a challenge for many people. According to the Findex survey (2017), close to 1.7 billion people remain “unbanked” in the world. Furthermore, the results identified that one fifth of the unbanked remain unbanked as they do not trust their banking system.

1.2 Context and Scope of Study

In 2009, an author by the name of Satoshi Nakamoto, wrote a paper titled *Bitcoin a peer-to-peer electronic cash system*. The paper proposed the idea of introducing a decentralised banking system which did not require the need for a third party financial institution to mediate payments. As will be seen in subsequent chapters, the emergence of Bitcoin as a technology can be attributed to the lack of trust people place in the financial system as Bitcoin has enabled people all over the world to gain access to a universal currency that is not controlled by any government or central body.

Among many things, the study proposes that people see a problem with the current financial system resulting in them seeking alternative means to banking without the need of a financial institution or intermediary. In trying to understand why this has happened, the study has set out to examine the adoption of Bitcoin in Venezuela. In seeking to answer the question around the role Bitcoin has as a currency in Venezuela, the study will examine how Bitcoin has performed relative to the Bolivar, Venezuela's domestic currency. Furthermore, the study will examine the socio-technical nature of Bitcoin adoption in Venezuela and how the political issues facing the country have influenced the adoption of Bitcoin.

In essence, this study is both economic and socio-technical. It is economic in the sense that Bitcoin is being utilised as a monetary currency by Venezuela and this requires investigation. It is socio-technical in the sense that there are deep rooted social problems in Venezuela causing citizens to resort to the technology underlying Bitcoin as a means to transact. For these reasons, the question is twofold: Is Bitcoin a currency in Venezuela or is it a technology that people are using as they have no other alternatives?

The study began in 2018 and has collected and analysed datasets around Bitcoin performance in Venezuela over a 6 month period ranging from October 2018 to March 2019. The results of the analysis are presented in chapter 4 followed by a socio-technical analysis of Venezuela.

1.3 Chapter Roadmap

The second chapter of this study addresses the question as to what is Bitcoin? This chapter explains the nature of the technology from a conceptual but also technical perspective, analysing the technical architecture and ideology of the technology as set out by the author Satoshi Nakamoto (2009). The chapter moves on to discuss the advantages and disadvantages of Bitcoin with references to where these variables are addressed in the study.

The third chapter details the current research into Bitcoin covering a wide range of socio-political areas surrounding the technology. The review is broken into topics assessing the political, technical, economic and environmental impact of Bitcoin on society. Opposing schools of thought are incorporated into the literature review followed by a summary conclusion on all topics.

The fourth chapter represents the research methodology incorporated to answer the question at hand. The methodology can be broken into two sections to answer the question from two perspectives. The first section incorporates a financial analysis of Bitcoin data in Venezuela by comparing the currency to that of the US Dollar and Venezuelan Bolivar. The analysis incorporates a methodology previously used by a lead researcher in the field of economics who has extensively assessed Bitcoin as a potential currency in the developing world (further discussed in chapter 3). The second part of the methodology assesses Bitcoin from a socio-technical perspective in so far as the study seeks to answer the question around the social subsection behind the emergence of Bitcoin in Venezuela with real life case studies incorporated into the analysis. The findings and analysis is also incorporated into chapter four together with the methodology as this approach is appropriate for the results and analysis of this paper.

The final chapter concludes with a more in-depth analysis on the research discovered and interpretations of the discoveries concluding with an answer to the question in so far as can best be answered. This chapter concludes with a proposal around further areas of research into cryptocurrencies.

Chapter 2: What is Bitcoin?

This chapter is designed as an introduction into Bitcoin as a means to better understand the technology and how it's design has impacted people and the current financial system. The chapter also provides a high level overview of the advantages and disadvantages of Bitcoin in its current practice.

2.1 History of Bitcoin

Bitcoin is a digital currency that is not backed by any physical commodity or government body. Bitcoin was first introduced as open source software in a 2009 white paper titled, *Bitcoin: A Peer-to-Peer Electronic Cash System* (Nakamoto, 2009). The author of the paper, Satoshi Nakamoto, today remains anonymous meaning that it could be a single person or group of people behind the creation of Bitcoin. Nakamoto's goal was to remove the need of a trusted third party financial institution (Nakamoto, 2009).

The first group of Bitcoin users were technology enthusiasts (England et al, 2018). The network remained miniscule compared to any other traded currency. It was the launch of the recently banned Silk Road website in 2011 that saw the emergence of Bitcoin amongst a wider community that was seeking to take advantage of the networks anonymity as a means to transact for illegal goods and services (Popper, 2015) as cited by (England et al, 2018, pp. 19). However, this growing user base attracted a more legitimate user base in the entrepreneurial community which saw potential in the technology behind Bitcoin as an innovative force that was ripe to disrupt the traditional banking system. England et al (2018) note that it has been the developing world that has most recently taken to the technology as a means to circumvent unstable monetary and economic hardship that has fallen upon them. Referring to Venezuela, *"Bitcoin is helping to keep pantry shelves full and medicine cabinets stocked, making life tolerable—if not always easy—in the midst of a socialist hell"* (Epstein, 2016) as cited by (England et al, 2018, pp. 19).

England et al (2018) note how Governments have increasingly intervened in policing the Bitcoin network since the scandal surrounding Mt Gox: the largest bitcoin exchange up until 2011 when it emerged that a security breach carried out over a number of years resulting in the theft of over 850,000 Bitcoins with a value of \$450 million. *"The first government inquiries into Bitcoin markets were, in fact, at the invitation of Bitcoin users who had lost money in the market. It did not take long for thieves to enter the bitcoin's libertarian paradise"* (England et al, 2018, pp.19). Subsequently, the emergence of Silk Road brought

more attention to governments who were under pressure to intermediate. However, as noted by England et al (2018), there has since been various legislative initiatives seeking to regulate the currency (FCA applying Bank Secrecy Act in 2013, efforts by Financial Regulators issuing subpoenas for documentation related to consumer protection, People Bank of China releasing virtual currencies to contend with Bitcoin).

2.2 The Technology behind Bitcoin

The Bitcoin currency is based upon blockchain technology. A blockchain is a design concept where a list of records are recorded sequentially through individual blocks. Every time a user generates a new record, the record is recorded through the creation of a new block in the blockchain. The blocks are linked to each other using cryptography. As a result, each new block creates a cryptographic hash of the previous block. This approach enables a validation system across the entire chain of blocks making it resistant to modification. Bitcoin and many other cryptocurrencies are based upon the blockchain technology and there is significant research and development into other potential uses for blockchain technology outside of finance.

The technology behind Bitcoin can be broken into the following elements as per Nakamoto's paper (2009).

- Transactions.
- Timestamp Server.
- Proof-of-Work.
- Network.
- Incentive.
- Reclaimed Disk Space.
- Simplified Verification.
- Combining and Splitting Values.
- Privacy.

Transactions

Nakamoto (2009) identified that the current need for a banking system is that it is required in order to manage a fair payment processing system across transacting parties. However, this system is flawed in that it "*suffers from the inherent weaknesses of the trust based model. Completely non-reversible transactions are not really possible, since financial institutions cannot avoid mediating disputes. The cost of mediation increases transaction costs, limiting the minimum practical transaction size and cutting off the possibility for small casual transactions, and there is a broader cost in the loss of ability to make non-reversible payments for nonreversible services. With the possibility of reversal, the need for trust spreads*" (pp.1). As such, the ideology behind Bitcoin was to create a public ledger system so that all transactions could be verified simultaneously in order to verify the absence of a

transaction. This would avoid the need for a third party as the system would be able to verify each transaction accordingly through self-governed code.

Timestamp Server

The verification begins with the creation of a timestamp. As such, when a payment is made, a hash of a block is created and published to the network using a timestamp server. *“The timestamp proves that the data must have existed at the time, obviously, in order to get into the hash. Each timestamp includes the previous timestamp in its hash, forming a chain, with each additional timestamp reinforcing the ones before it”* (Nakamoto, 2009, pp.2). In practice, this action of creating a timestamp can be seen as transferring a check from one owner to another.

Proof-of-Work, Network and Incentive

The next phase of the technology was to introduce a peer-to-peer validation method in order to prove that the transaction took place. This process is defined as a proof-of-work system. It has the effect of using each node in the network's server to validate a given transaction and broadcast the validation back to the network. Nodes only accept the block when all transactions in the block are valid by not having been executed previously (Nakamoto, 2009). As such, a Bitcoin can be defined as *“a chain of digital signatures”* (Nakamoto, 2009, pp.2). This proof-of-work system has also been referred to as Bitcoin mining which has evolved to provide as a means of employment to many individuals across both the developed and developing world (L.S, 2015). *“By convention, the first transaction in a block is a special transaction that starts a new coin owned by the creator of the block. This adds an incentive for nodes to support the network, and provides a way to initially distribute coins into circulation, since there is no central authority to issue them”* (Nakamoto, 2009, pp.4).

Reclaiming Disk Space, Simplified Verification, Combining and Splitting Values

While it is not entirely relevant for this paper, Nakamoto proposed innovative technologies that would enable the network to become scalable from a storage and verification perspective using Merkle Trees to have the effect of compacting the network's hashed blocks (Nakamoto, 2009, pp. 4 - 5). Nakamoto also proposed a method whereby transactions could be split and combined in order to make the network more efficient. The idea was to group smaller transactions into one larger transaction using a method of fanning in and fanning out (Nakamoto, 2009, pp. 4 - 5).

Privacy

Privacy has been a central pillar to the attractiveness around Bitcoin. The network operates on the basis of keeping the public keys to a Bitcoin wallet anonymous so privacy around transactions can be maintained. *“This is similar to the level of information released by stock exchanges, where the time and size of individual trades, the “tape”, is made public, but without telling who the parties were”* (Nakamoto, 2009, pp. 6).

2.3 Advantages and Disadvantages of Bitcoin Technology

Dennis Ng et al (2018) sought to put forward arguments for and against cryptocurrencies which have been outlined below for the purpose of this study.

Advantages

Low cost: Cryptocurrencies are built on the blockchain technology enabling users to transact without the commission costs levied by current third party intermediaries and / or financial institutions. There is also no physical cash involved as it is a fully digital currency. As will be seen in chapter 4 of methodology, this has proven to enable Venezuelans to transact more easily in tough economic conditions.

Democratised access: The blockchain technology underlying Bitcoin enables transactions to be processed without the need of regulatory processes. Users can set up a transaction wallet in minutes without having to go through rigorous know-your-customer processes. In addition, anyone can make a payment to any user on the network. There are no restrictions in place that control or prevent transactions. This element of financial inclusion is discussed in chapter 3 of literature review and is seen as a pillar of strength to countries in the developing world.

Decentralised: Blockchain enables a decentralised rule based ledger enabling users to validate transactions without the need of a central controlling entity. Payments made in the system are executed in accordance with the Bitcoin protocol meaning that no entity can control or manipulate where this money is transferred to. Payments made in the system are not reversible guaranteeing integrity across the network. There is no master server responsible for all operations as transactions are executed across hundreds of interconnected servers operating independently of each other. The payment system continues to work even if part of the network chooses to go offline. The concept of decentralisation is another pillar of support to all users and is discussed further in chapter 3 and 4.

Transparency and anonymity: Every transaction executed on the Bitcoin network is recorded through a sequential chain of blocks made available to the network using audit trails. The Bitcoin algorithms are quite similar to traditional banking in the sense that all transactions are recorded, however there is no information shared around the receiver or sender of the coins. Furthermore, Bitcoin is completely anonymous offering users the ability to remain anonymous on the network where the only unique identifier is a number which is

known to the owner of the currency. Users can create any number of addresses as they wish. As will be seen in chapter 4, this has enabled Venezuelans to seek refuge from governments that take illegitimate control of their citizens savings.

Speed: Any user can send money to anyone in the network within a matter of minutes.

Free from economic corruption: The Bitcoin network is limited with a supply of 21 million Bitcoins. This removes the ability of corporations to manipulate the value of the currency from economic issues such as hyperinflation. The networks value is determined by the laws of supply and demand that govern the participants in the network.

Rising value: Cryptocurrencies have proven to be an opportunistic investment for investors seeking to diversify their portfolios from more traditional investment assets. The process of investing is transparent and profitable.

However, there are drawbacks to cryptocurrencies:

Security: The rising interest in cryptocurrencies resulted in a rise of online exchanges and other related e-wallets which have a history of falling victim to hacking.

Environmental: The "*Proof-of-Work*" system underlying the Bitcoin protocol is the most popular form of validating transactions. However, it is the most inefficient from an environmental perspective. Kugler (2018) notes how the annual global energy consumption required to generate Bitcoin accounts for .29% of world electricity consumption. The mining of a single Bitcoin block - a block of transaction data on the network - consumes the same amount of energy to power 28 US homes per day (Kugler, 2018).

Performance: The Bitcoin protocol has been criticised for its ability to process transactions at scale. Bitcoin can process 2 transactions per second enabling around 170,000 transactions per day. This is dwarfed in comparison to the world's largest credit card companies that process up to 150 million transactions per day. Nevertheless, subsequent cryptocurrencies have proven to match this level of scale. Ripple can transact up to 5 million transactions per day.

Criminality: The ability for users to withhold their identifiable information from the network has resulted in an influx of criminal activity to launder money.

Chapter 3: Literature Review

This literature review examines Bitcoin from a variety of perspectives. Firstly, the literature discusses Bitcoin from a socio-political perspective in how the flaws of capitalism have resulted in the emergence of the networks technology. The literature then discusses the technical weaknesses of the network from a decentralised perspective in the sense that the networks architecture creates a new set of socio-political challenges in so far as it is currently governed. This leads on to literature focused around the flaws in the security ecosystem surrounding Bitcoin and the potential impact that these weaknesses can have on society. The next section follows Bitcoin from an economic perspective where discussion has focused around the socio-cultural values assigned to money, and how the design of Bitcoin is more than the design of a currency in so far as it is a social movement that is seeking a better financial system. The research concludes with a discussion around the environmental impact on society as a result of the underlying Bitcoin architecture, followed by an overall conclusion to the literature discussing the overall nature of research in the area of Bitcoin.

3.1 Political

As will be seen in the below literature, research into the political nature of Bitcoin is twofold. On one hand, there is a network of people that have resorted to using Bitcoin as a result of the lack of trust they place in their own government and financial institutions. On the other hand, there is the argument that while Bitcoin enables a trustless peer-to-peer network, it has the effect of forming its own centralised network which is contradictory to the networks original design and goals.

Dodd (2017) put forward the idea that historical proposals to reform the money system have been in place since the Great Depression with the general argument involving two forms of intermediation: from banks and from the state. Dodd (2017) suggests that while attempts have generally only focused on one area, Bitcoin is the first technology to threaten both areas which is what has accounted for much of its political appeal. Dodd (2017) further argues that Bitcoin is more than just a currency. It is a social movement, built on the overriding premise of protest: *“the broader appeal of Bitcoin is not simply that it takes money away from the control of banks and states, but that it removes politics from the production and management of money altogether”* (pp. 8). De Filippi et al (2017) point to the wake of the 2008 economic crisis in particular that resulted in the emergence of alternative exchange frameworks aimed at establishing different social relations. Furthermore, they note how it is the decentralised nature of Bitcoin that has raised hopes to potentially reshuffle financial institutions but also power relations within society: *“distributed networks have long been associated with a redistribution in power relation due to eliminations of single points of control”* (pp.3). Bitcoin is not only a technical innovation per se. It is a political movement driven by social change.

Hayes (2019) put forward the argument that the emergence of Bitcoin as a result of the 2008 crash was more opportunistic suggesting that the network really emerged as a result of ongoing technological advances combined with social and political forces. Hayes (2019) reframes the idea of Bitcoin to not be that of *“money but as socio-technological assemblages composed of a direct peer-to-peer exchange of property rights, a shared ledger of the exchange, and a mechanism to achieve consensus with reference to that ledger without resorting to a trusted third party”* (pp. 20).

Dodd (2017), De Filippi et al (2017), and Hayes (2019) put forward a strong argument for the political nature that drives the adoption of Bitcoin. This cannot be disputed. However, as will be seen in the below literature, research is not favourable in so far as proving Bitcoin to be an adequate substitute to the politics surrounding the current financial system. This is

mainly down to the networks design. Dodd (2017) adequately captures this point in his core thesis claiming *“that there is a paradox at the heart of the Bitcoin phenomenon. Bitcoin will succeed as money to the extent that it fails as an ideology”* (pp. 3). In essence, Dodd is stating that Bitcoin is just a different form of centralisation that will evolve with the same political issues that it is trying to circumvent.

Auray (2012), as cited by De Filippi et al (pp. 13), discuss the concept of enabling trustless peer to peer networks and how they are limited through three key challenges:

- *definition and protection of community borders;*
- *establishment of incentives for participation and acknowledgment of the status of contributors;*
- *and, finally, pacification of conflicts.*

However, De Filippi et al (2017), posit that understanding how Bitcoin addresses these challenges is extremely difficult as it has two different layers: the *“infrastructure layer”* based off blockchain technology, and an *“architectural layer”* comprised of a group of developers (2017, pp. 10).

The open self governing environment around Bitcoin has enabled the network to operate as a community enabling free access to participate in the network. However, this in turn creates significant challenges when it comes to overall protection of participants due to a lack of a central authority governing the network (De Filippi et al, 2017). Furthermore, this lack of central regulation within the network makes it susceptible to manipulation from network participants. They attribute weaknesses in the networks Proof-of-Work mechanism which they argue is subject to manipulation in the event that a group of developers could become large enough to take control of the system. They note how one or more of colluding characters could take control of the network by acquiring 51% of the networks hashing power which has the effect of censoring transaction validation of certain blocks over others (De Filippi et al, 2017). This can mainly be attributed to the networks reward system of *“mining”* which is seen as an economic incentive to reward participants that contribute to maintaining the network with computational power. Accordingly, the network is a:

“complicated, albeit mathematically elegant way of bringing a decentralised network of self-interested actors to collaborate and contribute to the operations of the Bitcoin network by relying exclusively on mathematical algorithms and cryptography. Over time, however, the growing difficulty of mining due to the increasing amount of computational resources engaged in the network, combined with the decreasing

amount of rewards awarded by the network, has eventually led to a progressive concentration of hashing power into a few mining pools, which are today controlling a large majority of the Bitcoin network – thereby making it more vulnerable to a 51% attack” (De Filippi et al, 2017 pp. 15).

This potential flaw in the system cannot be understated. There is no one accountable to the creation of Bitcoin. The trust is placed entirely on the networks participants who remain entirely anonymised. De Filippi et al (2017) point to how this architectural weakness has evolved into a centralised network that is ruled by an oligopolistic structure. In order for the network to succeed as a viable alternative currency, it should be regulated in some form to enable it to operate as a viable technology within social, economic and cultural beliefs in modern society. As such, their argument is that Bitcoin - in so far as it is currently designed - does not circumvent any need for some form of central authority. It simply has created a different political authority that no one can hold accountable.

Atzori's (2017) work also confirms that of De Filippi et al and how the ideology to decentralise government services through an open, unpermissioned blockchain entails a whole set of unknowns, which may outweigh the benefits of a decentralised currency. Atzori (2017) argues that the lack of transparency in the decision making process combined with a lack of accountability over the networks core developers calls into question the overall beneficial nature of distributed networks, making some blockchain expectations unrealistic.

Atzori (2017) outlines three core reasons:

- The architecture of the network requires a level of scalability that at times can result in too small a group of miners required to process the mathematical transactions. This lack of scalability is better handled by centralised units with reliable processing power.
- The blockchain can in theory be forked or abandoned by the community at some point in the future which would have devastating repercussions.
- The blockchain is too reliant on network connectivity and is susceptible to being shut down which could have the effect of there being no paper record of any historic transactions.

Giotitsas et al (2014) argue that while Bitcoin is widely seen as an “apolitical currency”, devoid of troubles that burden other currencies which is enabled as result of its self-governing code, it is still subject to emerging governance structures. Furthermore, while the code takes on the role of the central bank, the code still forms a rule of law which in itself imbues *politicalness* into the networks software. As result, “*Bitcoin as a piece of software is*

imbued with ideas drawn from a certain political framework" (2014, pp. 437). The fact that a small percentage of users control a huge amount of the currency has the effect of exhibiting features of the credit system that it was supposed to overcome, thus threatening the viability of the entire project.

3.2 Security and Regulation

While Bitcoin has proven to be a secure network - in so far as executing transactions on top of blockchain technology - users are still susceptible to various security weaknesses attached to the ecosystem surrounding the network. Naware (2016) assessed the security weaknesses identifying issues in four respects: attacks to Bitcoin wallets, double spending, botnets and the 51% attack discussed earlier.

Bitcoin Wallets

The Bitcoin currency is stored in wallets containing public keys used to receive the currency. A private key is also used to verify that you are the owner of the wallet. While they seem practical to the overall ecosystem, they create significant risk to the holders in the sense that there is no consistency in how they are secured given that they are outside of the network and managed by various different providers. Kaushal et al (2017) researched into the gap between the theoretical-architecture underlying Bitcoin and the practical-implementation of the Bitcoin system in terms of achieving decentralisation, with a specific focus in the field of Bitcoin wallets and their susceptibility to hacking. Furthermore, Weaver (2018) discusses how the fact that cryptocurrencies are controlled by private keys makes them available to anyone who gains access to this key making them highly vulnerable to theft.

Double Spending

Naware (2016) notes how double spending on the network can be achieved in two respects: *“If a merchant doesn’t wait for transaction confirmation, the attacker sends two conflicting transactions into the network and Bitcoin’s are spent two times by attacker. Another way is to premine one transaction into a block and then spend the same coins, before releasing the block into the blockchain”* (pp. 1734). This is a clear example of how the network could be susceptible to manipulation should a central pool of hackers take control of the network.

Botnets

Naware (2016) refers to the Pony Botnet scandal of 2013 which resulted in the theft of over \$220 thousand Bitcoins from various wallets. Weaver (2018) also notes that the entire cryptocurrency environment faces huge systemic risk from worms. Furthermore, Peer-to-peer systems written in common languages such as C and C++ are particularly vulnerable to being hacked with worms that are deployed across multiple currencies accessible on

victims computers. Weaver (2018) notes that the cryptocurrency Dogecoin (coded in C++) has received no updates in over 2 years and has a notional value of over \$550 million making it the 27th largest cryptocurrency in the world by market capitalisation.

51% attack

As noted above by Filippé et al, Naware (2016) also identifies this point as the most dangerous weakness surrounding Bitcoin: *“When an individual or a group of individuals owns more than 50% of the computing power within the bitcoin network, the network is opened up to the possibility of a 51% attack. The advantage in computing power can be used to fork the main transaction blockchain and do fraud, including the double spending attack”* (pp. 1734).

There is a growing area of research into the criminal activity being carried out in the Bitcoin network. Weaver (2018) argues that one of the primary roles of the design around Bitcoin is to avoid a system of censorship resistant payment system, making Bitcoin inherently flawed as it only really facilitates illegal activity such as ransom payments, drug dealing, money laundering and those seeking to evade currency control.

Deventer et al (2018) researched into the extent of criminal activity in the Bitcoin network identifying two key areas where criminals take advantage of the currency:

- Cyber enabled crime through computers and the Internet such as hacking and malware, and
- Cyber assisted crime such as drug trade in online forums.

Their research involved a test exploring the authenticity of cryptocurrency exchanges on specifically the underground web. They identified various money laundering services that enabled criminals to exchange Bitcoin into new addresses that were untraceable. Their findings concluded that laundering cyber crime proceeds using Bitcoin exchanges is a user-friendly and working concept. They further proved that the costs of laundering under this system were cheaper than other non-cyber related laundering services. They noted that the start and endpoint for these money laundering services rests with the exchanges and propose that proper regulatory control over these exchanges would make way for a more compliant use of Bitcoin (Deventer et al, 2018).

Foley et al (2018) sought to quantify the level of criminal activity carried out on the Bitcoin network. Their methodology involved reconstructing the network of transactions between

users. They then applied a network cluster analysis to identify two distinct communities within the data - those exhibiting legal and illegal characteristics. They then used these characteristics in simultaneous equation models that identify the illegal activity. An example of such an approach was to measure the extent to which individual Bitcoin users take actions to conceal their identity and trading records. These characteristics would then be built into their model.

Their results returned the following facts and data points:

- They found that illegal activity accounts for a substantial proportion of the users and trading activity in Bitcoin.
- 26% of all users are associated with illegal activity.
- 46% of transactions are associated with illegal activity.
- 23% of the total dollar value of transactions are associated with illegal activity.
- 49% of all time transactions are associated with illegal activity.
- At the time of writing in April 2017, they estimated that there are 27 million Bitcoin market participants that use Bitcoin primarily for illegal purposes.
- These users annually conduct around 37 million transactions, with a value of around \$76 billion.

National regulators have been active in applying existing and new regulations to the cryptocurrency world. Research in this area is relatively new and points to the underlying blockchain technology as the facilitator of illegal activity (Campbell, 2018, pp. 290). However, governments have not been slow to prosecute abusers of the currencies under various different legislation. The US Department of Justice invoked the Money Laundering Control Act of 1986 in prosecuting Bitinstant CEO Charlie Shrem, who was found guilty of aiding and abetting unlicensed money transmission in 2014. He pled guilty to his crimes (Campbell, 2018).

England et al (2018) also discuss at length the potential impact government intervention could have on cryptocurrencies. Bitcoin was initially subject to government intervention at the request of Bitcoin users when they were victims of theft from third party exchanges (England et al, 2018). In each case of theft, users of Bitcoin approached governments for help (Popper, 2015) as cited by (England et al, 2018). There were also additional efforts by government to intervene in the growing use of Bitcoin throughout 2012 and 2013 with the activity through Silk Road and also linkages to counter terrorism and money laundering. In March 2013, the Financial Crimes Enforcement Network applied to have regulation under the Bank Secrecy Act applied to virtual currencies to the effect that anyone found selling

virtual currencies would be considered a “money transmitter” and subject to relevant regulation (Popper 2015) as cited by (England et al, 2018, pp.19).

However, one of the key challenges with regulating Bitcoin itself is in classifying whether or not it is a currency. Guadamuz et al (2015) discuss this legal challenge in respect of the US and Europe which they note as having divergent approaches within cryptocurrency legislation. Accordingly, the US prohibit any currency being created that directly competes with the US Dollar. US authorities have not acknowledged Bitcoin in this regard which means various currency based legislation would not be applied. The EU on the other hand has developed legislation to capture virtual currencies under the Electronic Money Institutions Directive.

3.3 Economic

According to Hayes (2019), *“the Bitcoin project was much more about technological solutions to social problems than about reinventing money and disrupting the monetary order”* (pp.19). However, there has been leading research in the area of economics and finance assessing the future of Bitcoin as a form of money, see Carrick (2016), Dallyn (2017), Levent et al (2018) and Symitsi et al (2019). In one respect, the research is financial in nature assessing the performance of Bitcoin as a currency relative to other currencies. Various models are incorporated and discussed below in so far as they are relevant for this research paper. The other respect covers the currency from a social perspective in so far as understanding that not all answers are conclusively financial in nature and require more questions to be asked. Carrick (2016) makes this point in referring to the body of research in financial psychology where *“attitudes have been shown to have a large effect on how market actors perceive value; that is, biases that people have influence the way information is processed and evaluated”* (pp. 2325). In any case, both financial methodologies and discussion need to be taken into account when assessing the socio-technical and financial value that people place on Bitcoin. This paper will assess research on Bitcoin from a currency perspective including different model approaches that have been incorporated together with an assessment of the economic value people place on Bitcoin as a unit of currency.

In assessing Bitcoin from a financial perspective, the research can be broken into the following questions:

- Is Bitcoin a currency?
- Is Bitcoin a sustainable currency?
- What parts of the world are most appropriate for application of Bitcoin as a currency?

The main economic debate surrounding Bitcoin is whether or not it is a currency (Carrick, 2016). Carrick (2016) sought to answer this question within the context of developing countries. His paper referred to three key criteria as first cited by Kiyotaki and Wright (1989). For tender to be considered a currency:

- It must enable transactions.
- It must be able to provide a unit of account.
- It must be able to provide as a store of value.

Carrick's (2016) research incorporated a methodology exploring Bitcoin as an alternative to emerging market currencies by comparing its value to that of the volatility of major currencies, emerging market currencies and to that of an emerging market exchange traded

fund. Using the Pearson Correlation Coefficient, his research found that Bitcoin contained more volatility than emerging market currencies concluding that Bitcoin could offer as a complement to emerging market currencies from a risk adjusted perspective. In essence, Carrick is suggesting that Bitcoin could offer as a substitute in times of need:

“The state of Bitcoin as a legitimate currency is unclear. It demonstrates the hallmarks of a currency, but its volatility brings into question whether it clearly meets the requirements of a currency. The volatility has been its largest source of criticism, but this is to be expected of a young currency. Many currencies have suffered from high levels of volatility, but the main difference between these currencies and Bitcoin is that Bitcoin is not backed by a government. It is clear that the legitimacy of Bitcoin as a currency will remain ambiguous for the foreseeable future. In order to gain wide acceptance as a currency, it is going to have to continue to grow in use for several more years” (pp. 2323) .

Dallyn (2017) highlights the different criticisms of Bitcoin as a currency from various commentary in the field of economics. Firstly, he notes that for Bitcoin to be a viable currency it must be governed by a central authority so as to avoid susceptibility to fraud. Secondly, the field argues how Bitcoin is far too volatile for it to operate as a unit of account. Finally, is the fact that there is no sound economic basis for the price attributed to Bitcoin. Fiat currencies are backed by government whereas cryptocurrencies are speculative. However, Dallyn (2017) instead posits Kapriks theory of market singularities - the idea that markets for specific types of goods and services are not of a measurable value - claiming there are two dimensions of value within the Bitcoin market: value attributed through market price, the predominant perception of market value in economics terms, and value established as a collective ascription of worth. Dallyn’s (2017) position is that there are actually two schools of thought in respect of Bitcoin. The first school is that of the economists in the academic field: *“The most prominent group of Bitcoin critics have been academics working in finance and economists. Economic critiques have been put forward principally via social media; in contrast, academic economic analyses of Bitcoin and electronic currency are relatively scarce”* (pp.4). The second school of thought is that of the Libertarian: *“the durability of Bitcoin’s price value is sustained by the belief system of the community that surrounds it”* situating *“Bitcoin as a peculiar ideological market singularity, which is characterised by a libertarian belief system”* (Dallyn, 2017, pp. 465).

Dallyn (2017) does not side with either school of thought but opens the question around how Bitcoin should be researched in so far as it is more than just a decentralised monetary instrument. In so far as Bitcoin is a cryptocurrency, Dallyn (2017) argues that focus should

be given to the belief system underlying Bitcoin given that *“the design and issuance of any monetary system is essentially political”* (pp. 471) .

Dallyn concludes that Bitcoin is better assumed as an asset, however his research opens the question around how libertarian society assumes how a given asset should be classified and this does not make its classification conclusive. In this respect, he notes how Bitcoin was introduced as a result of the 2008 financial crisis and should be given further consideration as a currency asset as there is a community seeking an alternative to traditional fiat money (Dallyn, 2017, pp. 468).

Further research in the field of Bitcoin as a currency is financial in nature. Levent et al (2018) sought to understand the relationship between Bitcoin and other financial assets such as commodities and various other global indexes. Their thesis was to understand if investors in stocks of the S&P 500 would be influenced by price movements of the currency and concluded that there was data to infer that there is a relationship. Symitsi et al (2019) sought to understand the economic value of Bitcoin as a diversification asset from other assets in a portfolio and found there to be many benefits to include Bitcoin within a given portfolio. The research carried out by Levents et al and Simitsis et al is not relevant for this paper, however it does highlight the different approaches taken to understand Bitcoin value in economic terms and confirms points made by Carrick (2016) and Dallyn (2017) in that much of the research omits the psychological value underlying Bitcoin.

Scott (2016) explored the idea that Bitcoin could be applied within the context of international development and financial inclusion, proposing three narratives around how Bitcoin could be empowering to developing nations:

- Facilitating low-cost remittances for those seeking to transfer small amounts of money internationally.
- A means to provide access to the “unbanked” with an international bank account easily accessible through a wallet on a mobile phone - rather than having to set up an account with a formal institution.
- Providing a basis for a richer set of financial services.

Scott (2016) suggests that low cost remittances for international trade provide for a huge opportunity for underdeveloped and developing countries discussing the adoption of technologies like Rebit in the Philippines and BitPesa in Kenya, both of which offer low cost e-currency wallets enabling users in the western world to transfer local currency into cryptocurrency which is then exchanged on the receiving end. Further noted, is the threat

by international institutions to shut off facilitates to countries such as Somalia which is believed to transact for the purposes of terrorism.

Scott (2016) discusses the ability of Bitcoin to enable local businesses to transact: *“Local merchants in poorer countries may struggle to access international payments systems to sell their goods abroad. For example, a rural crafts cooperative from Zimbabwe might struggle to set up a website with an integrated credit card payments system, but getting a Bitcoin address might enable them to sell products in exchange for Bitcoin tokens, thereby avoiding traditional e-commerce systems (which often involve having to set up a merchant account with a formal bank”* (pp. 5).

Scott (2016) further discusses the role of Bitcoin in enabling banking facilities to users that have access to a personal computer or mobile phone. These users can access various applications that provide them with access to a Bitcoin wallet. The users can obtain a public key that represents their account within a global system allowing them to resemble a “quasi-bank account” to build up savings. In the context of a country with poor banking infrastructure, such a technology could hypothetically be a safer way to hold money. Furthermore, it could offer a more convenient way to transfer money in everyday transactions (pp.6).

Clegg’s (2014) research proposed five reasons why Bitcoin could prove to be a financial solution for developing economies as a result of the following five functions attributable to the technology: distributed currency networks, dependability, electronic payments, low transaction fees and financial inclusion.

Distributed Currency Network

Clegg (2014) proposed that Bitcoin *“marked an incremental advance in cryptography and computer science but a significant advance in practicality and utility of the internet”* (pp.3). Accordingly, Clegg argued that the decentralised nodes underlying Bitcoin were much less likely to fall prey to corruption of governments and other financial institutions. Furthermore, he outlined how such corruption is a construct on a social level that requires a deeper understanding. In this respect, he made reference to the M-Pesa mobile money system which has experienced huge success not just as a result of its technology but due to the fact that *“customers trust Safaricom (the owner of M-Pesa) a great deal because of its president Michael Joesph, who was born in South Africa and therefore had no tribal affiliations”* (pp.4).

Dependability

Clegg (2014) argues that the dependability of a country on a central bank or government is far greater than dependability on the Bitcoin network in that the removal of a single node could stop the network from operating in the case of a central bank or government. Accordingly, *“Dependability is essential for currency networks in developing nations due to the volatility of governments and private enterprises. It has been identified, that unstable banks and financial institutions are significant barriers for nations to overcome poverty. This is due to consumers being unable to maintain their savings accounts which they rely upon to hold their wealth and small firms can find it difficult to access investment to grow their business. Not being able to use these established financial methods has led to innovative alternative methods of continuing economic activity, however, on a macroeconomic level, this has led to a lack of broader growth”* (Clegg, 2014, pp. 5).

Electronic Payments

Clegg (2014) again refers to the huge success experienced by the M-Pesa banking system in Kenya which he notes as having a huge impact on enabling citizens to manage their finances in spite of local shocks such as theft, harvest problems and job losses. Furthermore, the system enables ease of access to users without having to go through complicated Know-Your-Customer processes enabling a more welcoming financial system.

Transaction Fees

Clegg (2014) also notes the ability of low cost transaction fees from decentralised banking services.

Financial Inclusion

Clegg (2014) notes how one of key benefits of Bitcoin is its ability to enable better access to banking services in so far as helping the one billion people who have access to a phone but do not have access to a bank account: *“It is evidently easier to establish points of internet access in some areas than to create entire financial infrastructures”* (Clegg, 2014, pp. 6).

While Clegg puts forward sound arguments around the value Bitcoin can bring to the developing world, his points lack depth in the sense that they are in some way contradictory. He refers to the M-Pesa banking system throughout many of his arguments which he posits as a real world example of how Bitcoin could be adopted. However, while M-Pesa has

proven to be a hugely successful technology in Kenya, it still represents a centralised authority in that of a telecoms network. A government can easily intervene into the operation of a telecom provider given the infrastructural presence that telecoms hold in a given country. Furthermore, Clegg's points are theoretical in nature and are not entirely supported by much analysis. This is a common trend across much of the literature discussing Bitcoin in a developing world context.

Nevertheless, there is growing discussion around the need for governments to really start considering the introduction of digital currencies into their monetary policy to facilitate a fairer banking system. In November 2018, the IMF released a paper discussing the pros and cons of a central bank digital currency. The paper was released on the back of a speech given by Christine Lagarde (2018), IMF Managing Director, in which she noted three public policy limitations of the current financial system: (i) financial inclusion, (ii) security and consumer protection, and (iii) privacy in payments:

“The case is based on new and evolving requirements for money, as well as essential public policy objectives. My message is that while the case for digital currency is not universal, we should investigate it further, seriously, carefully, and creatively. More fundamentally, the case is about change—being open to change, embracing change, shaping change. Technology will change, and so must we. Lest we remain the last leaf on a dead branch, the others having decided to fly with the wind. In the world of Fintech, we need to harness change so it is fair, safe, efficient, and dynamic” (Lagarde, 2018).

The IMF specifically note that cryptocurrencies are not sufficient in the sense that they are inefficient in their processing speeds: *“Cryptocurrencies are the least attractive option, receiving a low score in settlement speed because of current technological limitations”* (IMF 2018, pp.14). However, they note how citizens should be entitled to some form of privacy around their payments to avoid situations where commercialisation of customer data is becoming a growing concern globally: *“There are legitimate reasons people may prefer at least some degree of anonymity—potentially when it comes to everyone except the government, and regarding the government unless a court order unlocks encrypted transaction information. It is a way to avoid customer profiling—commercial use of personal information, for example, to charge higher mortgage rates to people who purchase alcohol. Another advantage of anonymity is limiting exposure to hacking”* (pp.10).

3.4 Environmental

Also of great importance is the research into the environmental impact Bitcoin has had on society as a result of the Bitcoin mining process. As discussed in chapter two, Bitcoin mining refers to the process of adding transaction records to the blockchain ledger.

O'Dwyer and Malone (2014) ran a study to assess the potential profitability that a Bitcoin miner could make. They found that if the value of a single Bitcoin is less than the cost of the energy required to generate it, then there is a consideration to understand if and when Bitcoin mining has been profitable compared to the energy cost of performing the mining. However, they conclude that specialist hardware is usually required to make Bitcoin mining profitable. Furthermore, they also found that the entire network consumes the same level of Ireland's average annual energy consumption.

Ullrich et al (2018) expanded the scope of research on energy consumption of Bitcoin by assessing the networks ability to shutdown an entire power grid. Their logic was based on the concept that power grids are designed to maintain an equilibrium of power supply to demand and that extended periods of imbalance cause blackouts. They concluded that based on current growth rates of the mining network, it would be possible that Bitcoin could destabilise an entire power grid in the event of a sudden outage of power.

Ullrich et al (2018) proposed three methods to circumvent this from happening:

- Change of process to the software: Updating software so that it takes issue of sudden load swings into account. The effect would be to reduce the risk of destabilising power grids.
- Further efficient increase: Their research showed that the efficiency of Bitcoin did not improve as more miners were added to the network. This is a result of less efficient hardware being utilised.
- Replacement of Proof-of-Work: This is a common theme within the Bitcoin communities and has been discussed at length in academic and non-academic fields. They noted Proof-of-Stake designs that have been proposed requiring cryptocurrency units to be held by a miner in order to participate in the mining process.

Furthermore, Kruger (2018) notes how there has been an introduction of other cryptocurrencies such as Ripple and Stellar that have offered more environmentally friendly

versions that are based on semi-centralised models. Furthermore, there are also systems that use a Proof-of-Stake method such as Dash and PIVX which provide rewards as if they had originally mined the currency itself.

3.5 Conclusion to Literature

There is an abundant amount of literature assessing Bitcoin ranging from political, economic, technological, environmental, legal and so on. However, the research is very much siloed into specific areas of study.

As Dalyn (2017) noted, there is plenty of research in the field of economics, however there is little research into the practical application of Bitcoin as a currency in so far as it is used for reasons outside of rudimentary economics. Research concerning the socio-political nature of Bitcoin is extensive and well thought out in so far as the general consensus is that there is significant socio-political factors driving the networks adoption. Furthermore, the research is not biased in this area with the general consensus being that the emergence of Bitcoin is a result of a lack of confidence in the current financial system. However, the consensus continues to identify potential political weaknesses created by the technology itself in that it can evolve to become its own corrupted network.

Research has also identified the network to be prone to significant security weaknesses in the sense that the ecosystem surrounding Bitcoin has evolved to fall victim to various cyber attacks as outlined in the review. However, there is growing consensus amongst many governments toward a future where regulation can be extended to the ecosystem. Furthermore, the IMF has taken innovative steps toward acknowledging Bitcoin and other cryptocurrencies as technologies that have the ability to heavily impact social lives of their users.

Economic research into Bitcoin raises interesting questions in so far as how the field views money. Carrick (2016) and Dalyn (2017) put forward strong arguments surrounding the adoption of Bitcoin to be something more important than just a financial instrument, opening up the question for further research in so far as to the socio-technical impact that this currency is having on users lives.

Finally, there is considerable research in the field of the environmental impact caused by the technology underlying Bitcoin and the effect it is having on society questioning whether the value it offers is worth the impact to the environment. This is significant as the world evolves with more questions in understanding how the human race is evolving at the cost of the planet.

Notwithstanding the above, the research opens up an interesting opportunity to address Bitcoin from both an economic and socio-technical perspective using real life scenarios

where the adoption of Bitcoin is a result of these two interrelated parameters. The paper will now move on to assess Bitcoin from an economic and socio-technical perspective using the current political crisis in Venezuela as a research study to help understand how Bitcoin can be applied to a current political crisis.

Chapter 4: Methodology

This study has selected Venezuela as the subject country to assess the suitability of Bitcoin as a sustainable currency for its citizens. Venezuela is currently experiencing a socio-economic and political crisis dating back to 2010 under then president Hugo Chavez. Among many things, the country is experiencing the worst hyperinflation across world currencies which has left many citizens resorting to cryptocurrency as a more stable means to transact for everyday purchases (Di Salvo, 2019). Accordingly, Venezuelans are adopting cryptocurrency as a result of their own domestic currency becoming worthless due to hyperinflation: a cup of coffee now costs 2,800 Bolivars which translates to 28 cent. Furthermore, over 3 million Venezuelans have left the country as a result of not being able to afford essential goods such as medicine and toilet paper (Di Salvo, 2019).

To combat the rising inflation, the Venezuelan government released their own version of a cryptocurrency in February 2018 under the trading name Petro. The currency was said to be backed by Venezuelan reserves such as oil and gas, however the Petro has had very little uptake by Venezuelans which can widely be attributed to the lack of confidence in the government. Furthermore, as will be seen in the methodology, data for volume trading of the Petro confirms the lack of adoption across the country. Venezuelans have chosen Bitcoin as their preferred cryptocurrency seeing it as a more suitable option given its decentralised framework that is free from government control. Venezuela is currently the world's fourth largest trader of Bitcoin behind the United States, Russia and United Kingdom (Alford, 2018).

Venezuela presents an interesting case for Bitcoin for two reasons. Firstly, Venezuelan citizens are choosing to use Bitcoin as they see it as a better economic alternative to their own domestic currency. Secondly, they see it as a method to transact without the disintermediation of their government. The country is not only at war with their domestic currency but also at war with their socialist government. Given the Venezuelan case at hand, the country is a suitable subject to answer both sides of the research question.

The first question will assess Bitcoin from an economic perspective, incorporating a proven financial methodology to assess the sustainability of Bitcoin as an alternative to Venezuela's domestic currency. This framework is appropriate in understanding whether Bitcoin has the potential to enable developing countries to adopt their own financial system without the need of a central government or financial intermediary. Previous research in this area has proven Bitcoin to not be financially sustainable when compared to currencies in other developing countries: see Carrick (2016), Dallyn (2017), Levent et al (2018) and Symitsi et

al (2019). However, the crisis in Venezuela offers a new opportunity of investigation given the unusual level of hyperinflation facing the Bolivar.

The second question will examine the use of Bitcoin from a socio-technical perspective. This approach is appropriate for this study as the investigation and results indicate the country is not only using Bitcoin for economic relief but also as a means to escape the social and political issues facing the country.

4.1 Bitcoin as a Currency in Venezuela

As outlined in the literature review, there is significant research in the field of finance and economics measuring the viability of Bitcoin as a currency. However, the research questions have not been applied to a specific country experiencing hyperinflation to the extent of Venezuela. This creates a new opportunity to investigate if Bitcoin could replace the Bolivar.

The research question assesses the exchange rate volatility of three currencies to the Euro using their daily price movements: Bitcoin, the Dollar and the Bolivar. The volatility is calculated using three commonly used statistical methods in the field of data science: Standard Deviation, Skewness and Kurtosis. This framework represents the methodology used by Carrick (2016) as discussed in the literature review (see chapter 3).

Standard Deviation

According to Adkins (2018), standard deviation is the square root of the average variance of the data from its mean. In currency terms, the standard deviation represents the perceived volatility of a given currency (the level at which the exchange rates change). It is a relatively simple measure to calculate and is best interpreted by comparing the result from one currency to another. In finance, it may be used by investors to understand whether or not a currency is worth investing in. However, for the purposes of this study, the research is not concerned with Bitcoin from an investment perspective as this is not relevant for the question at hand. However, the research is concerned with Bitcoin from a viability perspective in so far as it could replace the Bolivar at some point in the future. Thus, we can use the standard deviation result to compare the different standard deviations across all currencies and infer if the results highlight a potential future for Bitcoin over the hyperinflated Bolivar.

Standard deviation makes the assumption that currency performance takes on a normal distribution that looks quite similar to a bell curve. According to Adkins (2018), if the standard holds true, then approximately 68% of the expected outcomes should lie between ± 1 standard deviations from the average currency price, 95% should lie between ± 2 standard deviations, and 99.7% should lie between ± 3 standard deviations. It is important to again note that this study is not concerned with the statistical outcomes in so far as we are not examining the currency from an investment risk perspective, however these outcomes will help us in understanding each currency in comparison to one another.

If a currency has a low standard deviation, the results can be interpreted to mean that the currency has a low number of deviations from its average price - it is a stable currency and this study can assume that the Dollar to Euro will produce this result. In contrast, currencies with high standard deviations experience large deviations from their price which would be more appropriate from Bitcoin and Bolivar. In essence, we can interpret these results to mean that the currency is far more volatile and less reliable from an economic perspective.

A risk associated with standard deviation is that it is strongly impacted by outliers (large changes in the price of a currency) as it assumes a normal distribution of the bell curve. This limitation is important as it will have the effect of producing bias results of one currency over the other. For this reason, this study will incorporate two additional statistical methods: skewness and kurtosis.

Skewness and Kurtosis

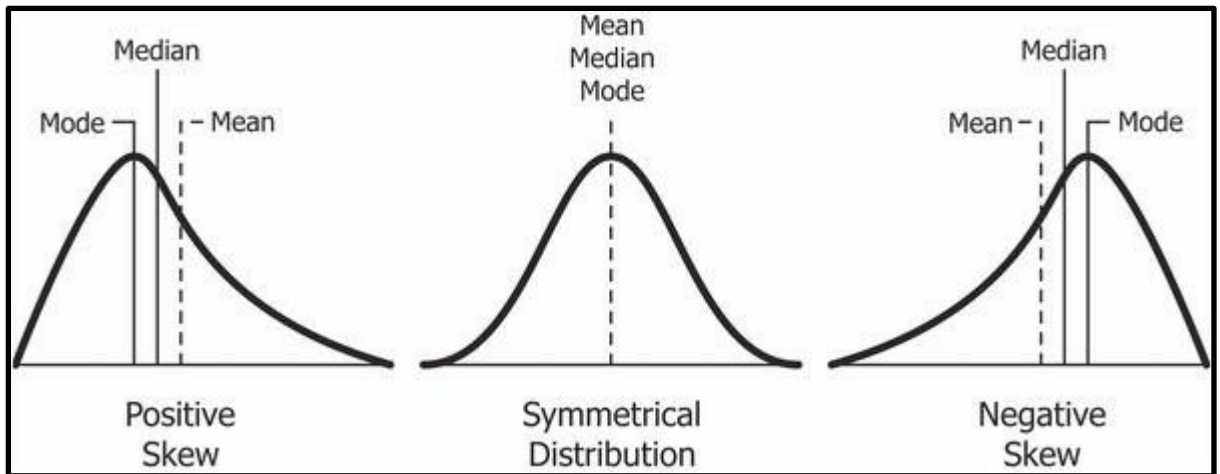
Skewness and kurtosis are formulas often incorporated alongside standard deviation to better understand distribution around the bell curve. Skewness is best described as the lack of symmetry around the bell curve and can outline the shape of the distribution around the bell curve. Kurtosis is best described as the pointedness of the peak in the bell curve.

Distributions can experience right skewness or left skewness. According to Chen (2019), skewness is positive if the tail on the right side of the distribution is longer or fatter than the tail on the left side. Skewness is negative when the tail on the left side of the distribution is longer than the tail on the right side. The mean and median of negatively skewed data will be less than the mode. If the data graphs symmetrically, the distribution has zero skewness, regardless of how long or fat the tails are (Chen, 2019).

According to Kenton (2019), distributions with large kurtosis exhibit tail data exceeding the tails of the normal distribution. Distributions with low kurtosis exhibit tail data that are generally less extreme than the tails of the normal distribution. High levels of kurtosis of the distribution implies that an investor will experience occasional extremes, more extreme than the usual + or - three standard deviations from the mean that is predicted by the normal distribution of returns (Kenton, 2019).

The below image was obtained from codeburst.io (2018) outlining the interpretation of each of these statistical methods.

Image 1: Distribution around bell curve.



Application of Methodology

Datasets for all three currencies were obtained from Investing.com (Dollar and Bolivar) and Coindesk.com (Bitcoin). It was not practical to include these datasets in this paper, however Appendix 1 provides a publicly available link to access the datasets and analysis performed by this study. The research selected the Euro as a reference currency as previous studies around Bitcoin have incorporated the dollar as the base currency creating an opportunity for research around the Euro, see Carrick (2016), Dallyn (2017), Levent et al (2018) and Symitsi et al (2019). Furthermore, the United States Government has put in place various economic sanctions against Venezuela which can have the effect of skewing data reliant on the dollar as a base currency.

The assessment is made in respect of a 6 month window from October 1st 2018 to March 31st 2019 as data was readily available for these periods and represents the most recent period available when this study began.

This methodology relied on standard deviation, skewness and kurtosis functions provided by Google Sheets.

Findings and Analysis

Table 1: Findings and Analysis

	<i>n</i>	Mean	Standard Deviation	Skewness	Kurtosis
EUR / US	130	0.007543076923	0.002591935569	0.8298637892	0.6661538635
EUR / BTC	182	142.98	142.0969723	2.304950197	6.355025116
EUR / VES	156	30.24	124.3959844	9.308480608	96.93507337

Interpretation of Results

It should be noted that the sample size across the different datasets varies in size as per column *n*. This is a result of the number of days of data available over the 6 month period. The Euro to Dollar and Euro to Bolivar datasets omit exchange rate data for the weekend and holiday periods which is standard for the international foreign exchange markets. Cryptocurrencies do not cease trading during these periods. The mean represents the average daily price change for each of the respective currencies and is not useful from a comparative perspective.

The standard deviation was calculated based on the difference in daily price changes for each of the respective currencies. This was calculated by subtracting the closing price from the opening price in respect of each day. The sample standard deviation formula available in google sheets was applied to run the calculation which produced the above results.

As can be seen from the results, the Dollar is a much more stable currency than both Bitcoin and the Bolivar. We can interpret these results to understand that the Dollar offers much more stability over the other currencies as it is within 1 standard deviation of the mean. However, both Bitcoin and the Bolivar are significantly more risky with 142 and 124 respective deviations away from the mean. This would indicate that compared to the Dollar, there is considerably more volatility attached to Bitcoin and the Bolivar than to the Dollar. Furthermore, the results also highlight that Bitcoin experiences a higher number of standard deviations from the mean than that of the Bolivar which could be interpreted to say that Bitcoin is more risky than the hyperinflated Bolivar.

However, standard deviation should not be assessed in isolation when assessing the volatility of a given currency. The reason for this is that the method assumes a normal

distribution and can be strongly influenced by outliers impacting on the overall result (Adkins, 2019).

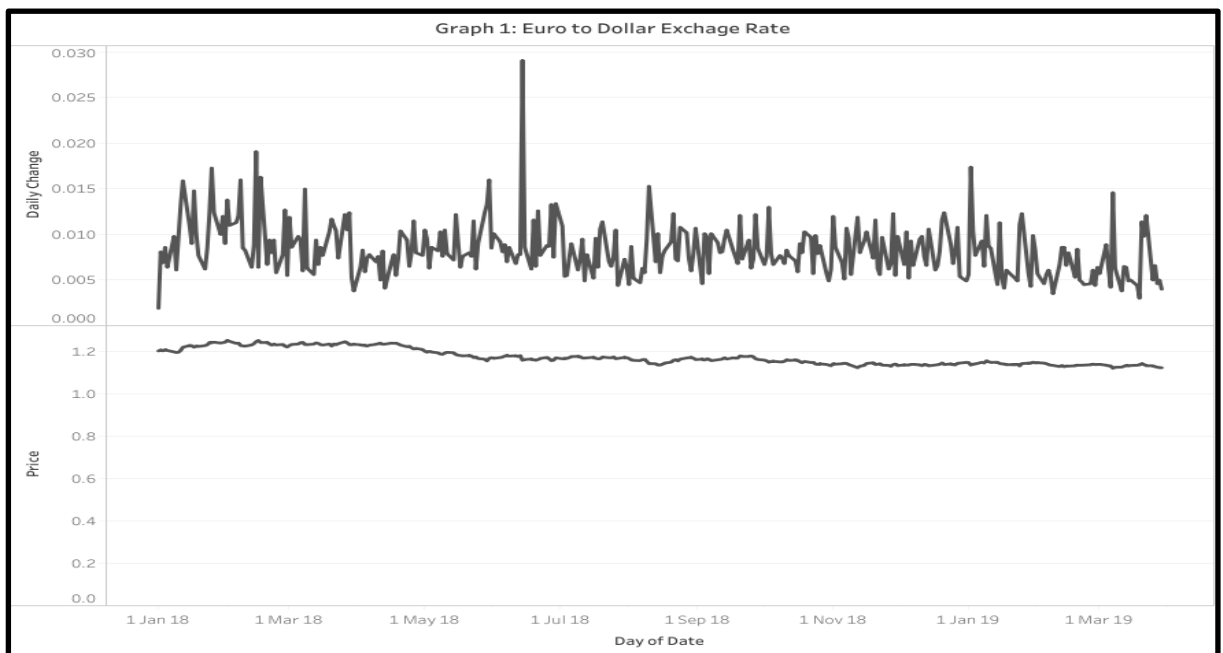
The skewness and kurtosis results of the methodology provide an insight into the extremes of the data which can offer as a better indicator to understand the overall risk of the currency from outliers. It can clearly be inferred that the Dollar exhibits significantly less risk to Bitcoin and the Bolivar with results of skewness and kurtosis in decimal ranges.

However, as can be seen from the data, the Bolivar contains far more extremes than that of Bitcoin with much higher levels of skewness and kurtosis. This study can interpret these results to mean that while Bitcoin is volatile in so far as the price of the currency swings far from its mean, it still does not exhibit as many extremes as that of the Bolivar. This can be better explained in the Graphs 1 - 3.

Graphs 1 - 3 represent line charts over a 6 month period for each of the respective datasets used in the methodology. Each graph illustrates daily price changes with the price of the currency provided below.

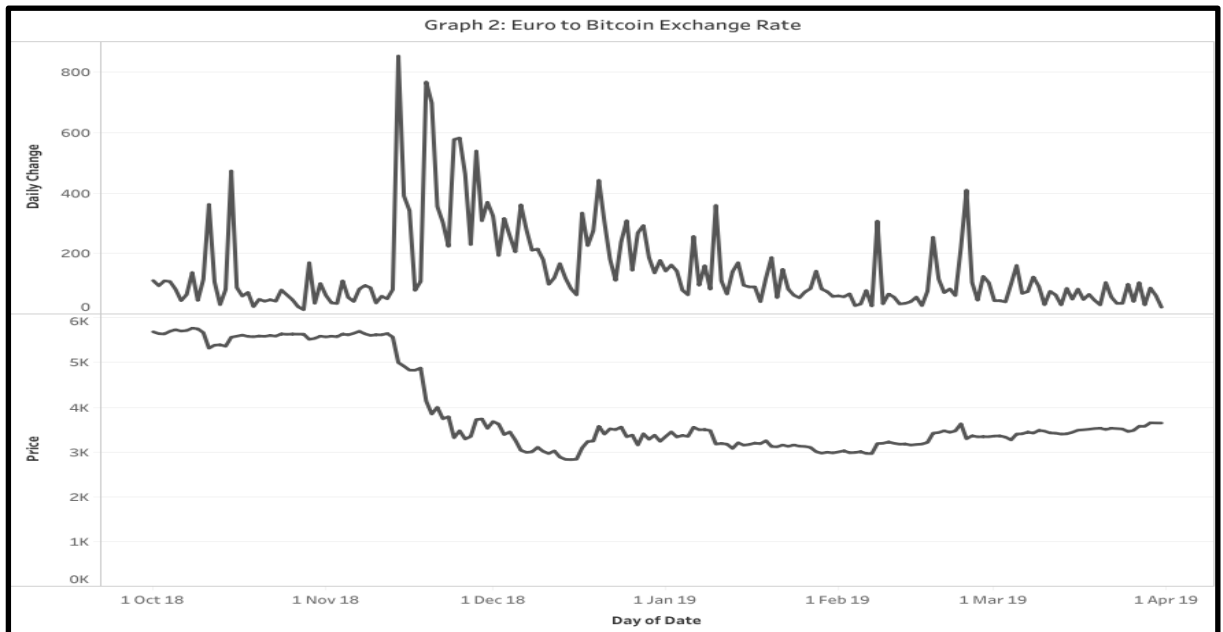
As can be seen, the Dollar is the most stable currency with daily price movements in decimal ranges.

Graph 1: Euro to Dollar Exchange Rate

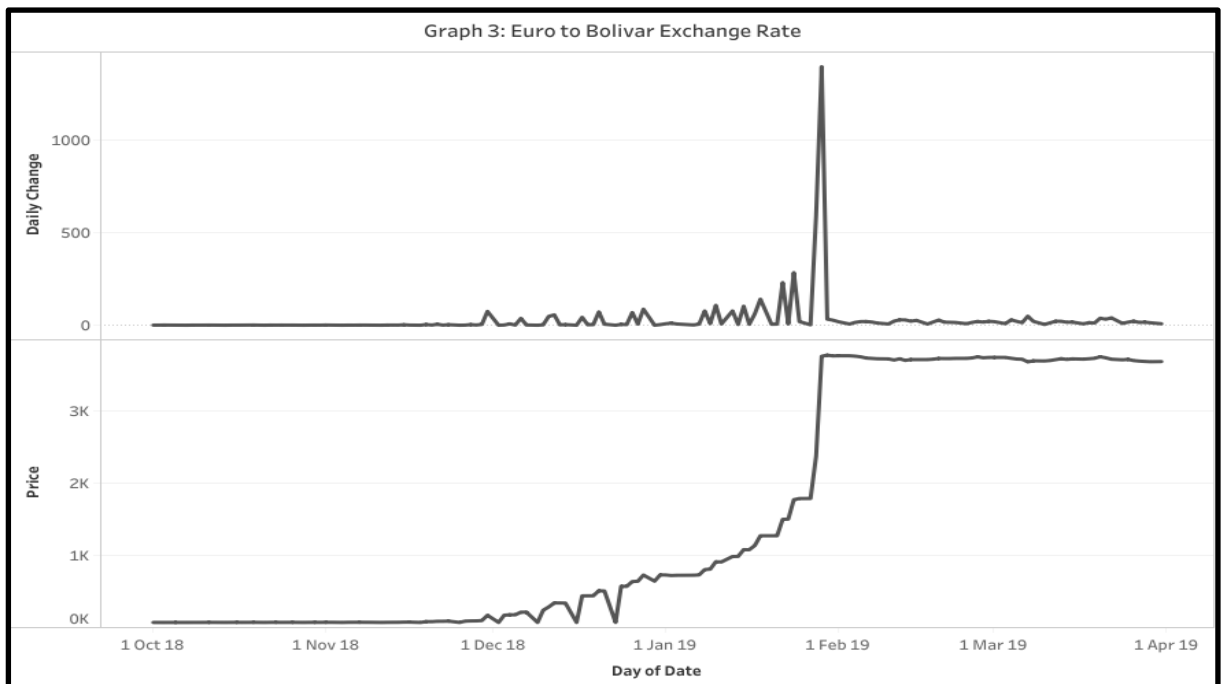


However, Bitcoin and the Bolivar are most volatile with price changes in the hundreds and thousands respectively.

Graph 2: Euro to Bitcoin Exchange Rate



Graph 3: Euro to Bolivar Exchange Rate



Furthermore, as can be seen from graph 3, the Bolivar inflation spiralled out of control from December 2018 representing a more extreme level of volatility than that of Bitcoin and the Dollar. As can be seen, the Bolivar price moved from a price level of just under 1 to over 4 thousand between the period of January to February 2019. Bitcoin on the other hand

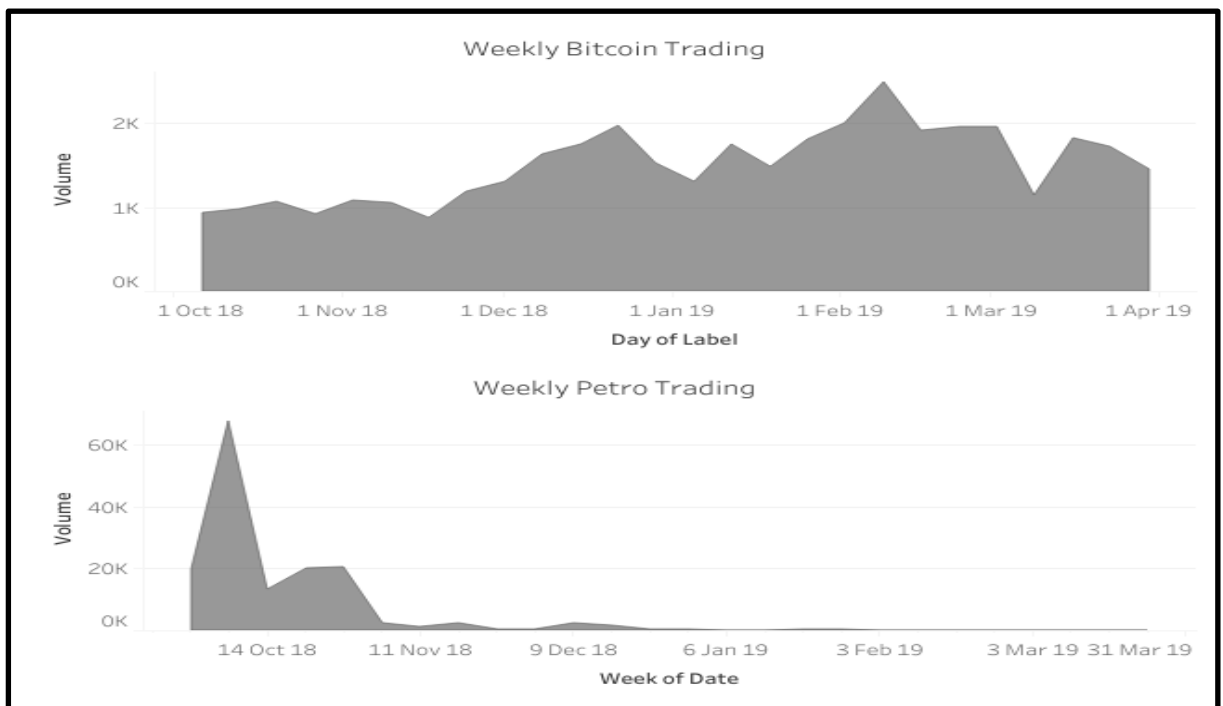
remained relatively stable for this period with a price range between 3 and 4 thousand. This would explain why the Bolivar has higher levels of skewness and kurtosis.

As such, irrespective of the large swings in the price of Bitcoin, Venezuelans have sought refuge in the currency. The study can also infer that while Bitcoin is a better economic substitute to the Bolivar, it still does not suffice as a stable economic currency. This is reaffirmed when compared to a currency such as the Dollar.

These findings begin to ask the question as to why Venezuelans are choosing to adapt a currency such as Bitcoin and requires investigation around the level of social importance Venezuelans place on Bitcoin outside of pure economics. The results begin to ask the question as to what are the socio-technical reasons behind Bitcoin adoption.

Furthermore, the below graphs represent Bitcoin and Petro trading volume over the 6 month period from October 1st 2018 to March 31st 2019. As can be seen, the below graphs highlight the increased adoption of Bitcoin across Venezuela and the significantly less trading of the Petro. This is a significant insight as the Petro offers the same conveniences as Bitcoin in so far as it is a digital currency, however the citizens lack of adoption infers more social reasons leading to the research expanding into a socio-technical analysis as to why Bitcoin is being adopted.

Graph 4: Weekly Bitcoin and Petro Trading Volume



4.2 Socio-Technical Analysis

Trying to understand the effect of Bitcoin as a form of money in society is not completely answered by incorporating financial models alone. The models are conclusive in telling us hard financial facts, however they do not paint the full picture as to the social impact Bitcoin is having in Venezuela. For this reason, the research can be expanded into our second question as to why Bitcoin is being used as a last resort for Venezuela irrespective of the economic flaws pertaining to Bitcoin.

According to Cartelli (2007), *“Socio-technical theory hypothesizes the presence of two subsystems in every organization or corporate; they are the technical sub-system and the social sub-system”* (pp. 1). Thus, while Bitcoin can be interpreted to be a technical sub-system, it must also be understood as a social process that is taking place as a result of this innovation.

Cartelli (2007, pp. 1), refers to Watsons explanation as to what we mean by technical and social sub-systems:

“The technical sub-system is much more than the sum of the equipment in the organization; it can be identified with the process responsible for the conversion of system inputs into system outputs. The conversion process must be continuously controlled to be sure that system goals can be achieved;

The social sub-system, on another hand, is much more than the set of technical control tasks to be performed by people. Technical tasks are combined with individual jobs and with responsibilities assigned to groups. Any analysis and redesign of the social sub-system implies a revision of the jobs and of the corresponding social roles, for the implications they have on the technical sub-system and for the extent to which they enhance or reduce the quality of working life for the individuals and the groups involved in production.”

Cartelli’s assessment of socio-technical theory is appropriate for the Venezuela case study. On one hand, Bitcoin is the technical sub-system: an innovative technical process transmitting information with the goal of providing a financial system. On the other hand, it is much more than a technical process. It is a system that has real impact on people's lives allowing them to take on a different social role that enables them to take control of their financial independence. The system has no requirement for entry. Participants are free to

come and go as they wish. They have access to a basic system without having to forgo independence and privacy.

Hayes (2019) explored Bitcoin from a socio-technical perspective arguing *“that there are imperative technical and social processes of Bitcoin that transcend its status quo money”* suggesting that *“Bitcoin and other ‘cryptoassets’ are properly socio-technological assemblages that enroll both human and nonhuman elements, and which are indeed of sociological interest, but not because they operate as money per se. Rather, it is what these assemblages are able to accomplish: they bring people together directly through the radical disintermediation of institutions, which are in turn superseded by a technological locum”* (pp. 2). As such, Hayes is proposing that Bitcoin is much more than a currency to Venezuela. It is enabling Venezuelans to circumvent their oppressive government regime by opening a banking system that is free from state control and manipulation.

According to Wulf (2018), Venezuela's demise started back in the early 20th century as a result of policies implemented by the Chavez and Maduro regimes. Wulf (2018) notes how Venezuela used to have quite a diverse economy consisting of various different industries. However, now they rely on imports for 80% of food sources, and food production accounts for as little as 4% of GDP. Wulf (2018) further notes how *“policies of import and export construction, redistribution of wealth, massive government spending, monetary policy, price controlling, currency controlling, and exchange rate controlling have all poor economic effects and the economic indicators in Venezuela all tell the same story of high inflation, massive shortages, starvation, political turmoil, a devalued currency, economic inefficiency, and overall economic instability”* (pp.19).

Hyperinflation has been one of the root causes leading to Venezuelans seeking refuge in Bitcoin. According to a recent Forbes article by Coppola (2018), hyperinflation has been in place since November 2016 and is currently estimated to be in the region of 80,000% per year resulting in a poverty rate of 90% across the country. The Government has attempted to make reforms over the last 12 months which have included a denomination of the currency back in August 2018 and by increasing minimum wage by 58% (Coppola, 2018). However, these policies have only had the effect of worsening the problem. It is not difficult to see why trading of Bitcoin volume has increased so much over the previous 6 months given the disastrous economic performance of the Bolivar. Life savings for many Venezuelans have evaporated.

According to a recent article in Time Magazine (Galdstein, 2018), the Venezuelan Government introduced a new set of laws requiring all international remittances to go

through local state owned banks. The banks can charge a wire fee of up to 56% on transfers from Dollar to Bolivar in a process that can also take several weeks to complete. To circumvent these policies, *“Venezuelans have started to receive bitcoin from their relatives abroad. It’s now possible to send a text message to your family asking for bitcoin, and receive it minutes later for a tiny fee. Government censorship isn’t possible, as bitcoin isn’t routed through a bank or third party and instead arrives into your phone wallet in a peer-to-peer way”* (Galdstein, 2018). This process is far from economic in nature and reaffirms the social value brought to people through Bitcoin.

Access to basic banking is not the only social right that Bitcoin is enabling. Galdstein (2018) also highlights how the state has required these banks to record all transactions that individuals spend and receive removing their basic right to privacy. They have even gone to the extent of putting restrictions in place that stop Venezuelans from accessing their online banking information from locations with foreign IPs (Galdstein, 2018). Hayes (2019) discusses how privacy through the Bitcoin network was one of the underlying social values on offer to the networks participants noting that it is *“a shared belief that the widespread use of information technology poses an existential threat since governments or other powerful actors can eavesdrop on private affairs. But, at the same time, it is also a technology that can be used to restore personal privacy”* (pp.10).

Bitcoin has created jobs for Venezuelans. The Economist (A.F, 2018) recently discussed the rise of Bitcoin mining in Venezuela and how those looking to enter the mining industry could start working from *“the comfort of your own living room”* and all that is needed is *“three ingredients; some free software, a steady supply of (preferably cheap) electricity and a computer”*. However, this process has proven to be a real source of economic value to Venezuelans seeking access to income denominated in Bitcoins. CNBC (Sigalos, 2017) covered a news report interviewing different Venezuelans who quit their job to pursue a career in mining which offered a higher salary. Referring to a 29 year old Venezuelan father who entered the Bitcoin mining industry because he could not afford to support his daughter and wife due to his monthly governmental salary of only \$43: *“Because of my daughter, I didn’t think of it as a risk to what could happen to me in the company. I have to take the risk for her. I have to do this for her”* (Sigalos, 2017).

The above research analysis can conclude with two key findings:

Firstly, Bitcoin is not a sustainable alternative currency in so far as it can be analysed from an economic perspective. The data and subsequent results clearly illustrate that the currency is extremely volatile creating significant risk for those that rely on it to transact for

day to day purchases. This point is the general consensus of research in the field of economics surrounding the currency and is further supported by the findings in this study which sought to assess Bitcoin in respect of an extreme case of Hyperinflation. However, these findings are not conclusive in answering the question around why people are using the currency.

Secondly, this study can conclude that the adoption of Bitcoin is more than just a response to an economic crisis as a result of the findings from the socio-technical analysis of Bitcoin adoption throughout Venezuela. Despite the wild swings in the technologies price, Venezuelans are relying on Bitcoin as means to transact without the intermediation of their government. The technology has enabled the country to use the technology underlying Bitcoin as a path to financial independence and social solidarity.

Chapter 5: Conclusion

This study has identified two key findings.

Firstly, Bitcoin, in so far as it is a form of currency in economic terms, does not offer enough evidence to suggest that it would suffice as an alternative form of economic money that can prove as a long term replacement to Venezuelans. This conclusion can be made with reference to the financial analysis of Bitcoin in the context of Venezuela and when compared to a more stable fiat currency such as the Dollar. The results from analysing 6 months of data identify that Bitcoin is an extremely volatile economic currency which creates the same economic risk to Venezuelans as that of their own domestic currency. With that being said, it has demonstrated less volatility to the bolivar and as noted in the methodology, the statistical results can produce biased interpretations which can be seen when analysing the inflationary price of Bitcoin which is not at a scale to that of the Bolivar. For these reasons, we can infer our second finding.

Secondly, the adoption of Bitcoin in Venezuela is driven by a range of social factors outside of economic discussion which typically find fault in Bitcoin. As can be seen from the socio-technical analysis, the adoption of Bitcoin represents a range of socio-technical assemblages that go far beyond the purpose of everyday banking. Venezuelans are adopting the currency as a means to supplant the political and social injustices placed on them by their corrupt government. In this respect, Bitcoin is proving to be successful. It is providing Venezuelans with access to global financial markets and in some cases economic income so they can feed their families.

The findings in this paper support part of the previous research in the field, specifically with respect to Dodd (2016) and Hayes (2019) in that there is a strong socio-technical movement behind the adoption of Bitcoin. The adoption of Bitcoin is a strong representation of a society attempting to remove corrupt institutions from restricting their citizens with access to a basic banking system. As such, Dodd (2009) put forward the idea that Bitcoin will succeed as money in so far as it will fail as an ideology. Venezuela is a strong case for this position. As can be seen, the findings identify that Bitcoin does not provide as an adequate economic substitute to money in the sense of the volatility that surrounds the currency. However, it is succeeding as an ideology in that it is achieving the political goals that it set out to accomplish - removing the need for trusted third parties (Nakamoto, 2009).

The results also outline the politicalness behind money as set out by Robertson (2007), Carrick (2016), Dallyn (2017) and Hayes (2019). This aspect of politicalness leads onto

further questions around the political impact that blockchain technology will have on the future money system, questioning the role played by state bodies and financial institutions in managing their citizens' money. As per the previously discussed IMF report (2018), there is a role for cryptocurrencies in the future in so far as they break down barriers for citizens that want fairer access to a monetary system. However, decentralised cryptocurrencies, in so far as they have been implemented to date, are yet to demonstrate full capabilities as a pure monetary system that can replace such intermediation. Notwithstanding their limitations, Bitcoin does offer an insight into how technology can shape the future money system. As Scott (2016) notes, Bitcoin has demonstrated an ability to offer a means of financial inclusion to developing countries that would otherwise be discriminated from accessing a fairer system. This opens up research opportunities into the newer forms of decentralised cryptocurrencies that could evolve to enable more inclusion. However, this study can not conclude that it will be Bitcoin that succeeds as the study can infer that current adoption of Bitcoin in Venezuela is a result of a lack of trust in their government. It is a last resort.

Furthermore, the findings can also support the position that Bitcoin is creating a new risk for Venezuela in the sense that the country is resorting to a different form of centralisation in the Bitcoin network which in turn creates a new set of challenges for its citizens. Venezuelans are subject to volatility that is outside of the control of their domestic environment given that Bitcoin is a globalised currency subject to large swings outside of their control. As Roper notes, many Venezuelans *"own USD bank accounts, and for those who don't, a thriving black market is ready to exploit their need for a stable yet familiar currency. With such high demand for the world's most stable fiat, the push to transform Venezuela into a Bitcoin-driven economy might be misguided"* (Roper, 2019). In a sense, Venezuela is being forced to adopt this currency as a last resort, especially when there are more stable alternatives for them. This raises the question around the level of education citizens have around Bitcoin and how a technology can take advantage of people.

The paper also opens up the question around privacy of money and how society can use new innovations in technology to protect the commercialisation of their data. This is important given the vulnerability of citizens to having their data exposed to third parties whether they be governmental or in the private sector. Lagarde (2018), noted in her speech that the future of privacy around purchasing data will become a concern when citizens find that they are excluded from borrowing at fair rates because of the nature of goods they choose to purchase, such as alcohol. The case of Venezuela presents an even more challenging situation where citizens are under government surveillance around all purchasing activity.

While this paper has specifically focused around Bitcoin, there is an opportunity to investigate alternative cryptocurrencies to Bitcoin and how they could offer to be a more sustainable alternative to Venezuelans. It could be argued that the future of money and technology rests in the removal of central governments and private institutions whereby technology administers all control and the State takes a back seat where they are only involved in so far as monitoring money laundering processes. Proposals of this nature are in active discussions within the International Monetary Fund (Lagarde, 2018). There is an opportunity for research in how these cryptocurrencies could be designed and the social impact they could bring to the developed and developing world.

In conclusion, the core thesis of this paper is that while Bitcoin is performing as a currency in Venezuela, it does not demonstrate economic viability that would facilitate a conclusive determination as to whether or not it is a sufficient currency. This can be attributed to the findings in the analysis and to the fact that alternative fiat currencies demonstrate a much safer alternative to Bitcoin. For these reasons, the thesis can conclude that Bitcoin is being used as a last resort by Venezuelans who have lost hope in their own domestic government resulting in them relying on a developing technology to enable them to survive. With that being said, there is a future for cryptocurrencies such as Bitcoin but perhaps in a different form which offers independence, liberty, and reliability that can potentially be achieved without human intermediation.

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10.15760/honors.523

Appendix 1

The below link is a publicly accessible link to the datasets I obtained for analysis in this paper. The link allows for view only access and no amendments can be made to the analysis.

Table 1 represents a summary table which has been provided in methodology.

Tables 2, 3 and 4 represent datasets for all three currencies provided for in methodology.

Table 5 represents datasets detailing daily Bitcoin trading in Venezuela in methodology.

Table 6 represents local bitcoin volume trading in Venezuela as outlined in methodology.

The final tab provides links to where datasets were obtained.

<https://docs.google.com/spreadsheets/d/1Ysy0GdZgv4gBunSdSGAz41-EFghxDz6R4kGKLJGpQtA/edit?usp=sharing>