Drew University College of Liberal Arts

Future of Cryptocurrency: An empirical analysis of Bitcoin as a mode of transaction and investment.

A Thesis in Business

By

Sanchit Sahni

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Abstract

Over the years, the number of Bitcoin users have increased due to its decentralized technology. However, recently a number of experts have begun debating Bitcoin's viability as a global currency. This particular study contributes to this debate by closely examining the economic purpose served by this digital currency within the financial market. By outlining the possible uses of Bitcoin, this study performs empirical analysis to examine the currency's ability to function as a useful mode of transaction and investment. Among a number of considerations, this project studies the importance of Bitcoin's regulations and security in achieving widespread economic acceptance. The research further investigates the timeline of Bitcoin to understand the impact of these determinants on its price. Moreover, the research considers investors' trust by studying Bitcoin's price movement through regression analysis with time series data. Bitcoin price and return are explored as a function of financial assets (like gold) and other related variables (like Google Trends). Results suggested that Bitcoin indeed faces challenges as it seeks to rival more traditional forms of money. Inconsistent regulations and security breaches pose major obstacles for Bitcoin's acceptance as a mode of payment. The empirical analysis of Bitcoin returns showed a weak relationship with the considered variables, highlighting the possibility of other factors playing a part in the fluctuation of Bitcoin's returns. The results, coupled with the high levels of volatility over time, suggest that Bitcoin is internally driven, making it a risky mode of transaction and investment.

To my family and friends,

For continuously supporting me

To my committee members, Professor Marc Tomljanovich, Professor Forrest Shue, and

Professor Steven Kass,

For their valuable time and mentorship

* * *

Thank you

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Preface

Money is an essential component of life. It is not only used to complete daily transactions, but also to store value in the form of investments over a given period of time. Traditionally, the most popular means of transaction used by individuals include paper money and credit cards, while on the other hand, real estate, stocks and, bonds are the most popular mediums of investment. So, under which of the above-mentioned titles does Bitcoin fall?

Recently, Bitcoin has taken the world by storm with its rising popularity. For individuals who are unaware of the term 'Bitcoin,' the New Oxford American Dictionary 2018 edition defines it as '*a type of digital currency where encryption techniques are used to generate the units and is independent of any central authority'*. In other words, Bitcoin is a decentralized form of digital currency.

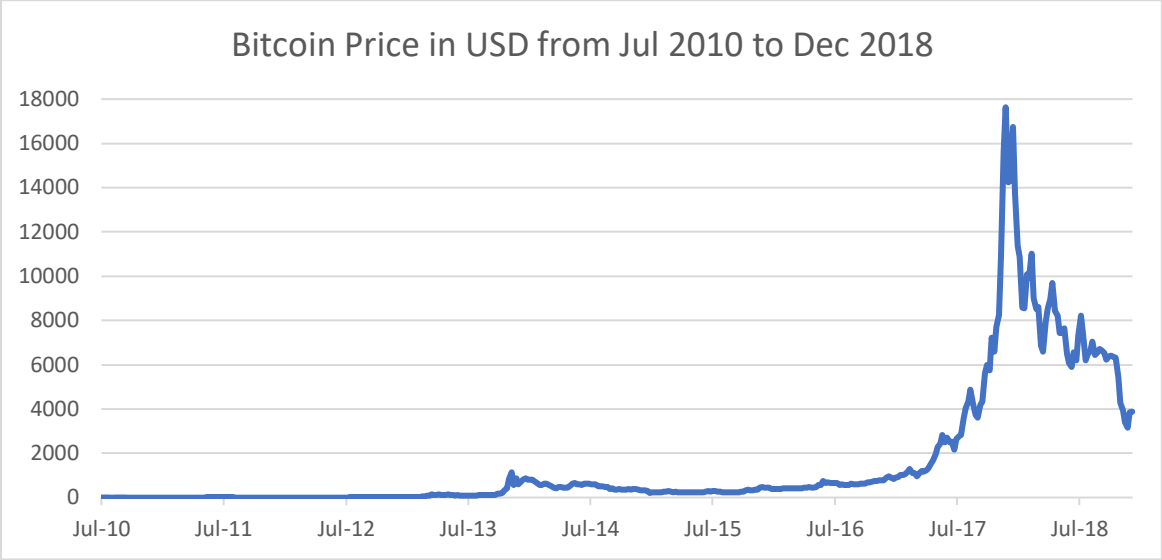
My first encounter with the term 'Bitcoin' was in the year 2014, during my junior year of high school. While playing a video game, my friend brought to my attention a newspaper article discussing Bitcoin and sought my views on the subject. As any usual teenager, my first reaction was, "What is Bitcoin?" My friend's explanation was vague at best, but his discovery nonetheless introduced me to the fascinating economic story behind it. The introduction to this newly discovered term brought about a streak of curiosity within me. I vividly recall reading various articles that night to get an understanding of the new digital currency. To my surprise, I did not find any of the articles to provide a successful enough explanation to cure my curiosity. Since that day, I always retained the word Bitcoin in the

back of my mind. I was captivated by the existence of this new technology burgeoning in the world.

All this while, I knew something called Bitcoin existed, but did not have the opportunity to delve deeper into the subject and learn more about it. Moving to New Jersey, I found myself near the financial capital of the world and therefore started paying more attention to Bitcoin price movement and events related to it. Initially, I sought views from my economics and business professors about Bitcoin. All of them had different perspectives on of what this technology was, and what it can become in the future.

During the Wall Street Semester, I was given the opportunity to write about any financial instrument that impacted the business sector. To take advantage of this golden opportunity, I selected Bitcoin as my topic and began to conduct research about it with full dedication. As a part of my semester's final research, I studied the whole journey of Bitcoin, along with Blockchain and its effect on the financial market. I got so intrigued coming up with new findings and analysis during my research, bringing me the idea to explore the topic on a broader scale as the subject for my bachelor's degree thesis. One of the early memories which pulled me towards researching this area is the graph of Bitcoin price in U.S. Dollar below showcasing its volatility.

Graph 0.1



Bloomberg L.P. (2019) Bitcoin Price in USD, 07/23/10 to 12/31/18. Retrieved from Bloomberg database.

When I started the journey of writing this thesis, I had no clue what would happen to Bitcoin by the time my research reaches its conclusion. I was simultaneously excited and nervous about the uncertainty surrounding the future progression of Bitcoin. However, one thing that motivated me to continue pursuing this research was my curiosity and interest in learning more about the cryptocurrency market. I always considered Bitcoin as a substitute for the traditional money we use. Going forward with the research, I first narrowed down the reasons we use money and applied it on Bitcoin. The two primary reasons as I previously mentioned are, either we transact through money as a mode of transaction, or we store a value in it over time making it an investment. Where will Bitcoin fit in the future? It could be one of them or both or even neither of them.

Structurally and conceptually, there are five major sections that I have tried to cover in this thesis. The first two sections discuss the background of the topic. More specifically, the first section focuses solely on the history of money over the years, followed by the background of Bitcoin and similar cryptocurrencies in the second section. The third section then analyzes Bitcoin as a mode of transaction by discussing the security and regulation aspects of the currency. Following that, the fourth chapter emphasizes Bitcoin as a mode of investment, by relating it to other forms of financial assets and variables, to show their impact on the price of Bitcoin. Lastly, I form my conclusion of the discussion along with its limitations and possible future studies beyond my research topic.

From the beginning of this thesis, I knew there was minimal data present for Bitcoin. The word Bitcoin was in fact non-existent before 2009, and it was uncommon for journals to publish articles about Bitcoin until late in 2014. Therefore, finding scholarly articles discussing the background of Bitcoin was a challenge. However, many reputed newspapers provided valuable information when it came to the timeline of the digital currency. I always checked the information gathered with a number of different newspaper articles, as such articles are not always peer-reviewed. The data of Bitcoin prices over the years is the sole primary information available to people regarding the currency's performance, which in turn helps to study and confirm a lot of reports on it. The research in this paper studies the Bitcoin data from July 2010 to December 2018. Additionally, in the past couple of years Journal of Economic Perspectives, Economic Letters and other similar journals have

published very informative papers, which have been used as the basis of this research. Lastly, my thesis committee members' insights were a great source of help, without which the thesis would not have been complete.

This paper thus aims to introduce the concept of Bitcoin to its readers and tries to explain its rise and fall in price since the year 2010. It offers perspectives on the future of Bitcoin, and by extension, cryptocurrencies in general. The research intends to show the impact of various events in the currency's short history, in addition to correlating it with the performance of other financial assets. The question involving the use of Bitcoin is a broad and perhaps ambitious one, which I try to analyze by directly considering it alongside with paper currency and other electronic form of money. Hence, if money has existed to serve a discernible economic purpose in this world, would the widespread use of Bitcoin likewise provide newfound value in the financial sector?

Ch:1 History of Money

Money is defined as a medium of exchange that can be used to buy goods or pay for services (Kiyotaki et al. 1989). Over the years, money has reshaped into different forms to aid in the process of transferring goods. Traditionally, a primary way to exchange goods was through the barter system. The evolution of global monetary system over time has led to the electronic exchange between individuals in the contemporary world. This section discusses the history and evolution of money, tracing the different mode of transactions over time.

The Evolution of the Payment System

Centuries ago, before the invention of any medium of exchange, people traded through the reciprocal exchange called the barter system (Kiyotaki et al. 1989). Since there was no existing medium of exchange, individuals exchanged goods and services directly for other goods and services. Holding on to the agriculturally based society, the barter system proved to be an efficient mode of exchange for the people. For example, Person A would exchange one kilogram of rice with Person B who offered one kilogram of wheat. In its effect, there was no particular value assigned to a good. Individuals could buy goods based on what they could offer. In the example above, one kilogram of wheat is assigned a value of one kilogram of rice. However, if the transaction occurs with another Person C who offers one kilogram of corn, the value of wheat will be different. Hence, the value of goods in the barter system did not have a set value. Also, this system was inefficient due to its limitations

because both the people taking part in the transaction had to accept what the other person was offering. This was known as 'Double Coincidence of Wants', where two individuals happened to want the same thing, leading to a trade (Davies 2010). For individuals, it was sometimes difficult to find buyers with shared interests, which made the barter system very inconvenient. This system also prevented participants from storing their value over time, as the value of the good would depreciate due to physical deterioration, for example a fruit rots over time and loses its value. The existence of such problems made the barter system very inefficient.

For a less economically stifled and more fluid trade, the world required a medium of exchange which assigned a standard measure of value to goods and overcome the double coincidence of wants. The standard measure of value helped to store value over time without any deterioration. This advancement in the payment system came in the form of 'money'. Money constitutes a legal tender, used as a medium of exchange to make payments (Luo 1998). The legal tender can be an item or a verifiable record which functions as a payment method and is used to repay the debts as well (Luo 1998). The history of money started with the use of commodities.

Commodity Money

Commodity money consists of an object like gold, which has an intrinsic value (Davies 2010). Such objects are valuable resources and function as money through the value of the resource itself. The use of commodity money goes back to 3000 BC, to Mesopotamia

(Powell 1996). In this society, people used the value of barley (a crop) to act as commodity and function as a medium of exchange. Around 650 BC, the Lydians introduced the most common commodity money which exists in today's world as well in the form of precious metals like gold and silver (König 2001). Metals such as gold, silver, bronze, and copper were the most popular form of commodity money. They were highly valuable, durable, and could store value over time. Such properties of metals made them fit well to act as a form of commodity money. People could trade without the existence of double coincidence of wants, which made trading even more efficient. For example, 10g of silver had a fixed value and could be exchanged for the crop required by the buyer. The trading through a medium of exchange was more convenient and efficient for both buyers and sellers as it was widely accepted. The commodity money system gradually developed into the representative money in the seventh century (Jevons 1989).

Representative money consists of tokens, which do not have an intrinsic value of their own but can be exchanged on demand for a commodity that is a valuable resource (Wray 2002). The token's face value is supported by the commodity, which can be exchanged. The early use of representative money came in the form of receipts issued to people who deposited gold and silver in a warehouse, dating back to the 17th Century (Wray 2002). Individuals could use the receipt as a mode of payment, introducing representative money as a new and productive medium of exchange. Representative money in the form of receipts were promissory notes, which were used by the individuals during that time period to buy and

sell goods more conveniently. This central idea eventually led to the introduction of fiat currency.

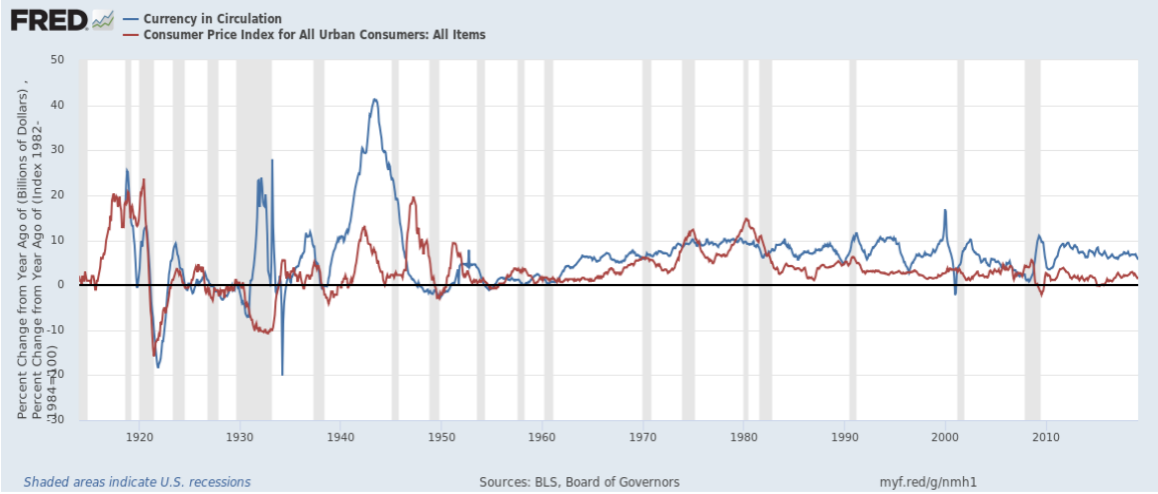
The Transition to Fiat Money

Both commodity money and representative money shared one particular downfall: the valuable metals were scarce, and it was difficult to continue mining in order to meet the people's demand of money (Davies 2010). Circulation problems of commodity money then led to the discovery of fiat money. Fiat money does not require physical commodity value to back it up. Fiat money is in the form of printed paper or coin (just like the promissory notes in representative money), which is declared as a legal tender by the government (Luo 1998). The U.S. law accepts the money as a medium for any economic transaction. Notes and coins do not have any intrinsic value. Instead, the acceptance by the government and law provides a face value to fiat money. Fiat money was first used 100 decades ago in China (König 2001). Marco Polo introduced fiat money in Europe during the 13th century. Initially in Europe, gold standard notes replaced forms of commodity money such as gold coins. In the gold standard monetary system, the face value of currency links to the rate of gold set by the country. For example, if the U.S. sets the value of gold at $35 an ounce, the value of 1 dollar will be 1/35th ounce of gold.

A significant change in the U.S. Monetary System came after the World War II. Fiat currencies were being adopted by most countries, and their currencies were being fixed to the U.S. dollar instead of gold (Davies 2010). Fiat money initially resulted in economic

growth. However, it faced the issue of overprinting, making the currency worthless (Noko 2011). The graph below provides an overview of the rise in inflation that coincided with the increase of fiat currency circulating during the 1940s in the U.S.

Graph 1.1- Currency in Circulation and CPI. (2019, March 15). Retrieved from https://fred.stlouisfed.org/graph/?g=nF5X



Since fiat money is not linked to physical reserves, it risks becoming worthless. Fiat money functions well only with a central authority regulating the supply of the notes. The gold standard which backed U.S. currency ended in 1973. The central authority (also known as the central bank) was now responsible for maintaining the supply of the currency, in order for it to hold its value. Whenever currency is printed in an excessive amount, it tends to lose the face value it holds, and it further effects the economy and inflation of the country (Oomes et al. 2005). However, it also provides the government with the power to control economic variables by controlling the supply. This power does not always result in a national economic advantage.

A perfect example of this is the hyperinflation in the African country Zimbabwe in the early 2000s (Noko 2011). In Zimbabwe, the President's scheme led to a collapse in the agricultural sector. The President instituted land reforms, which provided lower class farmers without experience to take over the jobs to meet the country's food production demand (Noko 2011). As a result, there was a sharp drop in the export of Zimbabwe. This action was followed by a collapse in the manufacturing and banking sectors as well. With high unemployment, instead of tackling the situation with new economic policy, the government started printing the currency to pay off international debt due to the decline in the export. The excessive printing led to hyperinflation, and the face value of the fiat currency of the country (Zimbabwe Dollar) kept falling. Eventually, Zimbabwe switched to U.S. Dollar, a more stable currency. Zimbabwe provides a clear example of how government's power over legal tender can lead to a negative impact on the economy.

Moving back to fiat money, with few exceptions like the case in Zimbabwe, the introduction of paper notes without intrinsic value was successful and gained widespread use. People started gaining trust in the system, and the legal tender made transactions easier among individuals (Davies 2010). Similar to how people used to store the commodity money in banks by depositing it, people started depositing the fiat currency in banks. Over the last 50 years, developments in the field have been trying to simplify transactions (Luo 1998). Cheque was introduced to transfer funds directly from one bank account to another with a paper document, and became popular in the 1950s. The introduction of ATMs (Automated Teller Machine) made the availability of deposited cash easier for individuals

in the late 1960s (Davies 2010). Introduction of debit cards and credit cards by the banks, therefore made the currency more accessible. Access was no longer limited to particular hours or locations. Clients could access their funds with the help of the card issued by the bank.

Following that, internet banking was introduced by mid-1990s to transfer funds via the internet (König 2001). The technological advancement lead to the invention of internet-based applications like PayPal and Venmo to transfer funds and act as a medium of exchange. PayPal, established in 1998 and renamed in 2001, was one of the earliest modes of exchange on the internet (Acker et al. 2018). It gained widespread use due to the convenience it offered the clients. Cross-border transactions were also made easier and cheaper through PayPal. Venmo, on the other hand, was released a decade later in 2008 and later got acquired by PayPal in 2013 (Acker et al. 2018). Venmo made transactions easier as people could transfer funds through a mobile application. This technological advancement proved to be revolutionary in the age of social networking websites, as Venmo allowed its clients to simply add friends and transfer funds to them through the application. It was more widely used within friends group or colleagues to transfer funds conveniently. Many similar applications have been launched to make transfer of money easier in this digital world.

Technological advancement took convenience to another level. Transactions became easier over time, and fiat currency completely replaced the commodity money. However, 2008

was a big year for the invention of a new, even more revolutionary mode of payment that no one had ever thought about before; Bitcoin. Although peer-to-peer transactions were being discussed in the early 1990s, but no one came close to introducing a successful plan to establish this platform which could act as a new medium of exchange. No one had a clue how cryptocurrency could go from being non-existent, to one of the most popular form of currency in merely a decade.

Ch-2: Introduction to Cryptocurrency

History of Cryptocurrency

Cryptocurrency is a subset of the electronic payment system, where a transaction can occur without the presence of a financial institution. The 21st century signals a move from place to space, where transactions ensue apart from a specific geographic location. Usually during an electronic transaction, a third-party plays a role in verifying and facilitating the authentication of a payment. However, cryptocurrency in the purest form is a peer to peer version of electronic cash (Berentsen et al. 2018). The peer-to-peer functionality makes cryptocurrency completely decentralized, eliminating the need for a central authority in completing a transaction. In fact, it closely relates to the peer-to-peer file sharing used in Bit-Torrent, where the file does not exist at one particular destination.

The origin of cryptocurrency is rooted in the Crypto-anarchy movement of 1992. The movement in the early 90's used cryptographic software for transmitting information to protect the user's privacy (Timothy 1994). Crypto is derived from the Greek word 'krúptō', meaning hidden or private (Timothy 1994). The rise in the Crypto-anarchism was attributed to the increase in surveillance at the time (Timothy 1994). The ability to encrypt (convert data to a code) and decrypt (convert code to data) provided the opportunity to digitally protect personal information, safeguarding freedom of speech from the incursion of government and subsequent censorship. Individuals did not feel they had the freedom to

express themselves with the rise in censorship. Cryptography thus helped people simultaneously share information and protect their identity.

Similar to Crypto-anarchism, cryptocurrency was introduced as an alternative to protect identity from the increased surveillance by financial institutions. The introduction of cryptocurrency provided the user with an alternative to the existing banking system with less interference and surveillance by governments. Cryptocurrency was therefore built on the basic ideology that emphasized protection of one's identity during a transaction and their economic freedom. Instead of a central authority, cryptocurrency uses 'Blockchain' to record and verify transactions (Berentsen et al. 2018). Blockchain in cryptocurrency is defined as a distributed, decentralized, public ledger (Böhme et al. 2015). The ledger is not located at any one particular computer, but all computers that are a part of the cryptocurrency network. Just like a bank authenticates a transaction, in cryptocurrency, the network of nodes (computers) is responsible for verification; acting as a ledger. Each individual on the network has a private and a public key. The Blockchain is responsible for restricting users from double spending and helps create a secure digital identity.

To understand the concept of the 'Blockchain', let us consider a real-world example. Imagine Sam is sending money in the form of cryptocurrency to Ben. Both have a private key and a public key, providing them control over their individual funds. A combination of their private and public cryptographic keys will act as a digital signature i.e. the consent to authenticate the transaction. Once Sam's transaction is authenticated with the digital

signature, Sam's private key digitally generates an announcement certifying the transfer of cryptocurrency and attaches it to Ben's public key. Ben's public key will act as address, making announcement in his future transactions. This will form a block, which contains the digital signature, the timestamp and will contain other relevant information (but not the user's identification), which gets broadcasted on the network (Böhme et al. 2015). In this way, a series of blocks form a Blockchain, containing all relevant information to prevent double spending. The distribution of information over the network reduces the risk of hacking as it lacks a central point that would otherwise be vulnerable. It also eliminates transactional and processing fees associated with the existing electronic banking system. The distributed ledger records the transactions efficiently and prevents any alteration in the existing blocks without the digital signature. Therefore, the Blockchain is critical in the functioning of cryptocurrencies.

Introduction to Bitcoin

It was not until 2008 that cryptocurrency was first created and the history of money witnessed the advancement. Cryptocurrency was first mentioned in a paper introduced by an unknown person, referred to as Satoshi Nakamoto (Nakamoto 2008). This paper initiated the journey of the world's first cryptocurrency and consisted of the central tenet of cryptocurrencies – 'a decentralized, trustless and peer-to-peer system of currency.' The study referred to the most popular cryptocurrency today, 'Bitcoin.' Böhme (et al. 2015) stated that these characteristics made Bitcoin more flexible, private, and less subject to regulatory oversight than other forms of payment.

Satoshi Nakamoto was the one who developed the framework of coins that used digital signatures to prevent double spending. Nakamoto introduced one of the most significant innovations used in most cryptocurrencies as a transactional log today in the form of Blockchain. Bitcoin was the first digital currency which used this technology for storing data across the peer to peer network and kept owners of Bitcoins anonymous. Nakamoto's paper was initially posted on the mailing list discussion of cryptography in 2008 (Marr 2017). The idea was later launched in the form of software. Satoshi Nakamoto himself launched Bitcoin by creating the first entry in Bitcoin's global transaction register. It was the first block of the existing Bitcoin's Blockchain and is called the genesis block (Fanning 2016). Every other block can trace their lineage back to the genesis block (also called Block 0). The genesis block contained 50 BTC and was mined by Nakamoto himself. Since the central government was absent, there was (and still is) no central authority to issue Bitcoin to maintain the circulation of currency (Fanning 2016). Instead, Bitcoin had to be mined by solving algorithm problems online. The software to mine Bitcoins was not made available to the public until Jan 2009 (Marr 2017). To understand the mechanism of Bitcoin, it is necessary to understand the concept of Bitcoin mining.

Bitcoin mining is a process that connects the miner's electronic device to the Blockchain network, and in return, the miner is rewarded with cryptocurrency. Once the genesis block was mined in late 2009, Bitcoin v0.1 was released and allowed other users to mine Bitcoin (Marr 2017). The PC is used to mine Bitcoins similar to how tools are used to mine gold

from the ground. Gold needs to undergo a process to be extracted. Similarly, all the Bitcoin in existence today had to undergo the process of mining. Individuals use their PC's Bitcoin software to circulate Bitcoin transactions around the network, and thus work as auditors.

Mining is additionally used for verifying transactions and adding it to the public ledger (Fanning 2016). Miners are therefore the one responsible for solving the double spending problem. Miners solve this algorithm by discovering the 64-hexadecimal code. Once the algorithm is solved, the first miner to discover the 64-hexadecimal code is rewarded with a new block on the ledger. A miner collects pending Bitcoin transactions, verifies their legitimacy, and assembles them into what is known as a 'block candidate.' This way the information is shared across the network using the miner's PC storage as well as electricity (Evangelho 2018). As an incentive, miners are rewarded with Bitcoins based on the number of blocks they mined in a specific time period, releasing new coins into circulation. This process aids in maintaining the Blockchain, as the pending transactions get added in the form of a block by verifying the information through the network. When Bitcoin was first mined in 2009, mining one block would earn 50 BTC. In 2012, this value was slashed in half to 25 BTC and in 2016, this was further halved, resulting in the current value of 12.5 BTC (Evangelho 2018). As the number of miners increased, mining became more complicated, which also increased the average mining time. Mining has become a rigorous task today and is only done by professionals with expensive hardware. Hal Finney, a developer of PGP Corporation, was one of the first backers of Bitcoin and used to mine it (Décourt, 2017). Finney also stated that he could not mine cryptocurrency for long as the

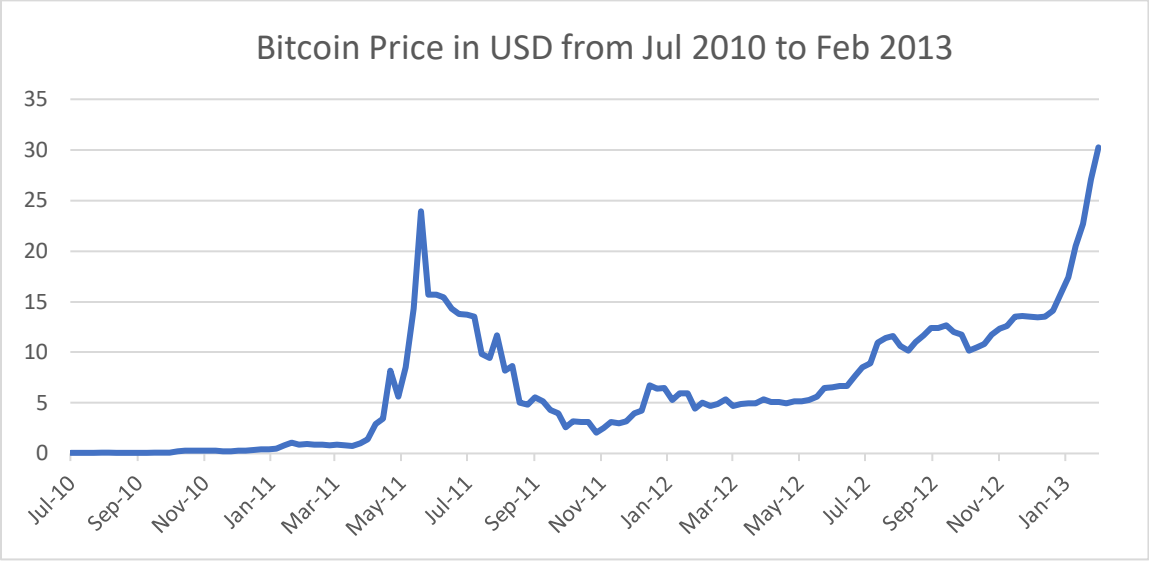
software required too much power. Mining requires a superior PC with very specific technology. Thus, Bitcoins progression in terms of users and popularity resulted in a higher level of difficulty in mining over time.

Timeline of Bitcoin

Examining the timeline of Bitcoin provides an understanding of the digital currency, and highlights the economic and structural development behind its technology. In 2009, mining was creating more coins every day. However, the value of Bitcoin was initially based on the price of electricity used to generate a Bitcoin. It was estimated to be roughly 1,309 Bitcoins for one dollar (Nian 2015). Note, this paper will consider the price of Bitcoin in U.S. dollars only. On May 10, 2010, the first real-world Bitcoin transaction took place by an individual named Laszlo Hanyecz, who offered 10,000 Bitcoins for a pizza, valuing each Bitcoin to be roughly $0.0025 (Vigna 2016). Shortly after, Bitcoin version 0.3 was released which triggered a surge of interest in the cryptocurrency (Vigna 2016). The latest version of Bitcoin caught the eye of Slashdot, a news outlet, which also contributed to this surge (Marr 2017). People's increasing interest in the concept helped create the first rise in the Bitcoin value (from $0.008 to $0.08). The increase in value also led to the creation of the first full-time Bitcoin exchange (marketplace to trade) called Mt. Gox (Böhme et al. 2015). By Feb. 2011, Mt. Gox exchange showed that the value of Bitcoin matched the U.S. dollar, creating a symbolic milestone for the growing currency. The growth of Mt. Gox resulted in the introduction of Bitcoin-exchanges in other countries. By April 2011, Bitcoins were being traded for British Pounds (GBP), Brazilian Reals (BRL) and Euros

(EUR). This paper presents various graphs of each Bitcoin's value phases to illustrate an in depth the timeline of the currency. (*Note: Price axis not scaled in different phase graphs*)

Graph: 2.1- Phase-1: Bitcoin Price in USD from Jul 2010 to Feb 2013

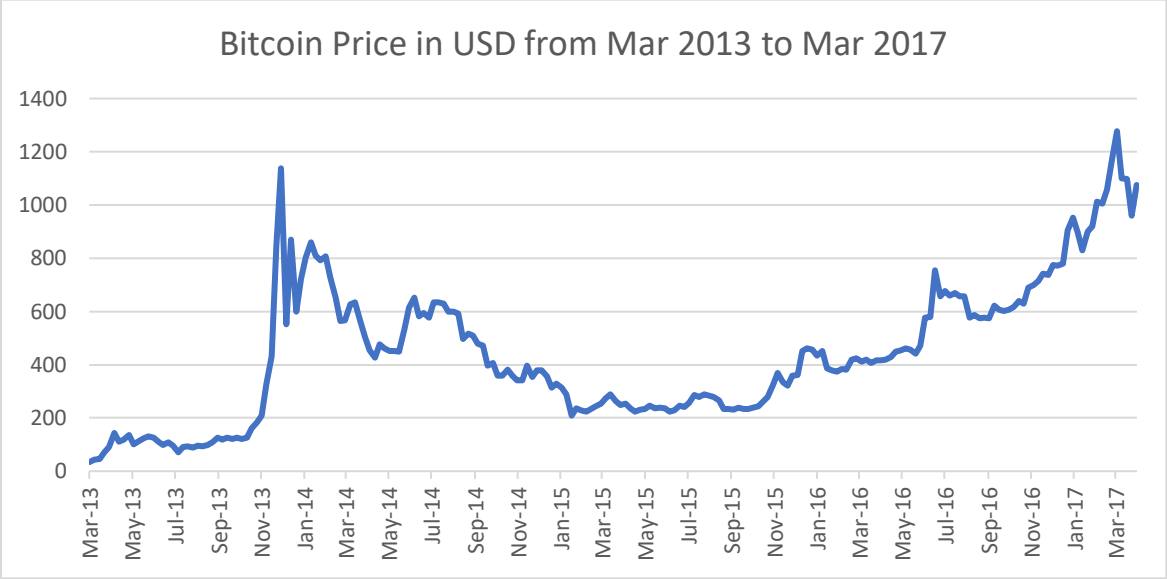


(Bloomberg L.P. (2019) Bitcoin Price in USD. Retrieved from Bloomberg database.)

The weekly price chart data dates back to July 2010. The initial rise in the value of Bitcoin was seen when Adrian Chen, an American Journalist, posted an article on the Gawker blog (Marr 2017). The article named "Underground Website Lets You Buy Any Drug Imaginable" offers a unique approach to the use of Bitcoin. Bitcoin is stereotyped as a black-market eCommerce revolution due to its anonymity. When combined with Bitcoin, Silk Road, also known as the dark-net market, was termed as a drug barter token. Within ten days of the publication, the value of Bitcoin briefly increased from $9.21 to $29.38. However, following this uptick, we saw the volatility of Bitcoin for the first time when the Mt. Gox exchange got hacked on June 19th, 2011 (Böhme et al. 2015). The hack was not a result of a faulty Bitcoin Blockchain design, but of a compromised computer that

belonged to a worker at the exchange, allowing a hacker to change the value of Bitcoin. This security breach resulted in the loss of Bitcoin, driving down its value due to investor's concern. After the drop in value, the exchange rate stabilized over the next year, and the value of Bitcoin was stagnant until Feb 2013. Bitcoin's next up-rise occurred in the early months of 2013 as a consequence of the Cyprus bailout (Luther 2017). In Cyprus, an island country, people were not able to access their cash deposited in the nation's bank. With the uncertainty in the safety of their banking system, individuals started seeking a safe haven by investing in Bitcoin, which led to the second phase of an increase in Bitcoin value (Luther 2017).

Graph: 2.2- Phase-2: Bitcoin Price in USD from Mar 2013 to Mar 2017



(Bloomberg L.P. (2019) Bitcoin Price in USD. Retrieved from Bloomberg database.)

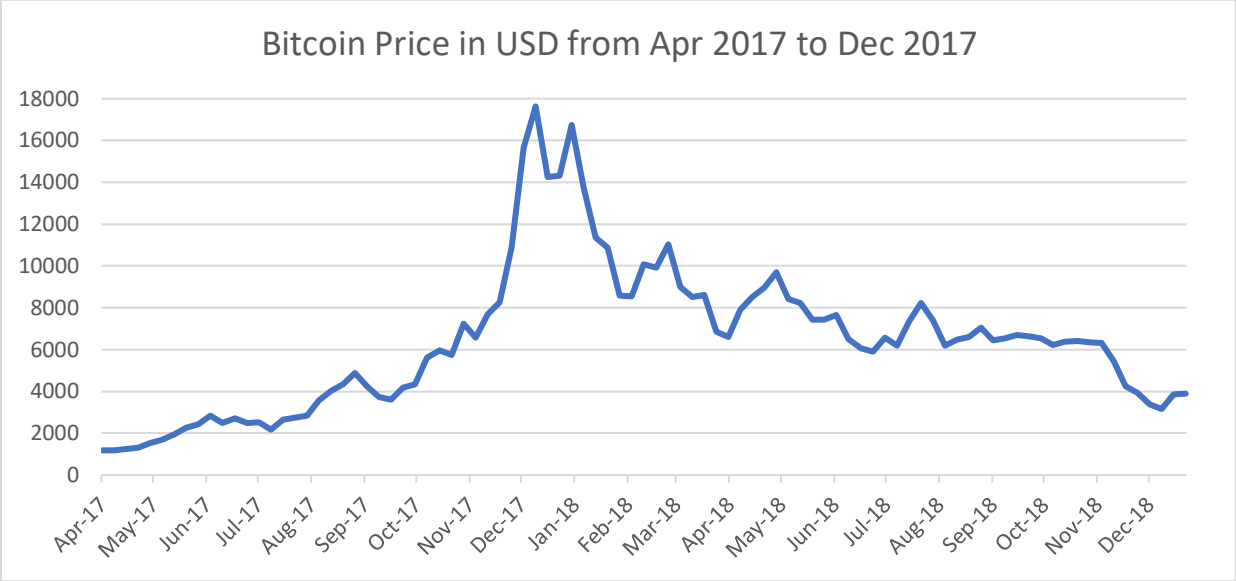
The value of Bitcoin jumped from $29 to $130 due to the increased trade volume in March 2013, as when people noticed the increase in value, they began investing (Böhme et al. 2015). Mt. Gox could not support the overwhelming number of trades that were taking

place, resulting in the failure of many of them. This caused panic among investors and thus, drove the value down again until the panic settled. Following that, there was a 600% increase in the Bitcoin price later that year. There were primarily two reasons behind this jump; both relating to increased support in the currency. The first being, in November 2013, at a U.S. Senate meeting, a panelist agreed that Bitcoin holds great promise. Jennifer Calvery, the director of Financial Crime Enforcement Network, stated that the U.S. government wants to operate in a way that will not affect Bitcoin's innovation (Yermack 2015). Secondly, the People's Bank of China was very convinced by this innovation and saw a future with the currency. Even though the Chinese government was hesitant to adopt the currency at that time, they allowed people to participate in the Bitcoin market (Yermack 2015). Following these occurrences, there was a sudden rise in the trading volume, where the price of Bitcoin grew from $188 to $1137 within a month as the trust in the currency grew.

However, the Chinese Government soon banned a financial institution from trading Bitcoin (Raymaekers 2015). Following this, in December 2013, the value of Bitcoin was slashed in half. A further slump in its value came in Feb. 2014, when various Bitcoin exchanges were attacked with Distributed Denial of Service. In response, Mt. Gox shut down its service and later stated that approximately eight hundred fifty thousand Bitcoins were stolen by hackers, and they had to file for bankruptcy (Böhme et al. 2015). The rate of Bitcoin slumped drastically. This was the most significant breach that led to questions about the security of Bitcoin trading. The fluctuation in price is illustrated by the graph

from March 2015 onwards. Some people took this opportunity and invested in the currency when the value was low, fluctuating the price of Bitcoin for the next couple of years between $300 and $600. The theft showed the risk involved in trading in an unregulated currency.

Graph: 2.3- Phase-3: Bitcoin Price in USD from Apr 2017 to Dec 2018



(Bloomberg L.P. (2019) Bitcoin Price in USD. Retrieved from Bloomberg database.)

In the subsequent years, Bitcoin gradually became widely accepted, and it is difficult to correlate the change in price of the digital currency with one particular event. The price fluctuated daily, and the market of Bitcoin kept growing. 2017 was one of the most significant years for Bitcoin. The value of Bitcoin had doubled by June to reach $2000 for the first time in history. The enormous increase can be largely (although not completely) attributed to the recognition of Bitcoin as legal tender in Japan by the Virtual Currency Act (Umeda 2018). The rapid growth increased its value to $8000 in November 2017.

Additional growth of Bitcoin occurred in December 2017 when financial firms, CME and CBOE, announced that they would begin Bitcoin futures trading (Schulz 2018). They listed financial products offering exposure to cryptocurrencies starting December 18, 2017. The number of people who recognized Bitcoin as a valid form of currency continued to grow. Bitcoin reached its all-time high $19,783 in December 2017. Note, the graph does not showcase the all-time high value as the data is weekly and Bitcoin briefly touched $19,000. Following that in early 2018, reports of hacked exchanges circulated among media outlets. Meanwhile, Facebook, and Twitter had restricted all Bitcoin advertisements (O'Donnell 2018). The investor's concerns kept rising. People began attributing further fluctuations in Bitcoin's price to various events. During the initial stages of this research (Dec. 2018), Bitcoin traded at $3,892.14. This paper analyzes the recent rise and the fall in the price of Bitcoin. The analysis will help understand an investor's perception of Bitcoin as a viable mode of transaction and a possible future investment.

Rise of Alternate Cryptocurrency

Before analyzing Bitcoin, it is necessary to provide a full economic portrait of alternative cryptocurrencies available on the market. As per the data available on the coinmarketcap website in Dec 2018, there were 2071 active cryptocurrencies worldwide. Still, Bitcoin remains the market leader, occupying a share of 51.77% of the market at the end of December 2018, highlighting Bitcoin's dominance rate (Coinmarketcap 2019). The alternative cryptocurrencies launched following the boom in Bitcoin were referred to as 'altcoins'. A few of the major altcoins today are named Ethereum, Litecoin and Bitcoin

Cash (Wood 2014). Many cryptocurrencies entered the market due to low barriers to entry. The fact that Bitcoin is holding on as the market leader after so many similar cryptocurrencies emerged is a consequence of a lack of differentiation on the part of users. Ethereum is the only cryptocurrency able to offer some type of differentiation in the market and has received global recognition (Wood 2014). Since otherwise there is low differentiation with low barriers to entry, many altcoins have entered the market but failed to achieve recognition. Most cryptocurrencies change the in-built code of the Blockchain and release its currency. Before moving forward to the analysis, the paper discusses Ethereum in order to compare and contrast the features of other altcoins with Bitcoin.

Ethereum, like Bitcoin and other cryptocurrencies, operates using Blockchain technology. Ethereum has the same underlying principle of being decentralized and innovates the existing functions of Bitcoin. Ethereum is also used to transfer smart contracts. Instead of allowing users to only store money and accounts on a block, Ethereum allows for newly coded programmed logic as it is referred to as a decentralized computing platform (Wood 2014). Ethereum is a special case, where cryptocurrency offers more than just the transfer of money. However, Bitcoin's entry into the market as the first of its kind has set time as a barrier to entry, therefore other cryptocurrencies have not been able to match the success of Bitcoin. Apart from that, other altcoins were basically a modified version of Bitcoin.

The rise in altcoins were a result of various drawbacks in Bitcoin, such as the increased difficulty in mining over time and a complicated Blockchain structure (Tschorsch 2016).

But, there were tradeoffs with such altcoins as they had lower acceptance and value retention rates compared to Bitcoin. The revolutionary nature of cryptocurrency has been associated with Bitcoin since its emergence, mostly due to the fact that it was the first of its kind and currently has a higher acceptance globally. For this reason and due to the high dominance rate, this study primarily considers Bitcoin in its empirical analysis of cryptocurrencies in financial market.

The analysis of Bitcoin in this study can be further extended into other cryptocurrencies in future studies. Such studies will provide a pathway to understand whether this research on Bitcoin, as a future of investment or mode of transaction, applies to other digital currencies as well.

Ch:3- Bitcoin as a mode of transaction

The remarkable transition of fiat money traces back to cash and has paved the way for the electronic forms we use today. Individuals have the flexibility to transact through traditional paper money, cheque, debit/credit cards, or various mobile applications. People have multiple options to choose from when it comes to their mode of payment for a good or service. Before jumping into Bitcoin, it is important to discuss the rise of other forms of payments. As per the Survey of Consumer Payment Choice (SCPC), during 2016 and 2017, cash payments made up only 27.4% of transactions in the U.S. (Greene 2018). According to the survey, a significant portion of payments took place via credit and debit cards. The convenience of card payments has helped encouraged users to use cards instead of carrying tangible money, and thus contributed to 55% of transactions in the U.S. (Greene 2018). Despite their convenience, cards were not always a popular choice for consumers. However, an increased trust in the security of card purchases contributed to their popularity as a mode of payment (Kim et al. 2009).

Security can be described as the set of mechanisms used to authenticate the source of information, allowing transactions to be completed (Kim et al. 2009). Kim (et al. 2009) believe in the notion that superior security improves trust within the buyer, leading to an increased use of the electronic payment. The authors further add that since users do not understand the technical side of the security, they evaluate it based on the user interface. Therefore, it is necessary to enhance the customer experience of security in order to gain their trust and further boost the use of e-payments.

In addition to security, the mode of payment should be widely accepted by the government so they can regulate the flow of money. Government control is necessary to avoid money laundering and illicit trading activities. Therefore, to function as an established mode of payment, it is not only necessary to establish trust with vendors and customers, but also the government itself (Mandjee 2015). This research studies the case of U.S. government. Bitcoin therefore faces two main issues when considering its functionality as a mode of transaction: it must gain the trust of customers and vendors with its security, and attain the trust of the government in accordance with legal regulations.

Security in Bitcoin

Security in Bitcoin is significantly different from that of other forms of transactions. It uses the technology of Blockchain, which was introduced in the second chapter. The technology of Blockchain helps to differentiate cryptocurrencies from traditional e-payment methods and provides a Unique Selling Point (*USP*). The distribution of transactions on the public ledger i.e. different computers using the network all around the world, makes it impossible for hackers to tamper with it. Thus, Blockchain is considered Bitcoin's biggest asset. The technology is said to be the future as it can be used in a variety of ways, and be applied to a diverse range of industries.

In November 2017, Microsoft executive Marley Gray went on the record to say that, "In Blockchain, the security and the integrity of the transactions, is rock solid" (Coram 2017). Benjamin Dykin, a cybersecurity attorney, based in New York further mentioned that,

"Blockchain is a system that can eliminate the need for trust in transactions" (Newgenapps 2018). Many other experts have gone on record showing their appreciation of this platform, as Blockchain helps to eliminate the third-party need. Blockchain is still considered to be in its early days. Each day, new Blockchain applications are found in different industries. Currently, Blockchain does not face any security issues in itself. Bitcoin is thus attractive because it was the first technology to use Blockchain which further helped the currency gain trust from its users. However, there are other security issues related to Bitcoin, which are making Bitcoin investors back out. Bitcoin faces the challenge of security with its private keys as well as at exchanges i.e. the place where individuals trade Bitcoin, which makes the value of Bitcoin volatile.

Blockchain's flawless security is not immune to hackers, as they can still gain access to the private key. As per chapter two, the pair of a public and a private key is necessary to complete a transaction. While the public key is available on the Blockchain for the sender to find the receiver, the private key as the name suggests, is a piece of sensitive information, only known to the owner of the cryptocurrency. These private keys act as a digital signature to authorize the transaction. Private keys make transactions irreversible, avoiding the problem of double spending. In short, the public key can be described as an email address and private key as the password. The Bitcoin saved in the wallet will be assigned a 256 character long alphanumeric code as a cryptographic function (Lane 2013). An example of a normal private key is shown below-

"*5Kb8kLf9zgWQnogidDA76MzPL6TsZZY36hWXMssSzNydYXYB9KF*"

The risk in the security of Bitcoin occurs when the private keys are not kept secret. Private keys exist in an alpha-numeric format. If the private key is revealed to a hacker, they can gain control of the currency, just like in the case of a person's hacked e-mail account. The user needs to protect their private key in order to avoid hackers. The public and private key exist in the form of coordinates, so that the user can send and receive Bitcoin by using them in a pair.

Private keys can be stored in three forms (Antonopolous 2014). Individuals can either store them within hardware, away from any online network. Such hardware exists in the form of USB and can be used when connected, to confirm a transaction. The second method, which is more traditional, requires the user to write the information on a piece of paper and refer to it when required. Finally, the most common technique used by consumers uses the web and mobile wallets to store private keys .

In these wallets, private keys are stored on the servers of the third-party i.e. the digital currency exchanges. Since the private keys cannot be retrieved once they are lost on hardware and paper, web wallets are preferred. In other words, these wallets prevent the loss of information. An excellent example of this can be found in the case of QuadrigaCX, a Bitcoin exchange in Canada. QuadreigaCX lost 190 million dollars because CEO Gerald Cotton stored private keys offline, on hardware, and had sole control over it. His sudden death resulted in the loss of the whole fund (Rushe 2019).

Therefore, the storage of private keys on servers are preferred by users. However, along with the convenience, web/mobile wallets bring in the issue of hacking. When private keys are available on severs, such servers are vulnerable to cyber-attacks. The history of Bitcoin points to several major events, during which the lapse of security lead to a decline in the price of Bitcoin. In contrast, Blockchain's security was not affected in any of these cases. Drawing upon the security aspect, in the past, Bitcoin has faced major exchange hacks. A cryptocurrency exchange is a business that lets individuals trade cryptocurrencies like Bitcoin in real time for other forms of payment (Li 2017). Just like trading on the stock exchange, a cryptocurrency exchange lets individuals buy and sell the digital currency they offer. The traded cryptocurrencies, in this case Bitcoin, are held in the cryptocurrency wallet. The wallet holds the public and private key, which are required for any Bitcoin transactions. Most of these security mishaps took place in the cryptocurrency exchanges, as a large number of private keys were made available to the hackers through the database of the exchanges. The reason behind these incidents lies within the lack of security standards required by a cryptocurrency exchange (Russolillo 2018). Bitcoin exchanges lack the security to combat intense cyber-attacks by hackers. Stock exchanges have laid down rules to make the market more secure, which is not mandated in the case of cryptocurrency. Many exchanges without restriction tend to not invest heavily in security and eventually end up facing a breach. As of January 2019, the Wall Street Journal reported that 1.7 billion dollars had been publicly reported stolen over the years from exchanges (Vigna 2019). The major breaches have been reported at Mt. Gox and Bitfinex. The details of the hacks over the years at exchanges is shown below (Khatwani 2018) -

Table 3.1[1]

Exchange	Date	Number of Bitcoin	Percentage Decrease in Bitcoin Price (one week)
Mt. Gox	Jun 2011	2,609	50.50%
Mt. Gox	Feb 2014	350,000,000	38.30%
Poloniex	March 2014	Unknown	24.13%
Bitstamp	Jan 2015	5,000,000	32.31%
Bitfinex	August 2016	120,000	12.67%

Major Security Breaches of Bitcoin

The involvement of intermediaries (cryptocurrency exchanges) in the decentralized design model has rendered the system vulnerable. In the past, major security breaches have impacted the Bitcoin price, by decreasing the returns by 31.38% on average. On one hand, exchanges increase market value by allowing buying, selling and exchanging cryptocurrencies. However, their existence leads to gaps in the security of cryptocurrency, which is what made it attractive in the first place. In chapter four, we will analyze the effects of security breaches on the Bitcoin return in the past.

Regulations in Bitcoin

Along with security, Bitcoin also needs approval from the government to be viewed as a mode of transaction (Mandjee 2015). Bitcoin can only be considered a global currency

[1] *Refer Appendix B*

once it gains acceptance within both the virtual and the physical world. The acceptance of PayPal and other forms of electronic transactions were more straightforward for one reason: the government still had control over the currency and could regulate it. Since Bitcoin is decentralized, it cannot be governed by a central authority as easily as services like PayPal can. While many experts consider this characteristic as revolutionary and futuristic, others argue that a lack of government control will lead to risks that will increase Bitcoin's difficulty in gaining the title of an official mode of transaction (Brito 2016). The use of Bitcoin thus clearly has significant potential in this evolving world. However, it is necessary to diminish the criminality it brings. In the past, Bitcoin's lack of regulations has led to its use for money laundering as well as payments over the Darknet (Lane 2013). Bitcoin has provided assistance to criminals as it aids in the anonymous execution of transactions. The unique selling point of decentralization in the form of Blockchain has provided success to Bitcoin, but has also resulted in its usage as a mode of payment for illegal activities.

Darknet, also known as the Silk Road, was an online black market to sell illegal drugs (Saito 2015). Users could anonymously visit the website without being tracked to buy the drugs they wanted. Silk Road was founded in 2011, just two years after the invention of Bitcoin (Jane 2013). Bitcoin assisted in this process perfectly as the buyer and seller could complete the transaction, without the risk of revealing their identity. Apart from drugs, the website provided a platform to gun runners and document forgers (Saito 2015). The anonymity in the market for illegal trading was impossible with any other form of transaction. Credit cards, debit cards, and even PayPal could be traced to both buyer and

seller. To maintain anonymity, Bitcoin was an ideal mode of payment from both parties. When an FBI undercover operation in 2013 finally led to the owner of the Silk Road, the site was immediately taken down. 144,000 Bitcoins were seized from the owner, valuing around 28.5 million dollars (Greenberg 2015). The incident itself highlighted how the advantages of Bitcoin were being misused in the market. Additionally, Reuters reported that around 1.2 billion dollars had been laundered through the use of cryptocurrency by July 2018 (Dreyfuss 2018). For Bitcoin to be recognized as an official currency by the governments, it must avoid similar issues.

The need for regulations in Bitcoin has been a big debate over the last decade. On one hand, we can see a clear need for intervention from governments to avoid markets like the Silk Road, on the other hand, overregulation of Bitcoin can easily prevent the growth of the cryptocurrency sector. Users are attracted to Bitcoin over other digital transfer services because it does not require a third party to facilitate the exchange. Brito (2016) mentions that it is necessary for regulators to develop a system that restricts the usage of Bitcoin for illegal activities while maintaining its benefits for legitimate users. Legitimate users refer to Bitcoin users who utilize the service not to get around the system, but as an alternative daily mode of transaction. If the regulatory system turns out to be aggressive, it can discourage the current legitimate Bitcoin users.

The U.S. (as well as global) financial laws before the introduction of Bitcoin did not foresee a technology like Blockchain. The introduction of new technology is always met with ambiguity, in an increasingly advanced world. Brito (2016) gives a perfect example of

VoIP, Voice over Internet Protocol, delivery of communication service over the internet. Initially, when VoIP was introduced, regulators only had control over the traditional telephone network. Regulators eventually came up with a modified set of rules for VoIP in a way that it did not infringe on the progress of the industry, and a stagnant market became competitive. The introduction of VoIP lead to advancements in the communication sector while simultaneously lowering the cost (Brito 2016). Bitcoin requires a similar approach to produce advancement in the financial field.

History of U.S. Regulation of Bitcoin

Studying the case of U.S., the development of regulatory problems in the cryptocurrency industry existed due to one ambiguity: will Bitcoin be considered as legal currency? U.S. regulation state that anything can be considered currency if it is designated as legal tender (Network 2013). Department of the Treasury, Financial Crimes Enforcement Network (FinCEN) stated that cryptocurrency is not declared as a legal tender in any jurisdiction as it not sanctioned by law (Network 2013). Therefore, ineligibility of Bitcoin to be considered legal tender makes the existing regulations of money inapplicable to Bitcoin. Going back to the early days of Bitcoin, FinCEN issued guidance on 18 March 2013, for the applicability of existing regulations on people administering, exchanging and using virtual currency (Network 2013).

The Bank Secrecy Act (BSA) mandates that ‘financial institutions’ must collect and retain information about their customers and share that information with FinCEN (Network

2013). The guidance clarified the application of the Bank Secrecy Act "to persons creating, obtaining, distributing, exchanging and accepting cryptocurrency" (Network 2013). The regulation under section C of the letter stated that "A person that creates units of this convertible virtual currency and uses it to purchase real or virtual goods and services is a user of the convertible virtual currency and not subject to regulation as a money transmitter." (Network 2013) It further stated that, "By contrast, a person that creates units of convertible virtual currency and sells those units to another person for real currency or its equivalent is engaged in transmission to another location and is a money transmitter" (Network 2013). Money Services Business (MSB) is referred to firms that convert or transmit money. The statement issued in the FinCEN letter implied that those who transmit money are the ones who are going to be regulated. A money transmitter as per the Bank Secrecy Act has to register with the federal government, collect information about their customers, and take steps to combat money laundering and the financing of terrorism by their customers. Therefore, virtual currency businesses are not just for Bitcoin, but others such as Ethereum and Ripple were part of the money transmitter sub-group.

While analyzing and breaking down the applications of the letter, Valkenburgh (2017) clearly defined the loopholes in the early stages of regulation. The three main actors mentioned in the letter of FinCEN were defined as administrators, exchangers, or users. The letter primarily mentions administrators for centralized virtual currencies, who become irrelevant in the case of Bitcoin since it is decentralized and controlled through Blockchain. Consequently, the pertinent sub-groups in the case of Bitcoin were divided into exchangers and users. Exchangers refer to those who buy, sell (for other currency), or transmit

Bitcoins. These include brokers and people working in businesses offering money transmission. Such individuals and companies must comply with the BSA and collect all of the relevant information. Users, on the other hand, do not fall into this criterion because they are considered in the guidelines as individuals who buy the virtual currency and use it for obtaining some product or service. However, the letter failed to address those who buy virtual currency like Bitcoin to invest, or to gift others, as well as for other non-exchange related business purposes (Valkenburgh 2017). These loopholes provided the very first examples of the issues accompanying the regulation of a new currency on the market. Such individuals are not considered in the letter and therefore, were unclear about what their obligations were.

In 2014, FinCEN issued rulings to clarify their administrative guidelines (Hindi 2014). In the newly issued statement, it was made clear that investing in virtual currencies like Bitcoin to advance one's own self-interest does not make them liable to comply with FinCEN regulations. Investors acting in the form of third-party intermediaries like Cryptocurrency exchanges were only liable to report as per the BSA. Along with this, their statement revealed that the distribution of software by the developers don't constitute money transmission and hence, don't comply with BSA obligations. Additionally, miners also constituted those whose legal obligations were unclear. As per the guidelines, it was stated that even though the miners function as intermediaries, they verify the transactions on the Blockchain, however, they do not receive the currency value, as it is distributed throughout the network. Therefore, miners were not responsible for complying with these regulations (Hindi 2014).

In the same year, the Internal Revenue Service (IRS) issued a letter providing guidance for general tax laws on virtual currencies (Aqui 2014). Notice 2014-21 (Aqui 2014) stated that the IRS would treat Bitcoin as property, rather than currency. This was done in reference to the Treasury's letter mentioned above, it could not be treated as a real currency because it wasn't considered a legal tender. The fact that it is a capital or a non-capital asset depends on the activities that Bitcoin is being used for. Simultaneously, the Commodity Futures Trading Commission (CFTC) issued a statement declaring Bitcoin and other virtual currencies as commodities under the Commodity Exchange Act (CEA) (Rizzo 2015). CEA defines commodity as "all services, rights, and interests in which contracts for future delivery are presently or in the future dealt in" (Rizzo 2015). All fraud and manipulation of Bitcoins would thus directly fall under its jurisdiction.

Moreover, the regulations became more complicated due to inconsistencies in the laws by state. For example, in Arizona, transactions and electronic signatures were legally validated in 2017, while the State of Kentucky provides no guidance for its residents (Resse 2018). Fourteen U.S. states have no opinion about virtual currency and have not issued any form of guidance.

The lack of uniformity in regulations renders Bitcoin's future very uncertain. While most individuals are left confused about regulations, others feel that this action is hindering the growth of the decentralized currency. Imagine the U.S. state government having no

opinions about stock market in some of the states. This scenario would not only leave clients concerned, but also make the service extremely unattractive. It is true that the past incidences do call for some regulations when it comes to Bitcoin. Additionally, the government does not want Bitcoin to become a means for the funding of terrorism, money laundering or other kinds of illegal trade. However, the regulations must be created in a consistent way that does not affect the legitimate users of Bitcoin. The regulations by FinCEN, IRS, and CFTC have many undefined characters. Such regulations lead illegitimate users to continue utilizing the currency with its loopholes, while on the other hand, the legitimate users plan to opt out of Bitcoin when considering the uncertainty of its future.

U.S. Central Bank on Cryptocurrencies

In a paper published by St. Louis Review, Berentsen (et al. 2018) argues that there is a significant unmet demand for liquid assets outside the private financial sector. The paper discusses the opportunity for central banks to issue cryptocurrencies in order to compete with the rise of Bitcoin as a way of achieving this demand. However, due to the lack of government control, cryptocurrencies can be used by individuals to protect against corrupt or otherwise undesirable governments (O'Sullivan 2018). The monetary policy is used by the government to control inflation and other aspects of the economy of a country. The existence of cryptocurrencies provide an opportunity to escape dire economic situations.

But, cryptocurrencies occupy a relatively small percentage of the financial market, and are not sufficient to currently impact government policies on a large scale (Bech 2017). The

Federal Reserve governor, Lael Brainard expressed his concerns regarding the vulnerability to hackers and money launderers, eliminating the possibility of U.S. central bank cryptocurrency in the foreseeable future (Silva 2018). Berentsen (et al. 2018) argues that the 'know your customer' (KYC) and 'anti-money laundering' (AML) standards of central banks make it impossible to release their own cryptocurrencies, as decentralized currency carries a lot of reputational risks with it.

Therefore, the a central bank cryptocurrency can be developed in the future to compete with Bitcoin to maintain government control. However, the critical characteristic of decentralized currencies in the form of anonymity raises a red flag for central banks and poses major challenges.

Bitcoin: Mode of Transaction?

Security and Regulations are necessary to establish Bitcoin as the future mode of transaction. As per the security aspect, Blockchain seems to provide a lens into the future. Since it is a public ledger, Blockchain allows Bitcoin to prevent hacking as it would be impossible to attack the whole network to steal Bitcoins. However, Bitcoin remains vulnerable due to the availability of private keys to hackers. This is because hackers can easily transfer Bitcoins to a different account by hacking the server (of the digital currency exchanges) that stores their clients private keys. In the past, this has heavily affected Bitcoin's price and brought up questions regarding the safety of using Bitcoin for daily transactions.

On the other hand, regulations must be placed by the government in such a way that both buyer and seller feel safe while transacting via Bitcoin. At the same time, regulations should not affect legitimate users of the currency. The case of Bitcoin's regulation in U.S. provided a clear example of that. Thus, regulations will have to be formulated in such a way that it will end the misuse of Bitcoin in illegitimate fields. The existing regulations lack uniformity. Much ambiguity exists due to the variation of regulations in different states as well as the fact that many undefined individuals exist in the current guidelines. The cryptocurrency sector therefore requires a National framework of regulations (in U.S. and other countries), which will not vary in different circumstances.

Thus, to conclude, Bitcoin needs to be more secure by increasing the security of the private keys at exchanges through altering some security standards. Additionally, it needs to cultivate well-formulated and uniform regulations to be considered a viable mode of transaction.

Ch-4: Bitcoin as an Investment Opportunity

Bitcoin's price volatility has helped long-term investors realize its significant returns. Bitcoin began trading at $0.06 in 2010, and briefly touched $18,000 in late 2017 (Bloomberg 2019). This change has contributed to an almost 30,000,000% return in eight years. On the downside, since 2017, Bitcoin has decreased in value, and is being traded at less than $4,000 at the end of 2018, showing investors a loss of 70% in only a year. The table below provides an overview of Bitcoin's return compared to returns from other popular assets & stocks throughout the last decade as well as within the most recent year.

Table 4.1
Bitcoin and Other Asset's Volatility and Return

	2010 – 2018 (7/23/10 – 12/28/18)		*2010 – 2017 (7/23/10- 12/29/17)*		*2017 – 2018 (1/5/18 – 12/28/18)*	
	Std. Dev ($)	**Return**	**Std. Dev ($)**	**Return**	**Std. Dev ($)**	**Return**
Bitcoin	2961.04	6,486,800.00%	1956.429	23,851,466.67%	2452.32	-76.77%
S&P 500	501.31	125.43%	420.16	142.47%	105.38	-9.38%
Apple	45.00	329.22%	33.98	376.19%	21.64	-10.93%
Amazon	471.40	1174.04%	276.92	942.62%	189.22	15.08%

Bloomberg L.P. (2019) Stock price data 07/23/10 to 12/31/18. Retrieved from Bloomberg database.

Seeing this price fluctuation through standard deviation, it is fair to say that Bitcoin is not one of the safest modes of investment when compared to other investment opportunities with lower volatility. This table is a signifier of this chapter's attempt to understand the trends of Bitcoin's price and return, by comparing it to other forms of financial assets and related variables.

Bitcoin and Other Related Variables

The growth of Bitcoin has gradually allowed people to conceive it as a promising investment opportunity (Corbet 2018). It is therefore critical to understand how Bitcoin moves in relation to other financial assets in depth. This section investigates how Bitcoin prices are impacted by changes in potential contributing factors, including the S&P 500 index, crude oil price, gold price, U.S. 10-Year Treasury Note, volatility index, and Bloomberg dollar spot index. Additionally, this study analyzes Bitcoin volatility with Google Trends data on the search term 'Bitcoin', which will demonstrate the relationship between social media attention and the demand of investors. Also, the study investigates the effect of security breaches on Bitcoin returns in the past decade.

Scott (2018) refers to Bitcoin as a highly speculative financial investment. Therefore, these economic and social variables are mentioned in order to determine whether Bitcoin is a viable financial investment. The S&P 500 index (as a standard for stock market), gold prices and U.S. 10-Year Treasury (as a standard for fixed-income returns) act as substitutes assets to Bitcoin for investors. Additionally, volatility index, oil prices and Bloomberg

dollar spot index (as a standard for U.S. dollar performance) represents the change in the overall economy and illustrates its impact on Bitcoin. Google Trends and Security Breach variables represent the additional factors related to Bitcoin prices and, further helps to study Bitcoin's trend. As mentioned earlier, Google Trends data will help demonstrate the relationship between Bitcoin price and people's interest in the asset, while the security breach variable is created to study the impact of security flaws on the Bitcoin prices and the investors demand. These variables, if found related to Bitcoin, can further help to explain Bitcoin's high volatility.

In the past, similar papers have been written to analyze the investment assets. Corbet (et al. 2018) analyzed the return and volatility transmission of three cryptocurrencies and the financial assets like GSCI Total Return Index, VIX and COMEX closing Gold Price. Corbet (et al. 2018) suggested that Bitcoin is highly connected to other cryptocurrencies and is disconnected from the mainstream assets. In another study, Dyhrberg (2016) suggested that Bitcoin can be used to hedge against stocks and American dollar in the short term. Gold showcases similar abilities, and Dyhrberg highlighted this aspect in her study. Bouri (et al. 2017) suggested that Bitcoin is suitable for diversification purposes only, when examined, conditional correlation with the stock indices, bonds, oil, and gold (based on Bitcoin data until 2015). Matta (et al. 2015) conducted study of Bitcoin prices and social interest through positive tweets, finding significant cross-relation. This paper attempts to expand Matta's 60-day study to a longer time period.

Data Sources and Variables:

The data begins in July 23, 2010 and runs through December 28, 2018. The data for financial assets are weekly, and are collected from Bloomberg Professional. Google Trends data has been retrieved from the Google Trends website and is present monthly (Google Trends). Security Breach variable is created, highlighting the 3-month phase within a security breach of a Bitcoin exchange mentioned earlier. Table 4.2 highlights the name of variables, its Bloomberg symbol, a brief explanation of the variable, and a variable symbol used in the subsequent model estimations.

'Continued on next page'

Table 4.2

Name	Bloomberg Symbol	Financial Asset	Variable
Bitcoin	*XBTUSD Curncy*	Price of Bitcoin	*BC*
S&P 500	*SPX Index*	S&P 500 index as a standard for stock market performance	*SP500*
Brent Crude Oil	*CO1 Comdty*	Price of Oil in USD/Barrel	*OIL*
Gold	*XAU Curncy*	Price of Gold in USD/Ounce	*GOLD*
U.S. 10 Generic Govt 10 Year Yield	*USGG10YR Index*	Index of US 10-year interest rate	*UST10*
Volatility Index	*VIX Index*	Measure of Stock Market Volatility	*VIX*
Bloomberg Dollar Spot Index	*BBDXY Index*	Index measuring USD performance in comparison to other foreign currency	*FX*
Bitcoin Return	----------	Weekly return as per Bitcoin raw Data	*BCR*
S&P 500 Return	----------	Weekly return of S&P 500	*SP500R*
Google Trends	----------	Data on the search term of 'Bitcoin' all over the world	*GT*
Bitcoin Volatility	----------	Six month average Standard Deviation of Bitcoin prices	*BV*
Security Breach	----------	Dichotomous variable[2],	*SB*
Bitcoin Monthly Return	----------	Monthly return as per Bitcoin raw Data	*BCMR*

[2] $SB = \begin{cases} 1 \; if \; security \; breach \; occured \; at \; a \; Bitcoin \; exchange \; within \; last \; three \; months \\ 0 \; otherwise \end{cases}$

Note: This paper will refer to the assets and their variable name during this section.

Methodology:

In this section, multivariate regression analysis is used to test the nature of the relationship between various aspects of Bitcoin and other variables. The regression analysis is a simple tool that evaluates the relationship between two or more variables based on the time-series data.

$$\boldsymbol{BC} = \boldsymbol{f}\,(\boldsymbol{SP500},\ \boldsymbol{OIL},\ \boldsymbol{GOLD},\ \boldsymbol{UST10},\ \boldsymbol{VIX},\ \boldsymbol{FX},\ \boldsymbol{GT},\ \boldsymbol{SB})$$

This mathematical model will help evaluate whether there is any significant linear relationship between data variables (independent variables) mentioned in the table above with the price of Bitcoin (dependent variable). The *F*-Test is used to demonstrate the significance of the model and, R^2 measures the strength of the model and dependent variable. The p-value of individual coefficient is used to study statistical relations that exist between the extant variable and Bitcoin.

This section breaks down the data variables into four broad models to study the relationship between Bitcoin and other variables, and determine its potential as an investment opportunity. Therefore, the research contributes to the study of Bitcoin in four different ways. Firstly, it estimates empirical relations to understand whether the fluctuation in the price of Bitcoin is related to the price of financial assets like stocks, commodities and the

value of the US dollar. Secondly, it analyzes Bitcoin's weekly returns[3] with the comparable return of the S&P 500 Index and prices of other financial assets. The multivariate regression helps analyze whether other financial assets have any effect on its price or return. Thirdly, Bitcoin volatility (standard deviation) is examined as a function of people's interest, calculated through Google Trends. Lastly, this section studies the impact of major security breaches on Bitcoin monthly returns. If security breach variable is found relevant to Bitcoin, another test, similar to test 1 is conducted with security breach variable included with other financial assets in the model. All empirical analysis will be performed using Microsoft Excel.

As per the previous studies, Bitcoin's relation with other assets is weak, as it makes Bitcoin investment a diversifier (Corbet 2018). Nevertheless, the study postulates that Bitcoin and Stock Market will have a positive relation, because with the increase in buying power, investors will tend to diversify their portfolio between the substitutes and put money into both these assets. However, with regard to oil, this study believes Bitcoin will have a negative relation due to the increase in energy price (related to Bitcoin mining) with the increase in oil prices. Based on Dyhrberg's (2016) study, this paper further expects Bitcoin to have similar financial features as gold, and hence showing a positive relation. The increased volatility in stocks showcased through the VIX index indicates increased risk in stock market, and will lead investors to incline towards Bitcoin, showing a positive

[3] The (weekly) return on asset *i*, is defined as:
$RET_t = (P_t - P_{t-1})/P_{t-1}$

relation. With regards to the U.S. dollar performance, this study predicts Bitcoin will have a negative relation as both these assets contribute in the off-shore transaction and weak dollar value would encourage the use of Bitcoin for this purpose. Matta (et al. 2015) research further indicates a close relation of Bitcoin and people's interest.

Data Analysis

Test 1: Bitcoin Price as a function of price of other financial assets

Bitcoin price is considered as a function of the six financial assets we took into consideration.

Therefore,

$$\boldsymbol{BC_t = \beta_0 + \beta_1 SP500_t + \beta_2 OIL_t + \beta_3 GOLD_t + \beta_4 UST10_t + \beta_5 VIX_t + \beta_6 FX_t + \varepsilon_t}$$

Multiple linear regression is conducted to predict Bitcoin Price based on price of SP 500 index, Oil, Gold, US 10-year treasury, Volatility Index and Bloomberg dollar spot.

Number of terms (K) = 6

To test the overall significance of the regression equation, the *F*-Test is conducted.

As the null hypothesis, the study postulates that none of the variables of test-1, i.e., the price of SP 500 index, Oil, Gold, US 10 year treasury, Volatility Index and Bloomberg dollar spot, will be significant predictors of Bitcoin price.

$$=> H_0: \beta_1 = \beta_2 = \beta_3 = \beta_4 = \beta_5 = \beta_6 = 0$$

The alternative hypothesis claims that at least one of the variables affect the price of Bitcoin.

$$=> H_A: H_0 \; is \; not \; true$$

Test 2: Bitcoin Returns as function of S&P 500 returns and price of other financial assets.

Similarly, in this test, the study considers the return on Bitcoin as a function of return of the S&P 500 and the price of other financial assets. Therefore,

$$\boldsymbol{BCR_t} = \boldsymbol{\beta_0} + \boldsymbol{\beta_1 SP500R_t} + \boldsymbol{\beta_2 OIL_t} + \boldsymbol{\beta_3 GOLD_t} + \boldsymbol{\beta_4 UST10_t} + \boldsymbol{\beta_5 VIX_t} + \boldsymbol{\beta_6 FX_t} + \boldsymbol{\varepsilon_t}$$

$$=> H_0: \beta_1 = \beta_2 = \beta_3 = \beta_4 = \beta_5 = \beta_6 = 0$$

$$=> H_A: H_0 \; is \; not \; true$$

Test 3: Bitcoin Volatility as a function of people's interest in Bitcoin, measured through Google Trends.

Google Trends data is present as monthly values relative to its all-time month end high, which was in December 2017. Therefore, Google Trends data values ranges between 0 to 100, 100 referring to its all-time high in December 2017. The dataset of Google Trends is available monthly from 2013 onwards.

In this test, a similar bi-variate analysis is conducted on *GT* monthly datasets with Bitcoin monthly volatility. The study considers the Bitcoin Volatility as a function of Google Trends data on search term 'Bitcoin'.

$$\boldsymbol{BV_t = \beta_0 + \beta_1 GT_t + \varepsilon_t}$$

$$=> H_0: \beta_1 = 0$$

$$=> H_A: H_0 \; is \; not \; true$$

Test 4: Impact on Bitcoin Monthly Return with Major Security Breaches.

The study tries to understand the overall effect of the major security breaches (discussed in ch-3) by conducting another bi-variate analysis on the Bitcoin monthly return dataset. The study considers the Bitcoin monthly returns as a function of the security breach variable *SB.* Therefore,

$$\boldsymbol{BCMR_t = \beta_0 + \beta_1 SB_t + \varepsilon_t}$$

$$=> H_0: \beta_1 = 0$$

$$=> H_A: H_0 \; is \; not \; true$$

Test 5: Bitcoin Price as a function of price of other financial assets while taking security breaches into consideration.

The study in this test considers Bitcoin price as a function of the price of six financial assets and the Security Breach variable. Therefore,

$$\boldsymbol{BC_t = \beta_0 + \beta_1 SP500_t + \beta_2 OIL_t + \beta_3 GOLD_t + \beta_4 UST10_t + \beta_5 VIX_t + \beta_6 FX_t + \beta_7 SB_t + \varepsilon_t}$$

$$=> H_0: \beta_1 = \beta_2 = \beta_3 = \beta_4 = \beta_5 = \beta_6 = \beta_7 = 0$$

$$=> H_A: H_0 \; is \; not \; true$$

This test investigates whether considering security breaches will make the fitted model a more appropriate for the Bitcoin prices.

Empirical Result:

Table 4.3
Test-1, Test-2 and Test-3

Variable	Bitcoin price *(BC)*	Bitcoin Return *(BCR)*	Bitcoin Volatility *(BV)*
Intercept	916.038 (3757.722)	-0.216 (0.117)	38.249 (67.726)
S&P 500 *(SP500)*	7.575*** (0.323)		
Brent Crude Oil *(OIL)*	-46.148*** (7.835)	-0.000067302 (0.001)	
Gold *(GOLD)*	6.172*** (0.811)	0.00016199* (8.9443E-05)	
10 Year Bond *(UST10)*	1297.775*** (222.249)	0.051** (0.023)	
Volatility Index *(VIX)*	56.098*** (15.761)	-0.006** (0.022)	
Bloomberg Dollar Spot *(FX)*	-20.515*** (2.760)	1.035 (0.662)	
SP 500 return *(SP500R)*		-0.107 (0.479)	
Google Trends *(GT)*			59.137*** (3.891)
Observation	440	439	72
R^2	0.732	0.043	0.767
Adjusted R^2	0.728	0.030	0.764
F	197.254***	3.246***	231.031***

Note: Standard errors in parentheses
*p<0.1; **p<0.05; ***p<0.01

Table 4.4

Test-4 and Test-5

Variable	Bitcoin Monthly Return *(BCMR)*	Bitcoin price (BC)
Intercept	0.296 (0.071)	11762.515 (3291.535)
S&P 500 *(SP500)*		7.801*** (0.286)
Brent Crude Oil *(OIL)*		-59.396*** (6.546)
Gold *(GOLD)*		5.288*** (0.680)
10 Year Bond *(UST10)*		773.082*** (156.693)
Volatility Index *(VIX)*		24.045*** (5.048)
Bloomberg Dollar Spot *(FX)*		-26.929*** (2.509)
Security Breach Variable (SB)	-0.441*** (0.163)	-1050.86*** (183.284)
Observation	100	440
R^2	0.070	0.741
Adjusted R^2	0.060	0.737
F	7.338***	177.728***

Note: Standard errors in parentheses
*p<0.1; **p<0.05; ***p<0.01

Result 1

A significant regression equation for Bitcoin price was found ($F(6, 433) = 197.254$, $p < 0.01$), with R^2 of 0.732. As the *F*-Test is significant at 1% level, the study rejects the null hypothesis and concludes that at least one of the explanatory variables is significantly correlated to Bitcoin Price in Test-1. R^2 value indicates the model fits the data. The fitted model estimates that Bitcoin price (*BC*) is equal to:

916.038 – 20.515 (FX) + 56.098 (VIX) + 1297.775 (UST10) + 6.172 (GOLD) – 46.148 (OIL) + 7.575 (SP500).

Thus, when other variables are kept constant, Bitcoin price on average[4]:

- decreased by 20.515 US dollars for each one unit increase in *FX*,
- increased by 56.098 USD for each one point increase in the *VIX*,
- increased 1297.775 USD for each percentage point increase in the *UST10*,
- increased 6.172 USD for each dollar increase in *GOLD*,
- decreased 46.148 USD for each dollar increase in *OIL*,
- increased 7.575 USD for each unit increase in the *SP500*.

Bloomberg Dollar Spot, Volatility Index, US Treasury interest rate, Gold price, Oil prices and S&P 500 index were statistically significant for Bitcoin prices at a 1% level,

[4] Note: Results with standardized coefficients for Test-1 are reported in Appendix E

highlighting that the movement in other financial assets have a relationship with the Bitcoin price.

FX negative relation highlights drop in the use of Bitcoin, for reasons including cross-border transaction, as U.S. Dollar becomes stronger and will be preferred. VIX positive relation is emphasizing on the increase of Bitcoin prices with the increase in the volatility of stock market, mainly due to investor's concern regarding stocks. *SP500* and the two fixed income capital's (*UST10* and *GOLD*) positive relation exist due to their existence as potential investments along with *BC* for investors with increased buying power. Lastly, *OIL* negative relation with *BC* exist due to increased Bitcoin mining cost with increase in the price of electricity.

With regard to Appendix C, Test-1 was conducted again on two different time periods. The findings revealed similar results for Bitcoin prices when compared to other financial assets. The first test consisted of data points of variables from July 2010 to December 2016, while the second test was conducted on the dataset of variables in January 2017 and December 2018. The *F*-Test is significant at 1% level in both cases, confirming that at least one of the explanatory variables is significantly correlated to Bitcoin Price and the fitted model is a good estimate for Bitcoin price (*BC*). With the rise in Bitcoin volatility in the second time period, the statistical significance of various variables was found to be inconsistent. However, in both the time periods, *SP500* was found to be statistically significant at 1% level, highlighting their correlation in price movement.

Result 2

The regression equation for Bitcoin return was found ($F(6, 433) = 3.246$, $p < 0.01$), with R^2 of 0.043. As the *F*-Test is significant at 1% level, the study rejects the null hypothesis and concludes that at least one of the explanatory variables is significantly correlated to Bitcoin returns. However, with such a low R^2, the fitted model was found to be statically insignificant to estimate the value of Bitcoin return. The current explanatory variables of the model do not explain the change in Bitcoin return in the data.

The significance of variables was inconsistent in this case. While Gold was statistically at 10% level, U.S.-10 year Treasury and Volatility Index were proved significant for Bitcoin returns at a 5% level. Rest of the variables were statistically insignificant to Bitcoin returns[5]. The result suggests that other factors, which are not considered during this research, result in the fluctuation of Bitcoin returns. Other possibilities include Bitcoin returns to be internally driven, directly by buyers and sellers.

Result 3

The regression equation for Bitcoin Volatility was found ($F(1, 70) = 231.030$, $p < 0.01$), with R^2 of 0.767. As the *F*-Test is significant, the study rejects the null hypothesis and concludes that that Google Trend is significantly correlated to Bitcoin Volatility. R^2 value indicates the model fits the data. The estimates that Bitcoin Volatility is equal to:

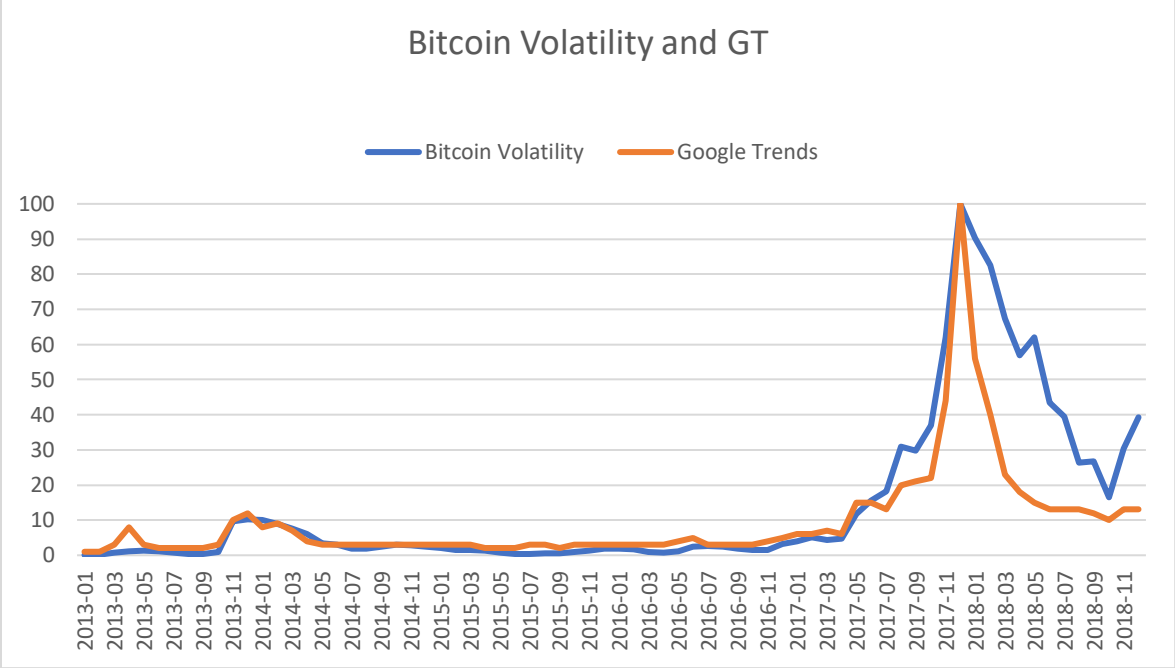
[5] Another similar regression to test-2, where each explanatory variable's (weekly) percentage change was used instead of their levels. Results are in Appendix G; each of the coefficients were found to be statistically insignificant in this case with Bitcoin Returns.

=> 38.249 – 59.137 (*GT*).

Google Trend was significant predictor at 1% level for Bitcoin Volatility. Thus, if google trends increase by one unit, the value of Bitcoin prices deviates by $59.137. This suggest that increase in google trends can lead to deviations (increase or decrease) in the Bitcoin prices. Additionally, when Bitcoin Volatility was also converted in relative maximum value, the study found a very close graphic relation.

Graph 4.1

Bitcoin Volatility (in relative maximum) and Google trends Data on 'Bitcoin'



The result showcases that the social interest of Bitcoin on internet has a correlation with changing price of Bitcoin.

Result 4

The regression equation for Bitcoin Monthly Returns was found ($F(1, 98) = 7.338$, $p < 0.01$), with R^2 of 0.070. As the *F*-Test is significant, the study rejects the null hypothesis and concludes that that the *SB* variable is correlated to the value of Bitcoin Monthly return. The fitted model estimates that Bitcoin Monthly Return is equal to:

=> 0.296 – 0.441 (*SB)*

With such a low R^2, the fitted model does not provide a good fit to estimate the value of Bitcoin return, needing more explanatory variables.

However, the security breach variable results with a -0.441 coefficient, which is significant at a 1% level[6]. This showcases that the bitcoin returns are highly correlated with the Security Breaches. Security breaches raises concern over Bitcoin's future, leading to a free fall in price due to mass sell off by investors. This leads to a drop of Bitcoin return in the subsequent months.

Result 5

A significant regression equation for Bitcoin price was found ($F(7, 433) = 177.729$, $p < 0.01$), with R^2 of 0.741.

[6] Note: A similar test with *SB* was conducted, where the study considered a permanent effect of the initial security breach on Bitcoin monthly returns. Qualitatively similar results were found and are available in Appendix D.

As the *F*-Test is significant, the study rejects the null hypothesis and concludes that that the at least one of the explanatory variables is significantly correlated to Bitcoin Price. R^2 value indicates the model fits the data. It is predicted that Bitcoin price is equal:

11762.515 – 1050.868(SB) - 26.929 (FX) + 24.045 (VIX) + 773.082 (UST10) + 5.288 (Gold) – 59.396 (Oil) + 7.801 (SP500).

Thus, when other variables are kept constant, Bitcoin price on average:

- decreased by 1050.868 US dollars with a *SB*,
- decreased by 26.929 US dollars for every increase in *FX*,
- increased by 24.045 USD for every increase in the *VIX*,
- increased 773.082 USD for every increase in the *UST10*,
- increased 5.288 USD for each dollar increase in *GOLD*,
- decreased 59.396 USD for each dollar increase in *OIL*,
- increased 7.801 USD for each increase in the *SP500.*

Security Breach Variable, Bloomberg Dollar Spot, Volatility Index, US Treasury interest rate, Gold price, Oil prices and S&P 500 index were significant predictors of Bitcoin prices at a 1% level. The addition of Security Breach variable makes the fitted model more accurate (when compared to test-1) to estimate Bitcoin prices along with the other financial assets.

Relation to Other Researches

The results correspond with previous findings by other scholars. As per the insignificant Bitcoin return's findings from *Test-2*, Corbet (et al. 2018) similarly suggested that financial market conditions are not significant influences of the returns of cryptocurrencies. Furthermore, the results of Bitcoin Prices in *Test-1* with respect to oil holds true as per the study conducted by Bouri (2017). Bouri (2017) considers Bitcoin an effective diversifier with respect to oil to minimize investor's risk, highlighting their negative relationship. Finally, Dyhrberg (2016) found a similar relationship between Bitcoin, gold prices, and foreign exchange as concluded in Test-1. He mentioned that Bitcoin can be added alongside gold (positive relation) to be used to hedge against the US Dollar (negative relation). Overall, the results matched our theoretical relation in all the trials. S&P 500, Gold, US. 10-year Treasury interest rate and Volatility Index have a positive relationship with Bitcoin Price. On the other hand, Oil Prices and Bloomberg Dollar Spot value has a negative association with Bitcoin Prices. The results also match Matta's (et al. 2015) study about significant cross-correlation between Bitcoin and its social interest.

Implications

Analysis of the regression results demonstrates that Bitcoin price and Bitcoin's returns have different outcomes when compared to other variables. Bitcoin price movement can be predicted in relation to varying prices of other assets. In the case of prices, the results proved to be relative as the values are compared to the previous week's data and the price

change does not have as significant an impact as the direction of growth. Therefore, Bitcoin indicate relation for price movement.

However, this is not the case with Bitcoin returns. This dissimilarity is due to the fact that returns are independent values, where each value has equal importance and consists of a lot of noise. The noise was a result of the high volatility of Bitcoin (as showcased earlier through its high standard deviation) compared to other assets (*SP500, Oil, Gold, UST10, VIX and FX*), and resulted in this insignificant consequence of Bitcoin returns in Test 2. The difference in these two results indicated for possible serial correlation in the price equation (Test 1). Returns, by their nature, tend not to exhibit serial correlation. Therefore, another regression test was performed, similar to Test 1, with a Bitcoin lag variable, taking Bitcoin's previous week price into consideration. The main motive for adding a lag in the price equation was to correct any potential serial correlation. The new equation with an additional lag variable provided similar results to Test 2[7]. Therefore, it indicated that it is difficult to precisely calculate Bitcoin's movement based on another asset's performance, thus making long term investments in Bitcoin risky and unpredictable.

On the other hand, Test-3's significance demonstrates a strong relationship between the Google Trends data and the volatility of Bitcoin. Google Trends data showcases the popularity of the search term 'Bitcoin'. However, further research indicated that it acts as

[7] Refer Appendix H

an endogenous variable, where it demonstrated that the rise in Bitcoin volatility can also be a factor to increased interest in individuals about Bitcoin, which further increase the frequency of search term Bitcoin, suggesting a cycle of events. The significance of this result remains ambiguous because is not clear whether the increased volatility leads to increased interest, or if increased interest leads to increased volatility, or whether a third factor that is directly linked to the other two. For example, the Mt. Gox hack made the price highly volatile and the event also lead to increased interest of people. Therefore, a third factor could also be responsible for this relation. Nevertheless, Bitcoin's volatility data yields a strong relationship with Google Trends data for the search term Bitcoin.

Additionally, security breaches showed significant results in relation to Bitcoin returns. The Bitcoin monthly returns face a drop by almost cutting down the returns to half its value. The results seem to match real world events as a major security breach leads to a free fall in Bitcoin prices due to the uncertainty of Bitcoin's future in the mind of investors. Security Breach variable, when additionally analyzed with other financial assets provided similar results like Test-1 with a better fit. All seven variables were considered a significant predictor and showed relativeness to Bitcoin price movement.

Overall, the study found the google trends data to be highly correlated with major deviation of Bitcoin prices over the years. But, the ambiguity of endogenous variable make the results less conclusive. Also, random security breaches were found to play a role in the decreased Bitcoin returns. Additionally, the Bitcoin price equation was subject to potential serial correlation due to existing differences in results when compared to the price equation with

Bitcoin price lag variable. The insignificance of the test 2 results further highlights the unpredictability of returns in Bitcoin, since its only source of return is through an increase in its price, which is highly uncertain.

Ch-5: Conclusion

This study investigated Bitcoin's capacity to function as both a viable mode of transaction and a potential investment within the financial market. When analyzing the background and history of money, it became very apparent that electronic forms of currency are replacing traditional paper money. Technological evolution in the realm of digital currency has thus provided Bitcoin as a new option in the market. Nevertheless, the results show that Bitcoin faces clear challenges as it seeks to rival more traditional forms of money.

Implications

As a mode of transaction, Bitcoin's Blockchain technology has revolutionized security features with its ability to behave like a public ledger. However, Bitcoin exchanges (intermediaries) require standardization in its security guidelines in order to avoid the hacking of private keys. Indeed, security breaches have an enormous impact on the value of Bitcoin. Along with the security guidelines, standard regulations must be introduced to avoid the misuses of digital currency in order to gain government acceptance. Regulations of Bitcoin should be altered without hindering its ability to act as a decentralized medium which is Bitcoin's most attractive feature. For this reason, U.S. Central banks have therefore been resistant to develop their own alternative to Bitcoin, as the anonymity aspect with decentralization of it does not align with their KYC and AML policies. Furthermore, state regulations require uniformity across the country as a fluid national framework for two reasons. Firstly, to facilitate in a smoother understanding for users and secondly to further avoid financial loopholes. The existing guidelines and regulations need to be

altered, in order to stabilize Bitcoin's value, meaning it is further necessary for Bitcoin to be considered a future mode of transaction. Hence, inconsistent regulations and compromised security at intermediaries pose major obstacles for Bitcoin's acceptance as a mode of payment.

Bitcoin demonstrates high volatility as an investment opportunity, highlighting the risk involved with the platform. The model of Bitcoin returns showed no relationship with existing financial assets, indicating Bitcoin's unpredictability as an investment. Bitcoin does not promise to provide a future cash flow, interest and principal/dividends, unlike other popular investment opportunities. Bitcoin's only source of return is through an increase in its price, which is highly uncertain. The regression analysis of Bitcoin returns provided insignificant results, suggesting that there are different explanatory variables, other than what was considered in the research, effecting the returns of Bitcoin.

Google Trends data for the search term 'Bitcoin' additionally proved to be closely related to Bitcoin volatility and can be used to predict its future movement. However, further analysis shows that the Google Trends behave as an endogenous variable, bringing about ambiguity as to whether this is the cause or effect of fluctuation in Bitcoin's price. On the other hand, security breaches were followed by a significant reduction in Bitcoin returns in their subsequent month, capturing investors' concerns over the currency's future. The results correspond with previous studies by other scholars, most notably Corbet et al. (2018) and Matta et al. (2015).

Therefore, Bitcoin is a highly speculative asset. There are variables which have shown a close relationship with Bitcoin in distinct time periods, but the correlation remains inconsistent in its pattern over the past decade. Overall, it is not sufficient to predict the returns of the decentralized currency. These results, coupled with the high levels of volatility over time, clearly characterize Bitcoin as a risky investment. The results suggest that there is a possibility that Bitcoin volatility might be internally driven by the buyers and sellers themselves. Hence, investors can use Bitcoin as a medium to diversify their current assets only if they are willing to take the risk involved with its volatile nature.

Limitations

Overall, most of the data is only relevant to the United States. The function of Bitcoin prices considers other assets which are only pertinent to one country. Stock and commodity indices of other countries have not been considered in the analysis. Additionally, the regression analysis does not consider the order of data. This study has not performed a time-series analysis to order predictors over time.

Future Studies

A similar, but broader study could be conducted to compare the other major cryptocurrencies like Ethereum and Litecoin with the existing financial assets to expand this research. Such a study could further help relate the behavior of such cryptocurrencies with Bitcoin. It would be interesting to see if any of the other cryptocurrencies yield results which oppose the results found in this study. The study can also be further expanded by

performing a time-series analysis of the model. This analysis will help to forecast the future movement of Bitcoin in greater depth.

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Appendices

Appendix A

Table 7.1 Correlation of different Financial Assets

	SP500	*Oil*	*Gold*	*UST10*	*VIX*	*FX*	*SP500R*
SP500	1.000						
Oil	-0.035	1.000					
Gold	-0.589	-0.417	1.000				
UST10	0.141	0.951	-0.598	1.000			
VIX	0.096	0.972	-0.555	0.964	1.000		
FX	0.497	-0.825	-0.051	-0.688	-0.697	1.000	
SP500R	-0.007	-0.123	0.091	-0.131	-0.152	0.074	1.000

Appendix B

Table 7.2 Percentage change after Major Hacks

Exchange	**Date**	**Initial Price of Bitcoin**	**Price of Bitcoin after the Hack**	**Percentage change**
Mt. Gox	Jun 2011	$22.59	$11.18	-50.50%
Mt. Gox	Feb 2014	$846.61	$522.36	-38.30%
Poloniex	March 2014	$630.53	$478.38	-24.13%
Bitstamp	Jan 2015	$294.89	$199.61	-32.31%
Bitfinex	August 2016	$663.11	$579.09	-12.67%

Appendix C

Table 7.3
Test-1 results over two time Periods

Variable	Bitcoin Price 2010 - 2016 *(BC)*	Bitcoin Price 2016-2018 *(BC)*
Intercept	31.163 (468.598)	-70614.583 (33691.518)
S&P 500 *(SP500)*	0.856*** (0.060)	16.134*** (3.495)
Brent Crude Oil *(OIL)*	-0.372 (0.956)	101.386* (53.443)
Gold *(GOLD)*	-0.126 (0.102)	27.918** (9.579)
10 Year Bond *(UST10)*	29.694 (27.718)	-5281.992*** (2022.682)
Volatility Index *(VIX)*	7.412*** (1.956)	58.144 (77.014)
Bloomberg Dollar Spot *(FX)*	-1.151*** (0.348)	4.848 (15.543)
Observation	337	104
R^2	0.685	0.676
Adjusted R^2	0.679	0.656
F	119.432***	33.800***

Note: Standard errors in parentheses
*p<0.1; **p<0.05; ***p<0.01

Appendix D

Table 7.4
Security Breach Variable with Permanent Effect

Variable	**Bitcoin Monthly Return**
Intercept	0.443 (0.099)
Security Breach Variable (SB)	-0.391*** (0.129)
Observation	100
R^2	0.086
Adjusted R^2	0.077
F	9.237***

Note: Standard errors in parentheses
*p<0.1; **p<0.05; ***p<0.01

Appendix E

Table 7.5
Regression results with standardized coefficients

Variable	**Bitcoin percentage change**
Intercept	1.5464E-07 (0.024)
SP 500 (SPX Index)	1.275*** (0.054)
Brent Crude Oil (CO1 Comdty)	-0.431*** (0.072)
Gold (XAU Curncy)	0.382*** (0.050)
10 Year Bond (USGG10YR Index)	0.219*** (0.037)
Volatility Index (VIX Index)	0.105*** (0.031)
Bloomberg Dollar Spot (BBDXY Index)	-0.711*** (0.095)
Observation	440
R^2	0.730
Adjusted R^2	0.726
F	195.938***

Note: Standard errors in parentheses
*p<0.1; **p<0.05; ***p<0.01

(Data was standardized with the formula: $\frac{Price - Average\ Price\ of\ the\ Asset}{Standard\ Deviation\ of\ Asset's\ Price}$)

Appendix F

Table 7.6

Bitcoin Price in USD Statistics

Mean	1537.420612
Standard Error	141.002064
Median	332.93
Mode	0.06
Standard Deviation	2961.043344
Sample Variance	8767777.683
Kurtosis	7.036880024
Skewness	2.595341453
Range	17630.06
Minimum	0.06
Maximum	17630.12
Sum	678002.49
Count	441

Appendix G

Table 7.7
Regression results of Bitcoin Returns with weekly returns[8]

Variable	**Bitcoin percentage change**
Intercept	0.040 (0.009)
SP 500 percentage change (SPX Index)	-0.158 (0.842)
Brent Crude Oil percentage change (CO1 Comdty)	0.062 (0.245)
Gold percentage change (XAU Curncy)	0.776 (0.524)
10 Year Bond percentage change (USGG10YR Index)	0.002 (0.208)
Volatility Index percentage change (VIX Index)	-0.083 (0.087)
Bloomberg Dollar Spot percentage change (BBDXY Index)	0.155 (1.284)
Observation	440
R^2	0.010
Adjusted R^2	-0.002
F	0.792

Note: Standard errors in parenthesis
*p<0.1; **p<0.05; ***p<0.01

[8] The (weekly) percentage change of asset *i*, is defined as:
$Change_t = (P_t - P_{t-1})/P_{t-1}$

Appendix H

Table 7.8
Bitcoin Price equation (Test 1) with Bitcoin price lag variable

Variable	Bitcoin price
Intercept	1212.086 (1243.379)
Bitcoin Price with one week lag (BCL)	0.962*** (0.016)
SP 500 (SPX Index)	0.269* (0.170)
Brent Crude Oil (CO1 Comdty)	-2.769 (2.613)
Gold (XAU Curncy)	0.055 (0.288)
10 Year Bond (USGG10YR Index)	-34.989 (78.102)
Volatility Index (VIX Index)	-1.928 (5.941)
Bloomberg Dollar Spot (BBDXY Index)	-1.264* (0.978)
Security Breach Variable (SB)	-68.375 (67.627)
Observation	439
R^2	0.972
Adjusted R^2	0.972
F	1908.79***

Note: Standard errors in parenthesis
*p<0.1; **p<0.05; ***p<0.01