CANKAYA UNIVERSITY

GRADUATE SCHOOL OF SOCIAL SCIENCES

DEPARTMENT OF ECONOMICS

MASTER'S THESIS
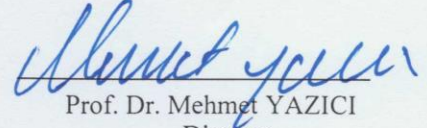
ANALYSIS OF BITCOIN MARKET VOLATILITY
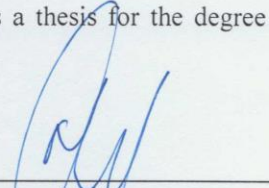
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SEPTEMBER 2018

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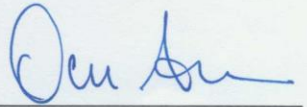
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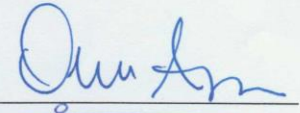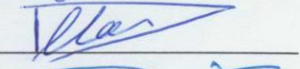Supervisor

Examination Date: 21.09.2018

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ABSTRACT

ANALYSIS OF BITCOIN MARKET VOLATILIY

HAŞLAK, Şüheda

Master's Thesis

Graduate School of Social Sciences
MSc., Financial Economics

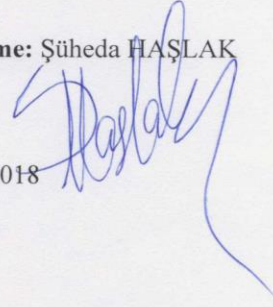Supervisor: Assoc. Prof. Dr. Elif Öznur ACAR

September 2018, 65 pages

In parallel with globalization, business operations have been so integrated that world is seen as a single market which is called as *"global village"*. This is also true for financial markets where funds are transferred from savers to borrowers in exchange for monetary assets. Bitcoin has recently emerged as a means of exchange in not only financial markets but also in real markets. In this regard, Bitcoin operations are vivid examples of such global activities in that its first appearance and expansion has been remarkable.

Bitcoin is a decentralized digital cryptocurrency that offers immediate payment to anyone and everywhere. Bitcoin can be sold, purchased and traded in other currencies. Bitcoin provides privacy and anonymity at a satisfactory level. Therefore, Bitcoin users can prove ownership of their operations on the bitcoin network with their secret keys and can spend their own value and transfer it to the new owner. Bitcoin performs the transfer by using a P2P network connection.

Independent individuals and companies, also known as "miners", who participate in the Bitcoin network, are motivated by rewards and transaction fees paid in Bitcoin. These miners can be conceived as the decentralized authority enforcing the credibility of the Bitcoin network.

The purpose of this study is to analyze Bitcoin prices mainly in terms of volatility and to answer the question whether Bitcoin price behavior is similar to a currency or a commodity. In the empirical part, therefore, we try to evaluate the relationship between Bitcoin and currencies – Bitcoin and commodities. Consequently, we compare Bitcoin with major currencies, i.e. USD, EUR, GBP and JPY, and with major commodities, i.e. Gold and Oil, on a daily basis for the period between 2010.07 and 2018.08. We employ Johansen cointegration, Granger causality, Impulse Response Functions and Forecast Error Variance Decomposition analyses in our study. Our results show that, Bitcoin does not have a long-run relationship with neither currencies nor commodities, but it has a short-run relationship with commodities, especially gold, which is a bi-directional one by and large. We, therefore, suggest that Bitcoin is acting like a commodity and gold is the most effective instrument that contributes to the volatility of Bitcoin prices.

Key words: Bitcoin, Cytptocurrency, Volatility, Currencies, Commodity Prices

ÖZET

BITCOIN PİYASASINDAKİ OYNAKLIĞIN ANALİZİ

HAŞLAK, Şüheda

Sosyal Bilimler Enstitüsü, İktisat Anabilim Dalı
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Tez Danışmanı: Doç. Dr. Elif Öznur ACAR
Eylül 2018, 65 sayfa

Piyasalardaki küreselleşme trendine bağlı olarak, tüm dünya "küresel köy" olarak adlandırılan tek bir pazar olarak görülmeye başlanmıştır. Bu durum, tasarruf sahipleri ile fon talep edenlerin karşılaşıp para transferini gerçekleştirdiği finansal piyasalar açısından da geçerlidir. Bitcoin fon transferlerinde kullanılan bir araç olarak son dönemde ortaya çıkmış ve sadece finansal piyasalarda değil reel piyasalarda da yeni bir çığır açmıştır. Bu anlamda Bitcoin operasyonları, ilk görünüşü, yapısı ve genişlemesinin dikkat çekici olması nedeniyle küresel faaliyetlerin canlı bir örneğidir.

Bitcoin, her yerde ve herkese anında ödeme sunan, merkezi olmayan bir dijital paradır. Bitcoin satılabilir, satın alınabilir ve diğer para birimlerinde işlem görebilir. Bitcoin istenilen düzeyde gizlilik ve anonimlik sağlamakta ve bu sayede Bitcoin'e olan güven artmaktadır. Ayrıca, Bitcoin kullanıcıları, operasyonlarının Bitcoin ağındaki sahipliğini gizli anahtarlarıyla kanıtlayabilmekte, kendi Bitcoinlerini harcayabilmekte ve harcama sonrasında yeni sahiplerine aktarabilmektedir. Bitcoin işlemlerinde, transferleri yönetmek için eşler arası ağ kullanılmaktadır.

Yönetim bilgi işlem gücüne sahip olan ve "madenciler" olarak da bilinen Bitcoin ağına katılan bağımsız bireyler ve şirketler, ödüller (yeni Bitcoin'in serbest bırakılması) ve Bitcoin'de ödenen işlem ücretleri ile motive olmaktadır.

Bu madenciler, Bitcoin ağının güvenilirliğini uygulayan merkezi olmayan otorite olarak düşünülebilir. Madencilerin bilgisayar sisteminde çözdükleri karışık kodlar neticesinde yeni Bitcoinler piyasaya kazandırılmaktadır.

Bu çalışmanın amacı, Bitcoin fiyatlarındaki oynaklığı analiz etmek ve Bitcoin fiyat davranışının bir para birimi yoksa bir emtia fiyatına mi benzediği sorusuna yanıt aranmaktadır. Çalışmanın ampirik bölümde, Bitcoin ve para birimleri ile Bitcoin ve emtia arasındaki ilişki değerlendirilmiş ve bu doğrultuda Bitcoin, başlıca para birimleri; USD, EUR GBP ve JPY ile başlıca emtia; Altın ve Petrol ile karşılaştırılmıştır. Analizlerimiz 2017.07-2018.08 tarihleri arasını kapsayan günlük veriler üzerinden yapılmıştır. Çalışmada, Johansen Cointegration, Granger nedensellik, Impulse Response Function ve Forecast Error Variance Decomposition testleri uygulanmıştır. Sonuçlar, Bitcoin'in uzun vadede para birimleri veya emtia fiyatları ile ilişkili olmadığını; ancak, kısa vadede başta altın olmak üzere emtia fiyatlarıyla karşılıklı bir nedensellik ilişkisinin bulunduğunu ortaya koymaktadır. Buna göre, emtia fiyatları Bitcoin oynaklığı üstünde daha fazla etkili görülmekte olup, Bitcoin'in emtia gibi davrandığı ve altının, Bitcoin fiyat oynaklığı üzerinde en çok katkı sağlayan enstrüman olduğu ileri sürülmektedir.

Anahtar Kelimeler: Bitcoin, Kriptopara, Oynaklık, Para Birimleri, Emtia Fiyatları

ACKNOWLEDGEMENTS

In this part I would like to begin my words by presenting my gratitude for everyone who has directly or indirectly supported me through my journey.

I am grateful for my parents Hikmet HAŞLAK and Gülay HAŞLAK for their efforts, support and care in all of my academic and professional career decisions.

I would like to show my great thanks and appreciation for my ex-supervisor Dr. Burak PİRGAİP on his endless supports through the thesis work and as well as his lectures.

I appreciate the efforts of Prof. Dr. Mehmet YAZICI through my educational progress in Çankaya University.

I would like to show my thanks to Assoc. Prof. Dr. Elif Öznur ACAR accepting to be my current supervisor.

I would also like to give special thanks for every lecturers and professors who have supports on my education.

Last but not least I would like to thank every individual, while wandering through my thesis.

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LIST OF ABBREVIATONS

BTC	: Bitcoin
ETH	: Ethereum
LTC	: Litecoin
XPR	: Ripple
P2P	: Peer-to-peer
USD	: American Dollar
EUR	: Euro
GBP	: British Pound
Q-Q Plot	: Quantile-Quantile Plots
ADF	: Augmented Dickey-Fuller Test
PP	: Phillips and Perron Test
VECM	: Vector Error Correction Model
IRF	: Impulse Response Function
FEVD	: Forecast Error Variance Decomposition

INTRODUCTION

Cryptocurrencies, especially Bitcoin (BTC), have recently been one of the highly debated topics in finance circles. BTC prices are closely followed by important databases and it has started to be accepted as a means of payment in some companies, even in some countries. Microsoft, Reddit, Expedia, Zynga, Domino's Pizza are some of the companies that accept BTC as a currency. Italy, US, UK, Finland, Australia, Singapore, Netherlands, Canada, Slovenia, and Isle of Man are known as Top 10 countries where BTC is accommodated as a means to purchase goods and services on the Internet. These developments, therefore, make it inevitable to investigate the BTC as a major cryptocurrency.

Advocates assert that BTC is a faster, cheaper, and convenient payment mechanism. However, skeptics think that cryptocurrencies are completely based on speculation and, sooner or later, its bubble will burst. Scholars and practitioners still discuss the characteristics of BTC regarding whether it is a currency or a commodity.

In this framework, we aim at addressing the following issues in our study:

- The importance of BTC
- Opportunities and challenges posed by BTC
- Analysis of BTC market in the light of volatility and its relationship between other currencies and commodities.

Our study considers BTC by providing a general understanding of its historical development at the firsthand. We also discuss supporting theories and BTC practices in the world and Turkey, as well. Further, the literature review is conducted to assess above-given issues. Different academic sources are consulted to make a through evaluation of empirical results.

Theories and models suggested by academics are paid close attention. We lastly employ our empirical methodology in order to support for our research with results and conclusions.

This study focuses on research of the volatility of the BTC prices. The volatility of gold averages around 1.2%, while other major currencies average between 0.5% and 1.0%. However, BTC is more volatile than any fiat currency pairs and its price has shown dramatic changes in recent years. For instance, BTC weekly volatility reached up to 60% per annum during 2017. Today, BTC prices still fluctuate rapidly and its volatility is very sensitive. We ask for the reasons of these price changes and we investigate it with the volatility of specific currencies and commodities. We analyze whether the volatility of BTC is affected by currency volatility or commodity volatility. Therefore, we employ Johansen cointegration, Granger causality, Impulse Response Functions and Forecast Error Variance Decomposition analyses in our study. Our results show that, Bitcoin does not have a long-run relationship with neither currencies nor commodities, but it has a short-run relationship with commodities, especially gold, which is a bi-directional one by and large. We, therefore, suggest that Bitcoin is acting like a commodity and gold is the most effective instrument that contributes to the volatility of Bitcoin prices.

Through the study the subject matter is divided into five chapters. Chapter I presents relevant information on history of cryptocurrencies and relevant theories which supports the ideology within subject matter. Chapter II includes information on specifically BTC, Chapter III includes some facts regarding BTC market. Chapter IV includes the literature review, empirical analysis and our findings. The study is concluded with the conclusory part.

CHAPTER I
CRYPTOCURRENCIES

Cryptocurrency, a combination of the words "Crypto" and "currency", refers to virtual currency that is connected neither to a central authority nor a brokerage house. As the name suggests, it can be excerpted and used only by means of passwords from the virtual wallets. With cryptocurrencies, people or institutions can enter into monetary transactions as if they do with hard currencies.

There are various forms of cryptocurrencies in the market such as BTC, Ethereum, Ripple, Litecoin, Dash, Monero, and Neo. Since these virtual currencies are registered on the computer system, they cannot be physically found in print.

Cryptocurrency does not possess any value, as opposed to precious metals, originating from the value of mining, and is independent from the state as opposed to paper money. On the other hand, its value is determined instantaneously under market conditions relying on demand and supply, as in the case of other currencies or commodities.

1.1. Brief History of Cryptocurrencies

Cryptocurrencies do not have a long-lasting history indeed. Before BTC, David Chaum and Stefan Brands had countless money technology beginning with the coin-based e-cash protocols. Adam Back developed hashcash, a business proof program for spam control. First suggestions for cryptocurrencies, based on the distributed numerical rig, were Wei Dai's money and Nick Szabo's bit-gold. Hal Finney developed reusable business proof (rpow) using hashcash as a business proof algorithm (Dönmezgel, 2017).

Actually, recent global financial crisis that had hit the world starting from 2007 lead to the birth of the cryptocurrency mainly because of the doubts on the traditional stability of the coins emerged after collapsing the mortgage market, thought as once strong, and unconventional measures applied in financial system.

Following the crisis, market confidence has declined considerably, many in search of a decentralized currency. Just in the process, a pseudonym named "*Satoshi Nakamoto*" created a virtual currency, i.e. BTC, that was not affiliated to a central bank for the first time. On August 18, 2008, the "Bitcoin.org" domain was registered at the anonymousspeech.com site. By registering through this site, it was again successfully concealed who the real owners of Bitcoin.org are. On October 31, 2008, Satoshi Nakamoto made a publication explaining the operation of the BTC system, the cryptocurrency. The most important thing he tries to prove here is; a BTC cannot be spent many times in the same place or in two different places. This means that in case two different transactions spend the same BTC, one needs to decide which one of the two is valid. Any attempt to spend the same BTC twice is called "double-spending attack" in the Bitcoin terminology and would be invalidated. In other words, it means that we will have the money function in the sense that we know.

The system was released as open source on November 9, 2008 for further development, and finally the first virtual currency 'Bitcoin' was created on January 3, 2009, and was used for the first time as a virtual currency in a transaction on January 12, 2009.

1.2. Types of Cryptocurrencies

1.2.1. Bitcoin

BTC is a digital currency created in 2009. It follows the ideas set out in a white paper by an unverified identity, Satoshi Nakamoto. BTC provides lower transaction fees when compared to traditional online payment mechanisms and is operated by a decentralized authority, unlike government-issued hard currencies.

In November 2008, a man named Satoshi Nakamoto sent a letter to a mail Group about cryptography titled "Bitcoin: Electronic cash system between spouses." This article describes the detailed methods of using a P2P to produce "a system for electronic transactions, regardless of the trust of a third party." In January 2009, the BTC network emerged with the release of the first open-source BTC client and the production of the first Bitcoin. Satoshi Nakamoto won the first block-mining prize of 50 BTC by scraping the first block of BTC (also known as the original block, genesis block or starting block) (Dönmezgel, 2017).

There was a lot of speculation that Satoshi Nakamoto was Wei Dai, Hal Finney, or someone from that team. Satoshi Nakamoto is likely to be a computer collective in the European financial sector.

The very first BTC transfer was to Hal Finney from Satoshi Nakamoto. Finney downloaded the BTC software when it was first released and received 10 BTC from Nakamoto in the world's first bitcoin process. Other early supporters were Wei Dai, the B-money's pioneer and Nick Szabo, the creator of bit-gold[1].

In the early days, Nakamoto is estimated to have produced 1 million BTC. Nakamoto, who cut all ties with BTC, handed over all control and management to the developer Gavin Andresen. Gavin Andresen later became the chief developer of the Bitcoin Foundation, which is closest to the official public opinion of the "anarchic" BTC community.

On August 6, 2010, a major vulnerability was identified in the BTC Protocol. Operations could not be verified correctly before being included in the transaction log or blockchain, allowing users to bypass the economic constraints of BTC and create an unlimited number of BTC. On August 15, this vulnerability was exploited and more than 184 million BTC were produced in one transaction and sent to two addresses on the network. After the error has been corrected and the network has been forcibly updated to a newer version of BTC communication protocol, this fake transaction has

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[1] Please refer to https://nakamotoinstitute.org/bitcoin-and-me/.

been deleted from the transaction log several hours later. This was the only significant security flaw ever discovered and used in BTC history[2].

BTC is one of the first digital currencies to use P2P technology to facilitate instant payments. Individuals and companies, also known as "miners", who participate in the Bitcoin network, are motivated by rewards and transaction fees paid in Bitcoin. These miners can be conceived as the decentralized authority enforcing the credibility of the Bitcoin network. New BTC is being released to the miners at a fixed, but periodically declining rate, provided that the total supply of BTC approaches 21 million. One BTC is divisible to eight decimal places where the smallest unit is known as a Satoshi. If necessary, and if the participating miners accept the change, BTC could eventually be made divisible to even more decimal places.

Bitcoin, with its historical background and rapid development, has become the de facto standard for cryptocurrencies, inspiring an ever-growing legion of followers and spinoffs. The currencies modeled after BTC are collectively called altcoins and are simply modified or improved versions of BTC. They have some advantages such as easy-to-mine and low cost, but also have disadvantages such as greater risk, less liquidity, acceptance and value retention. Main altcoins are discussed below.

1.2.2. Ethereum

Ethereum is a decentralized software platform, introduced in 2015, that enables Smart Contracts and Distributed Applications (Dapps) to be built and run without any downtime, fraud, control or interference from a third party. The applications on Ethereum are run on its platform-specific cryptographic token, i.e. "ether". Ether is like a tool for moving around on the Ethereum platform, and is sought by mostly developers looking to develop and run applications inside Ethereum. According to Ethereum, it can be used to "codify, decentralize, secure and trade just about anything." Following the attack on the DAO in 2016, Ethereum was split into

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[2] Please refer to https://cointelegraph.com/news/history-of-cryptocurrency-from-bitcoins-inception-to-the-crypto-boom.

Ethereum (ETH) and Ethereum Classic (ETC). Ethereum (ETH) has a market capitalization of $41.4 billion, second after Bitcoin among all cryptocurrencies.

1.2.3.Ripple

Ripple is a real-time global settlement network that offers instant, certain and low-cost international payments. Ripple "enables banks to settle cross-border payments in real time, with P2P transparency, and at lower costs." Launched in 2012, Ripple has reached a market capitalization of $1.26 billion. Ripple's consensus ledger does not need mining as opposed to BTC. In this regard, the usage of computing power is reduced and network latency is minimized. Ripple believes that 'distributing value is a powerful way to incentivize certain behaviors' and thus currently plans to distribute XRP primarily "through business development deals, incentives to liquidity providers who offer tighter spreads for payments, and selling XRP to institutional buyers interested in investing in XRP".

1.2.4. Litecoin

Litecoin, launched in the year 2011 and created by Charlie Lee a former Google engineer, was often referred to as 'silver to Bitcoin's gold'. Litecoin is based on a decentralized open source global payment network and uses "crypt" as a proof of work, which can be decoded with the help of CPUs of consumer grade. When compared to BTC, Litecoin is has a faster block generation rate and offers a faster transaction confirmation. There is a growing number of merchants who accept Litecoin.

1.3. Legal Status of the Cryptocurrencies in Jurisdictions

Legal status of cryptocurrencies, mainly BTC, depends on the jurisdiction. Some countries have explicitly allowed their use and trade, but some have forbidden it. In the same way, various government agencies, departments and courts have classified BTC in different ways[3].

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[3] Please refer to https://en.wikipedia.org/wiki/Legality_of_bitcoin_by_country_or_territory.

It is indeed easier to make a list of countries that ban cryptocurrencies: Algeria, Egypt, Morocco, Bolivia, Colombia, Ecuador, Saudi Arabia, Iran, Bangladesh, Nepal, Pakistan, China, Taiwan, Cambodia, Indonesia and Vietnam. Other jurisdictions, by and large, accepts cryptocurrencies either implicitly or explicitly.

Germany (legal)

According to the declaration issued by the Federal Financial Supervisory Authority on December 19, 2013, digital currencies are considered as legally binding financial instruments that fall under the category of legal regulations. The Bundesbank recommends using the term "crypto token." for BTC instead of virtual currency or digital money.

United States (legal)

The U.S. Treasury categorized BTC as a virtual currency in 2013. The Commodity Futures Commission, CFTC, categorized BTC as a commodity in September 2015. In September 2016, a federal judge ruled, "Bitcoin is clearly a fund". The largest number of crypto households and the forerunner of world BTC trade volume is the U.S.. Many countries are waiting for the conclusions of U.S.'s attitude and approach to establishing and regulating the legalization of cryptographic money

European Union (legal)

Although the European Union did not issue specific legislation on BTC's currency status, it stated that the conversion between Value Added Tax / Goods and Services Tax's traditional currency and BTC is not valid. In October 2015, the European Court of Justice ruled that "for Bitcoin and Digital currencies; the exchange of traditional currencies is exempt from VAT and Member States should be exempted from currency transactions, among other things ", thus making BTC a currency rather than a commodity.

Australia (legal)

In December 2013, the Australian Central Bank's manager said in an interview:

"We did not allow people who decided to trade in another currency in a shop in this country; nothing would stop them. That is why we have competing currencies."

In 2017, Australia has removed the double taxation applied to BTC. Australia considers BTC to be commodity. The Australian Post intends to make its digital identities by Block-Chain method with the desire to improve its services.

France (legal)

The French Ministry of Finance issued regulations on the taxation of virtual money experts and stock exchanges on July 11, 2014.

South Korea (legal)

Adult South Koreans may trade on registered exchanges using real name accounts at a bank where the exchange also has an account.

Russia (legal)

As of November 2016 declared, BTC is "not illegal" according to the Federal Tax Service of Russia. However BTC market sites are blocked and in court decisions stated that BTC is a currency surrogate which is outlawed on the territory of Russian Federation.

1.3. Cryptocurrencies in Turkey

When the legal regulations and developments in Turkey are examined, it is seen that the Central Bank has no direct control and application of cryptocurrency.

The value of the currency, which is completely digital, is not directly associated with the conventional currency that we use in our daily lives. So there is no direct

equivalent of the digital currency, and only individuals voluntarily want to pay for a digital currency.

The Law on "Payment and Securities Reconciliation Systems, Payment Services and Electronic Money" published by the Banking Regulation and Supervision Agency on 27.06.2013 requires the issuer to keep the fund that corresponds to the money in a fixed account even though the concept of "electronic money" is entered into the law. This is an approach that is contrary to the most current and common example of BTC. Therefore, it is explained that Bitcoin is not accepted as an electronic currency due to the risks it contains on 25.11.2013. In this context, it may be useful to separate the digital, virtual and crypto money concepts as electronic currency types as stated in the report presented by IMF staff at the beginning of 2016.

For years, it is thought that banks that follow the technology closely and offer innovative products and solutions to their customers in many different areas will work in this area. With a young and dynamic population, Turkey uses technology intensively. According to an international survey by 15 countries from Europe, USA and Australia, Turkey ranks first by 65% in the use of mobile banking on the basis of countries (ING, 2015).

As illustrated in Table 1, digital currencies, such as BTC, are considered as the future of online spending. Their participation in the opinion is shown on the basis of countries. This data also shows that the belief in digital currencies is the highest in Turkey.

Table 1 : Bitcoin is the Future of Spending Online

"Digital currencies — such as bitcoin — are the future of spending online"

Percent who answered "agree", "no opinion" or "disagree"

	Agree	No opinion	Disagree
European consumer	28%	30%	42%
Netherlands	9%	33%	57%
Belgium	13%	38%	50%
Luxembourg	14%	31%	55%
Germany	17%	25%	58%
Austria	18%	27%	56%
United Kingdom	18%	32%	50%
France	22%	31%	48%
Czech Republic	24%	39%	37%
Romania	26%	36%	38%
Poland	31%	40%	29%
Spain	33%	31%	36%
Italy	43%	26%	31%
Turkey	45%	28%	27%
Australia	16%	37%	47%
USA	28%	28%	45%

Sample size: 14,829
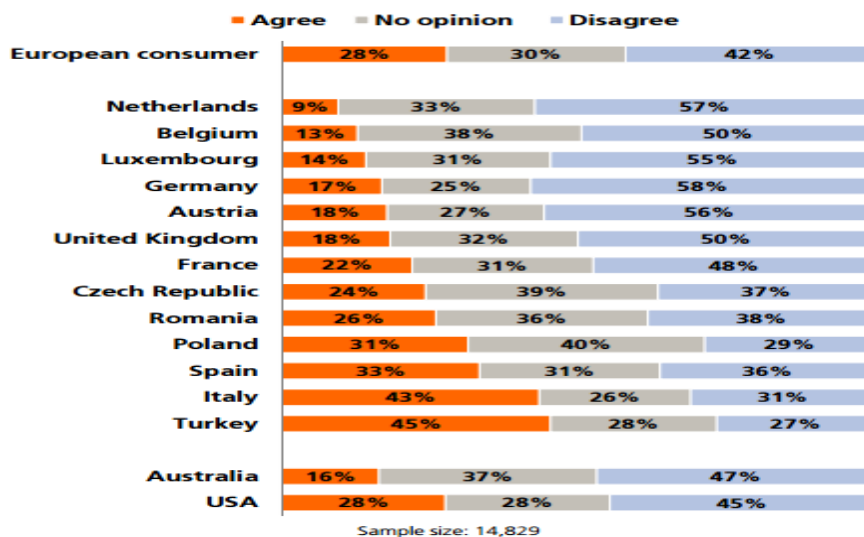
Source: "Mobile Banking, New Technologies and Financial Behaviour", ING International Survey, 2015.

1.5. Advantages and Disadvantages of Cryptocurrencies

Cryptocurrency, which has become very popular in the last decade, is still a question mark in the minds of many people. There are also those who are caught up in this new flux, making more bold investments, more careful and systematic. Cryptocurrencies have as many disadvantages as the benefits investors provide.

1.5.1. Advantages of Cryptocurrencies

The following are main advantages of cryptocurrencies[4]:

There is no inflation: There is no money supply increase problem because the number of money to be sent is mathematically certain. Although the inflation rate is low, it is thought to be overvalued. There are estimates that BTC will see 100 thousand dollars in this direction.

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[4] Please refer to https://coinpupil.com.

No risk of collapse: There is no risk of collapse because there are no political mechanisms that control the money or decide on the money. On the other hand, there are no bank owners who take your money to hide it and transfer it to their own companies. Therefore, the money will be much safer than now.

Safe and cheap: The confidence in the security of the current system is refutable, as services are provided by more than one machine. In addition, the bank intermediates in Internet shopping. However, because one does not have a card when shopping or transferring money on this system, everything is done very cheaply.

Light on load: One can only carry a password with 34 characters or purchase a QR code by installing it as an application on his/her phone.

1.5.2. Disadvantages of Cryptocurrency

The following are main disadvantages of cryptocurrencies[5]:

No trace or sign: It is difficult to keep this trail, especially because governments and the legal system are distant. This has taken the interest of individuals and groups who want to do illegal work. However, there are some regulations in this regard. Although there is no information such as name and surname, precautions are being taken to follow the machines that operate. However, some altcoins like Monero allow to trade without being traced and are preferred with it.

Losing is easy: One cannot claim when you lose 34 character keys. Whichever hand passes, it will be the new owner's money. In recent days, we witness more news about BTC theft. There are bars out there for solving this. Still, effort is needed to not lose or steal. There is no call center to call as one would call when he/she ran the credit card.

Shortage of consumption area: There are still very few alternatives. This is due to the fact that there are countries in which some virtual currencies are prohibited,

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[5] Please refer to https://coinpupil.com.

so their use is not encouraged and can not reach the maximum number of people in the world.

Sudden surge: One may experience a sudden decline because it is a currency that has a high volatility. Therefore, those who think about investment should be very careful.

CHAPTER II
BITCOIN AND BLOCKCHAIN METHODOLOGY

The name of 'Bitcoin' comes from a paper called as "bit" and the currency called as "coin". Raymaekers (2015) defines BTC as a digital representation of value not issued by a central bank, but accepted by businesses and persons as a means of payment that can be traded, stored and sent electronically. BTC transactions are done via a private key over Internet to another person or institution together with the sender's public key. In this transaction, transfer of BTC and its ownership is verified solely by a distributed network of computers and history log, blockchain, is kept.

The most valuable cryptocurrencies that is currently found in the market and adopted by the community by 2018 is shown below in terms of the total USD value. BTC is worth $115 billion. Ethereum and Ripple follow BTC, respectively. The total value of the cryptocurrencies in the list is around $180 billion. In addition to the digital funds listed below, there are more than 2.000 cryptocurrencies in the financial markets that value to $217 million. Although some of these cryptocurrencies that we talked about could create value for themselves, they all have different features, all of which are distributed decentralized blockchain technology, and all non-closed trades are traded on open stock exchanges.

#	Name	Symbol	Market Cap	Price	Circulating Supply
1	Bitcoin	BTC	$114.103.061.570	$6.592,39	17.308.287
2	Ethereum	ETH	$23.066.721.400	$225,24	102.409.365
3	XRP	XRP	$19.331.261.995	$0,484063	39.935.410.492 *
4	Bitcoin Cash	BCH	$8.845.579.918	$508,71	17.388.188
5	EOS	EOS	$5.204.835.593	$5,74	906.245.118 *
6	Stellar	XLM	$4.520.136.431	$0,240346	18.806.826.278 *
7	Litecoin	LTC	$3.379.913.327	$57,67	58.608.502
8	Tether	USDT	$2.798.530.927	$0,997188	2.806.421.736 *
9	Cardano	ADA	$2.111.751.095	$0,081450	25.927.070.538 *
10	Monero	XMR	$1.885.781.179	$114,52	16.467.182

Figure 1 : Crypto Currencies to USD (2018)

Source: https://coinmarketcap.com/all/views/all/

In parallel with globalization, business operations have been integrated insomuch that world is seen as the single market which is put as "global village". Bitcoin operations are vivid example of these global activities in that its first appearance and expansion has been remarkable. BTC was introduced by Satoshi Nakamoto in 2008. To him (2008), BTC is a P2P electronic cash system, which allows online payments to be sent directly from one party to another without going through a financial institution. This definition implies that Bitcoin can be considered as alternative currency as well as asset.
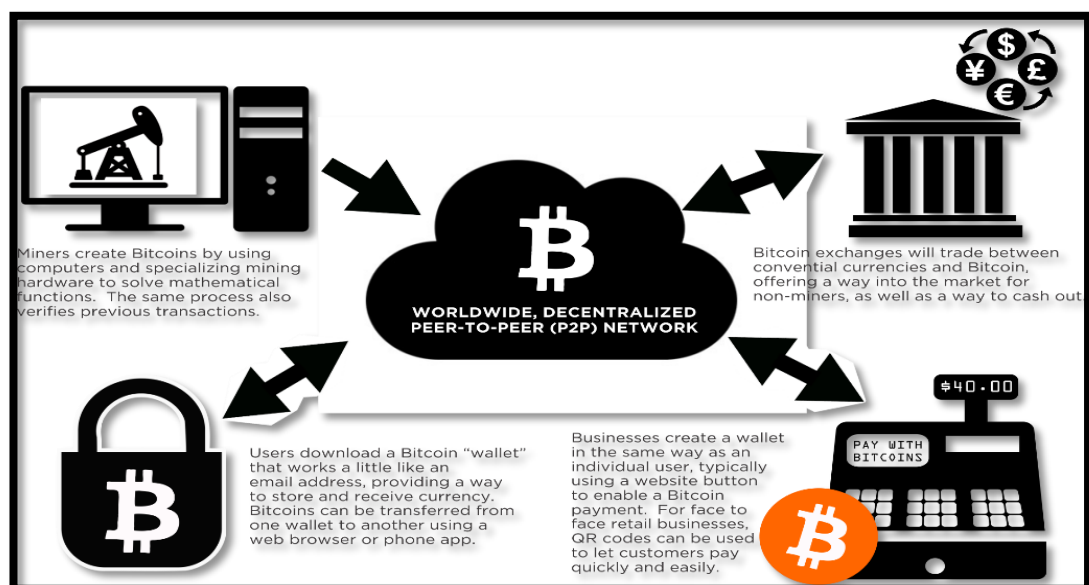
Figure 2: Bitcoin Network

Source: https://www.investopedia.com/tech/bitcoin-lightning-network-problems/

What is more striking about BTC is that it poses minimal risk to financial stability in that it is purely speculative. Besides cryptocurrencies's constantly increasing popularity might shake the throne of the traditional coin but according to a Swiss Institute's study, it will not replace traditional coins. Together with this, at the time where currencies are highly depreciated as happened in Argentina and Greece, use of BTC can be welcomed (Baur et al., 2016).

Cryptocurrencies can steer national currencies outside the country, which is equivalent to say that the cryptocurrencies lead to capital flight in an unconventional way. So the national authorities are on the alert for the cryptocurrencies in that it is not adequate to track the national currencies anymore.

BTC offers the promise of lower transaction fees than traditional online payment mechanisms and is operated by a decentralized authority, unlike government-issued currencies.

BTC is one of the first digital currencies to use P2P technology to facilitate instant payments. Individuals and companies, also known as "miners", who participate in the Bitcoin network, are motivated by rewards and transaction fees paid in Bitcoin. These miners can be conceived as the decentralized authority enforcing the credibility of the Bitcoin network. New BTC is being released to the miners at a fixed, but periodically declining rate, provided that the total supply of BTC approaches 21 million. One BTC is divisible to eight decimal places where the smallest unit is known as a Satoshi. If necessary, and if the participating miners accept the change, BTC could eventually be made divisible to even more decimal places.

2.1. History of Bitcoin

A brief history of BTC is provided in the subsection as follows[6]:

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[6] Please refer to http://historyofbitcoin.org.

2007

According to the legend, Satoshi Nakamoto began working on the Bitcoin consept in 2007. Although he is said to live in Japan, Nakamoto iş thought to be common nickname of more than one person.

2008

Times of global economic crisis... BTC white paper published in 2008, 31th October. BTC is a landmark for its history. Nakamoto, is an article describing the currency of BTC and solving the problem of double spending to prevent duplication of currency. Metzdowd.com named cryptography, published in the mail group.

2009

BTC 0.1 version is released. This version, compiled with Microsoft Visual Studio for Windows, had no command-line interface and was complete and flawless enough to reinforce speculation that it was developed by more than one person (or an academic with little programming experience and theoretical knowledge). By 2040, a total of 21 million BTC produced a BTC production system.

The first transfer of BTC currency took place between Satoshi and Hal Finney, a developer and cryptographer in block 17.

The first BTC was created rate on 2009, 5th October. The new Liberty Standard issued an exchange rate that determines the value of a BTC in the form of $ 1 = 1.309.03 BTC using an equation that includes the cost of electricity needed to run a BTC-generating computer.

2010

The first BTC stock market was born. The Stock Market, called BTC market, was founded by dollar as BTC exchange market.

The first real world operation using BTC takes place when Florida Programmer Laszlo Hanyecz offered to pay 10,000 Bitcoin for a pizza on BTC Forum. Based on the exchange rate at that time, the pizza purchase price was about $ 25.

BTC's value has risen ten times. During a five-day period starting on July 12, bitcoin's currency rose tenfold from 0.008 USD/BTC to 0.080 USD/BTC.

On July 17, 2010, the famous BTC stock exchange Mt. Gox set up. Unfortunately, Mt. Gox went bankrupt and closed by announcing that approximately 2.4 trillion dollars of BTC had been stolen or lost in 2014.

On July 18, 2010, Artforz set up OpenGL GPU hash farm and produced the first BTC block.

On August 15, 2010 a defect has been discovered in the bitcoin system that could lead to incorrect verification of BTC, causing an open 184 billion BTC to be produced.

On September 18, 2010, Slush's pool scraped its first block. By coin pool mining (mining), a method by which multiple users jointly try to extract BTC and share the benefits, has removed its first block.

In October 2010, the Financial Action Task Force, an intergovernmental group that develops and promotes policies to prevent Money Laundering and terrorist financing, issued a statement to warn people about the use of digital currencies to finance terrorist groups.

On November 6, 2010, according to the latest trade figures in Mtgox, the BTC economy, which was calculated using the number of BTC in circulation, exceeded $ 1 million. On mtgox the bitcoin price reached $0.50/BTC.

2011

Silk Road was opened for illegal trade, such as drugs. It is important for the history of BTC. Because Silk Road has negative impact on many people look at BTC.

On January 28, 2011, 25% of the total BTC was produced. With the production of block 105000, more than 25 percent of the total projected 21 million tons of 5.25 million BTC has been produced.

On February 9, 2011, BTC reached a dollar parity. 1 BTC = 1 dollar

On March 6, 2011, Mt gox was sold. Jed Mccaleb sold Mtgox to the Japanese tibanne company.

On March 25, 2011, second biggest difficulty level increase took place.

In April 2011, the first altcoin Namecoin was created.

2013

On May 2, 2013, the first BTC ATM was established.

On May 14, 2013, Mt. Gox's funds have been confiscated by us Homeland Security.

In July 2013, BTCTurk opened in Northern Cyprus the first Turkish bitcoin Stock Exchange.

On August 9, 2013, Bloomberg placed Bitcoin Ticker on site.

On October 2, 2013, the FBI shut down the Silk Road. The FBI shut down Silk Road, known as the online drug sales market, and seized BTC worth US $3.6 million. On top of that, BTC price fell from $ 139 to $ 109 in three hours.

On December 5, 2013, the Central Bank of China has banned BTC transactions. BTC price has dropped by 20%.

2015

On January 26, 2015, Coinbase announced it received $ 75 million in funding.

On July 30, 2015, Ethereum was born.

In August 2015, more than 160 thousand enterprises have agreed to pay BTC.

2016

In March 2016, the Government of Japan has announced that it recognizes virtual coins like BTC.

In August 2016, Bitfinex was hacked from the large bitcoin stock market and about 120,000 BTCs were stolen.

In September 2016, BTC's historic ATM record. The world-wide BTC ATM number has increased to 774.

In December 2016, Capital Markets Board of Turkey published a comprehensive report on BTC.

2017

In March 2017, the number of projects related to BTC published on Github exceeded 10,000.

On August 1, 2017, BTC was divided into two. BTC cash showed up.

On September 7, 2017, BTC price exceeded $ 4.500.

BTC Price Index's all-time high of $19,783.21 on Dec. 17.

2018

After reaching a new high at $17,000 in January, BTC prices have dropped to lows of $6,500 in April.

BTC price rises by 33% in April 2018 from $6,926 to $9,244, making this the best month so far for Bitcoin.

As of April 26th, BTC hit 17 million meaning only 4 million are yet to be mined.

2.2. Blockchain Methodology

Blockchain is a distributed database that provides an encrypted transaction set-up. Each piece of information in the database is stored in blocks, interconnected with each other through advanced encryption algorithms, allows transactions to be performed in a decentralized way. In the Blockchain network, all monetary transactions are registered. The most important feature of this system is that it is kept in more than one place, one network, rather than being held in one place in order to enhance the security of the information received. In case one of the recording locations is lost, the information is still stored in other recording locations in the network. The places where the information is stored are in relation to the previous and next block coming from it with a special encryption. In this case, when information is changed in one of the ring-forming circles, this information becomes incompatible with previous recordings. To change a record, one has to confirm the changes in a few ring-forming circles. Information from one place cannot be accessed, managed or redirected until someone reaches the other and the codes match and this information becomes apparent (Crosby et al, 2015).

Blockchain technology automatically updates itself every 10 minutes. Self-monitoring ecosystem with a digital value networks, updating the process, which takes place every 10-minute interval. Each of these operations is called the "block" and this arises two important things. First, the entire network is open to everyone and embedded principle of transparency. Be a need for greater computing power than all the other units of a network to change any information if the blockchain, and so corruption.

Blockchain technology can be used as a high security system in many areas, especially in areas such as banking, e-government, e-commerce, in digital contracts, in election systems and in copyright.

Bukovina and Martiček (2016) tell that BTCs are created in a so-called "mining" process in which participants, "miners", use computers rather complex problems. In particular, bitcoins have been emerged as a result of these efforts. It is

based on Block Chain technology which is a kind of ledger containing all transaction of bitcoins.

2.2.1. Bitcoin Mining

BTC mining is a procedure to approve the financing transactions in the Bitcoin market, to provide transfers and to produce new BTCs. Blockchain gives the user whoever is the fastest block producer and approving process in BTC mining works with a decentralized system. Whenever a new BTC is produced, the difficulty levels of blocks are also increasing, and computers with very powerful processors for mining are required. That is, BTC mining adds both to the blockchain and releases the new BTC. The mining process is concerned with compiling the last operations into blocks and trying to solve a difficult puzzle in computation. The first participant to solve the puzzle puts the next block in the block chain and collects the prizes. The prizes encourage miners and include both transaction fees (paid in the form of BTC) and the new BTC. The maximum number of BTC that can be found in the market is 21 million.

There is a need for miners to be able to approve the work done at BTC continuously. If a very radical and technological update does not happen, even after reaching the maximum number of BTC, they will win the BTC so that they will be rewarded for the action they solve. This will ensure that your mining continues.

2.2.2. Working Principle of Bitcoin Mining

All BTC transactions are transferred to Blockchain records where BTC is connected, and each transaction made from members is required to be approved. When the members approve the BTC transactions, the related amount is deducted from the purse and added to the counterparty. BTCs are kept and stored through a digital wallet. Everyone can reach the address of this wallet and even view its profile, but it is unknown who the person is. The wallet is encrypted with two different layers. Someone can get a general password, and a private password can be used for sending and receiving.

Thanks to mining, these transfer operations are added to and processed in Block chains, and everyone via blockchain records can view all BTC transactions made up to this time and made in the future. The miner will also receive the prize BTC at a certain amount as a reward for completing the block at the end of this transaction. As the number of operations done in BTC increases day by day, the block lengths are also quite large (such as the records kept in the book). As the maximum BTC count is approached, the amount of prize BTC distributed per block declines over time. All of this system is followed and approved on the software infrastructure where BTCn is manufactured and its processes are done.

A BTC process on the BTC network appears in a very short time that can be measured in seconds but not distributed by other users as it takes time for it to be approved. A digital signature of the transaction is valid by the user for any processing of the owned BTCs. An illegal operation is immediately rejected by other users on the network. No one can spend the BTCs they don't have. But, there is a risk that the same BTCs will be subject to other processes because it takes time to approve the transaction, although the information of the requested transaction will be disseminated to the entire network in a very short period of time. This risk is called "Double spending". At least 6 different P2P transactions are expected to be approved in order to avoid double expenditure risk (Çalkacıoğlu, 2016: 40).

BTC solved this difficulty with the blockchain, which is a book that is kept all records and protected open to the entire community. The new processes that propagate information on the network are grouped together, and the validity of all new processes is confirmed by comparing existing records. (Ankalkoti and Santhosh, 2017:1757).

The main way to avoid double spending risk is a two-stage process. (i) Distribution of transaction verification process to ensure the accuracy of the transaction and (ii) to guarantee the consistency of the block chain, everyone on the network is aware of a successful operation very quickly. The concept of BTCproof-of-work (PoW, work proof) to fulfill these requirements and it uses the probabilistic "Consensus Protocol" (Conti vd., 2017: 3).

2.2.3. Bitcoin and Blockchain Promised Future

With BTC and blockchain technology, many ways of doing business, especially in the financial field, also have the potential to change. A person, who wants to trade on a BTC system, uses a mathematical algorithm instead of relying on a third party. Moreover, when you want to transfer money with existing financial institutions, very small transactions can be more expensive than the transaction itself. People who don't want to put up with this cost, BTC system for a functional alternative offers (Martins and Yang, 2011).

According to Lessing (2016), BTC's most important innovation is to ensure the privacy of the system it ensures that all transactions can be tracked. There is no need for a central control authority to ensure the security of transactions and prevent double spending. The BTC network performs this as a whole, ensuring that the nominal value of BTC is maintained. BTC works on the same logic as the Internet as a P2P network.

BTC's open source code has been effective in its popularity and acceptance. In this way, transaction processes become transparent and the creation of new BTC is realized publicly. The open source code of the project also provides the advantage of competition and the creation of a rich ecosystem is easier. (Gringber, 2011).

One of the biggest benefits of BTC is its low transaction costs. Although BTC is a good option for direct transfer of limited amounts a key role in Internet commerce and digital economy it is stated that it can undertake (Grinberg, 2011: 170).

Countries evaluate BTC with its potential threats and advantages. For example, the Chinese government, along with the rise in its popularity, perceived BTC as a threat to monetary control in the country and banned it from trading with BTC since December 2013. However, this prohibition applies to banks and financial institutions. Other than banks and financial institutions, private companies and individuals can buy and sell BTC. As of now, there are three countries in the world where BTC is considered to be completely illegal. These countries are Kyrgyzstan, Bangladesh and Bolivia (Eurasian blockchain and digital money Research Association, 2017). There

are also features that will cause countries to perceive bitcoin as a threat. For example, the transfer of BTC may be a crime because of anonymity. The possibility of facilitating activities, facilitating tax evasion and allowing money laundering are the reasons that governments push to work on the issue. However, in spite of its negative side, it is stated that it is not possible for BTC to be banned by focusing on the potential threats it carries with Block chain Technology, which eliminates the need to rely on both the increasing popularity and the reliance on financial transactions. (Kostakis and Giotitsas, 2014: 435).

CHAPTER III
BITCOIN MARKET

BTC, which is used as a payment instrument in the purchase of products and services, emerged in 2009 and its importance has increased over time. The total market value of the BTC market is US $143 billion[7] and there are about 17.3 million[8] BTC in circulation. Its price is determined on supply and demand; can be purchased by following a number of ways, such as the cash, PayPal, bank transfer, BTC ATM.

BTC market, the first stock market to purchase and sell bitcoin, was established on February 6, 2010 and the number of BTC stock markets has increased over time. BTC exchanges, including official holidays within the framework of their own rules, 7 days 24 hours is open and is in a continuous process. To be able to perform trading in the stock markets, a BTC exchange must be member. During membership, official documents such as identity card, passport and invoice are usually requested for personal information. This situation creates an obstacle in the event of an anonymous transaction, making it easier to monitor the transfer transactions. Depending on the volume of transactions made on the stock exchanges, commission fees are charged, and this rate varies according to the stock exchange.

Since 2010, the trading volume of some stock exchanges has increased. Figure 3 shows the total transaction volumes of the stock exchanges in 5 years. Undoubtedly Mt.Gox's closure has deeply shaken the BTC market. Moore and Christian (2013) examined 40 notable Stock Exchanges in their study.

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[7] Please refer to https://www.forbes.com/sites/rogeraitken/2018/07/26/bitcoin-surges-past-8000-as-crypto-market-cap-passes-300b/#36c6cbf45372.

[8] Please refer to https://www.statista.com/statistics/247280/number-of-bitcoins-in-circulation/.
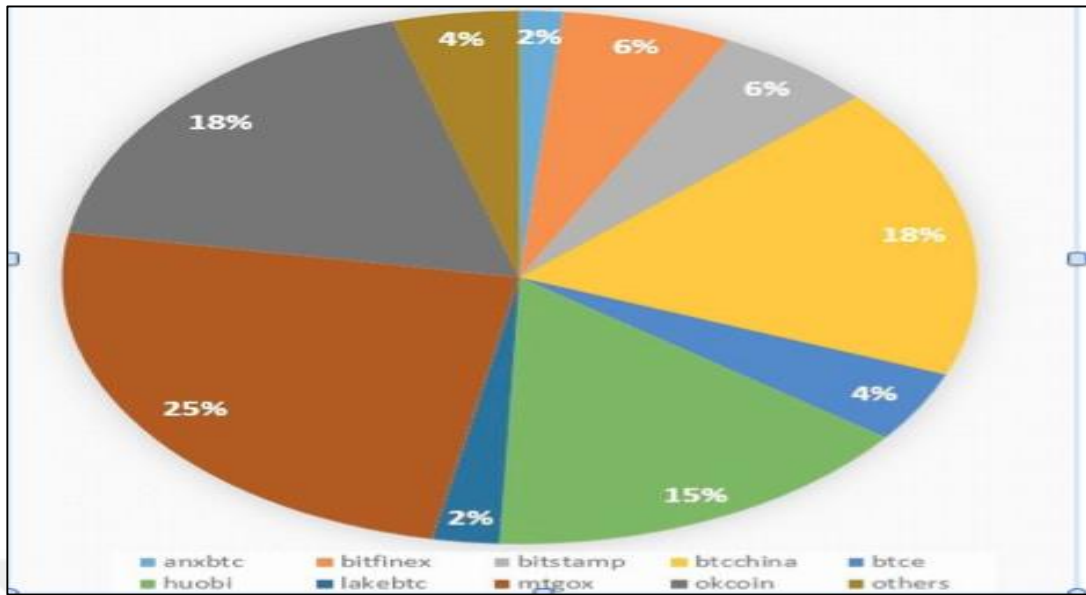
Figure 3: Market Shares In The Total Transaction Volumes of The Stock Exchanges (BTC, 5 Years Cumulative, 26/07/2010-27/07/205)

Mt. Gox has declared bankruptcy in February 2014, and most of it about half a billion dollars have been lost. With the closing of Mt.Gox, other stock exchanges the importance of the market has increased.

BTC is traded against many official currencies. The market shares of the currencies used in transactions in the bitcoin market are given in Figure 4.
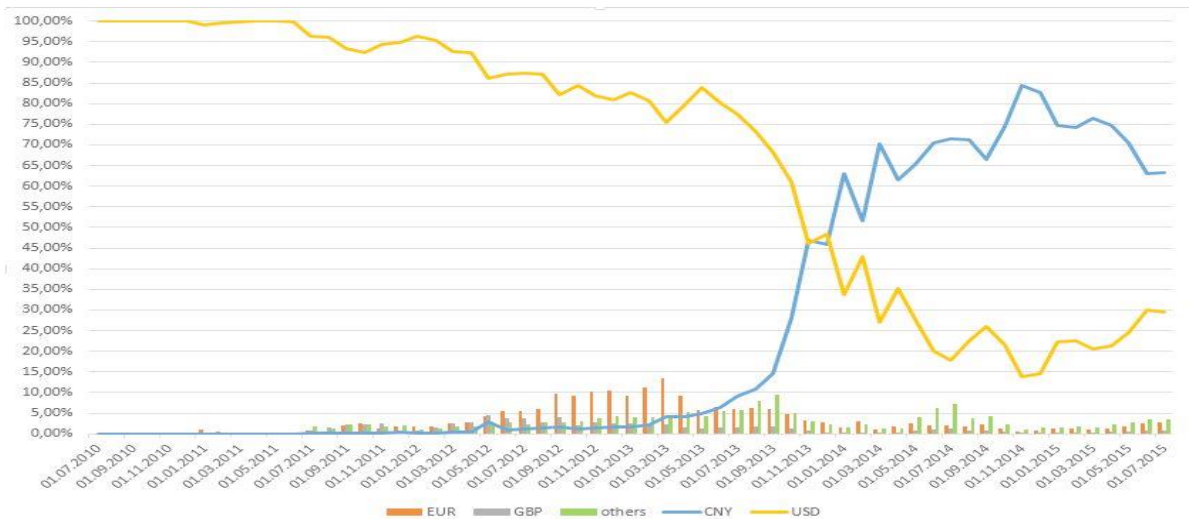

Figure 4: Market Shares In Total Transaction Volumes Of Currencies (BTC, Monthly, 26/07/2010-27/07/2015)
Source: https://blockchain.info

Two major currencies in the BTC market: the US dollar and Chinese yuan. From the beginning to a certain period of BTC operations in the United States, it appears to have occurred in dollars. BTC transactions are all in US dollars. By April 2012, the share of the US dollar was 92%. After this date, the US dollar, which was a leader in the transactions that took place until 2014, lost its leadership to China Yuan. Euro and British pound are likely to be low on market share as well as other major currencies.

3.1. Bitcoin Ecosystem

BTC increases the popularity over time and, accordingly, parallel to the rise in investment, it also created an economic activity area. According to Gültekin and Bulut (2016), the bitcoin ecosystem consists of six elements:

1. Mining companies: Mining companies are responsible for approving the transactions carried out on the bitcoin network and thus creating new bitcoin. From this point of view, they serve as a kind of Mint.
2. E-Wallet service providers: The applications enable the creation and storage of the digital keys that are required for users who are included in BTC network to be able to perform transactions.
3. Companies that provide financial services: These companies also provide financial services to classical financial institutions. Similarly, the funds held as bitcoin and forex trading, financial asset trading, stock trading, such as doing transactions and operating interest to BTC institutions.
4. Money markets (stock markets): These companies allow BTC to be exchanged with other currencies and receive commissions in exchange for this service.
5. Payment processors: With bitcoin or other virtual currencies, companies who want to pay to purchase goods and get service they need.
6. Multi-purpose companies: Such companies offer different combinations of services mentioned above. For instance, a multi-purpose company

provides both e-wallet service and payment process service at the same time.

3.2. The Effect of The Popularity On Bitcoin's Growing Value

BTC continues to be debated all over the world with its beneficial and adverse potentials, which they carry in particular virtual currencies. The arguments are mostly that the phenomenon of "money" will become completely virtual with the development of digitization and the internet. However, there are some parties who are cautious about the issue. The graph below shows the relationship between bitcoin and Google searches for the word "bitcoin". A very strong correlation between the price of Bitcoin and the search on Google is evident from the graph.
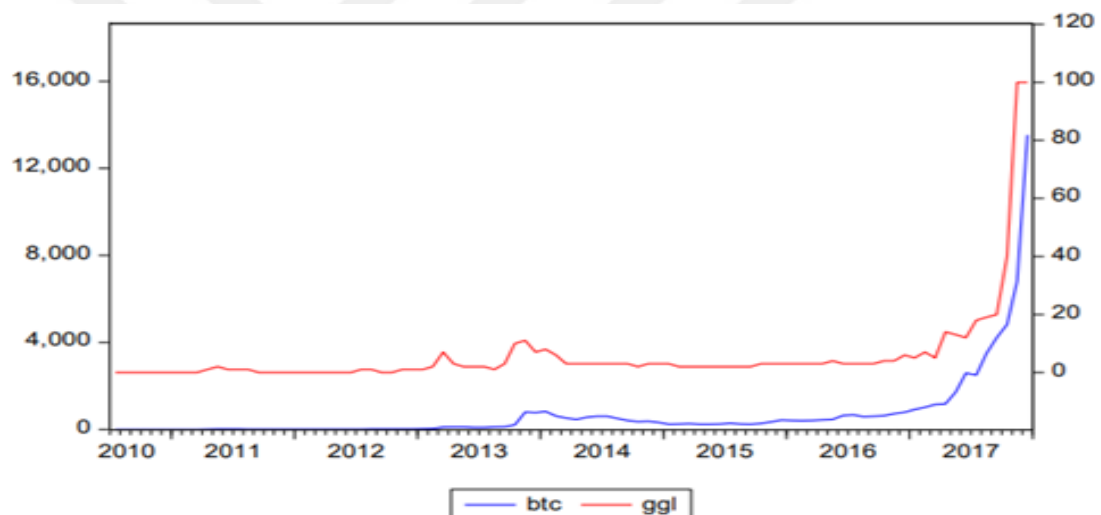
Figure 5: Relationship Between the Value of Bitcoin and its Popularity

Source: Genç. A. G. (2017), The Rising Face of the Digital Economy: The Analysis of Relationship Between the Value of Bitcoin and its Popularity

As of today, the market value of virtual currency in the world is expected to reach $1 trillion by 2018[9]. The number of available virtual currency over the Internet is about 1600[10]. As new virtual currencies emerge every day, blockchain technology continues to be developed.

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[9] Please refer to https://www.cnbc.com/2018/02/13/cryptocurrency-market-to-hit-1-trillion-valuation-in-2018-kraken-ceo.html.

[10] Please refer to https://en.wikipedia.org/wiki/List_of_cryptocurrencies.

3.3. Whether or not invest in Bitcoin

In this part of the study, it is assessed why or why not invest in bitcoin. There are several reasons to invest or not to invest in BTC but the most important ones are discussed.

3.3.1. Reasons to invest in Bitcoin

The following are some reasons why one should invest in Bitcoins[11]:

- No Existence of Third Party: BTC provides somewhat freedom in that no government check exists on bitcoin. Therefore, government cannot freeze someone's money by alleging illegal activities.
- No Taxes: As there is no third party in BTC, then there will never be a viable way of implementing a BTC taxation system.
- No Monitoring: Aside from the bitcoin owner, no one knows how many bitcoins the owner has unless a BTC user publicizes it.
- Reversal of Payment: Unlike the traditional payment methods in which the sender of money can issue a reversal order, in the BTC system, there is no way to reverse the bitcoin payment.
- No Paperwork: As is known, some paperwork is required to transfer, to open up a bank account, or to send a fund but this is not the case in bitcoin. BTC transactions do not involve any form of paperwork. Wallet and address are the needs for BTC operations.
- Accessibility to Markets: The users of traditional money may not be able to access traditional system to make any operations. But BTC can relax this constraint by simply using Internet. So Internet users can easily make their transaction via BTC.
- Charges and Fees: In the absence of any third parties or other factors that can affect the cost of transactions, BTC transactions cost way less than the cost of traditional transactions.

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[11] Please refer to https://bitcoinexchangeguide.com/10-reasons-why-you-should-invest-in-bitcoins/.

- Swift Transaction: In the traditional payment method, it may take time for a transaction to settle. But BTC transactions are done in a very short time period.

3.3.2. Reasons not to invest in Bitcoin

The following are some reasons why one should not invest in Bitcoins[12]:

- Extreme volatility: As it is discussed in detail, BTC is subject to extreme volatility. This is in part due to the lack of some traditional money properties. This high volatility makes the investment in BTC risky.
- Lack of Clarity: BTC is neither called as commodity due to complex mathematical formulae nor as currency due to lack of government support. So this increases the riskiness of BTC.
- The uncertainty about the underlying mechanism: Most of the people do not understand the phenomenon behind the BTC, some argue that it is a bubble and some others assets that it is a safe heaven. But one thing is for sure that no one is willing to invest in something, which is unknown to them.
- An unregulated space: As opposed to traditional money, BTCs are not regulated by government. There is some obvious risk in a platform in which unregulated schemes prevail.
- The issue of legality: Complicated legality of BTC is another issue. Even though it is not declared as illegal, Central Banks do not recognize. Some of the regulators of some countries.
- Have not issued licenses to companies for trading in any virtual or digital currencies.
- Prone to illegal activity: Due to the lack of government control, some illegal organizations or people who want to launder money are also utilizing the crypto currency space to their advantage.

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[12] Please refer to https://economictimes.indiatimes.com/wealth/invest/7-reasons-why-you-should-not-invest-in-bitcoins-cryptocurrencies/articleshow/60891341.cms .

There are various advantages as well as disadvantages that use of BTC poses and it is widely discussed in the literature. Iwamura et al. (2014) appraise the contribution of the Satoshi Nakamoto, the founder of the BTC, and stated that by preannouncing the total supply of the BTC, Nakamoto aimed at creating a currency without inflation. However, they added there is much room for improvement to have this kind of currency.

Raymaekers (2015) addressed the challenges and opportunities that BTC proposes. Accordingly, followings are the challenges bitcoin faces.

- Trust in service providers: Users want to be confident that bitcoin cannot be stolen or lost from their wallet and this can be accomplished by service providers.
- Price stability: Oscillation in the value of the currency creates a negative perception about the stability of bitcoin so that customers are shied away to use it.
- Technology performance: Underlying technology of bitcoin must "fit for purpose" in that BTC's performance must be supported by the technological infrastructure.
- Clear regulation: While a cryptocurrency itself cannot be regulated, its service providers are obliged to comply with applicable regulation in order for consumers to be adequately protected and to have confidence in those services.
- Compelling benefits: As people use traditional currencies, it is not easy to convert their preference into a new currency without providing additional benefits. So, BTC must be cheaper, faster, and more convenient to be preferred.

Bunjaku (2017) compiled several advantages of using BTC:

- Open code for cryptocurrency: The algorithm used is the same with the online banking. Besides, all information about the transaction in the BTC network is shared.
- No inflation: As there is no force to change the pre-determined 21 million BTC, there will not be inflation.

- Unlimited possibilities of transaction: Since every wallet holders can pay to anyone, anywhere and any amount, the number of transaction is assumed to be unlimited.

- No boundaries: Payments are impossible to cancel and this improves the integrity of the system. Because of this, growing number of shops accept BTC as a means of exchange.

- Easy to use: It is not easy to open up a bank account for company in some countries. In this sense, BTC is much more convenient to use.

- Anonymity: It is entirely anonymous and at the same time fully transparent.

- Speed of transaction: It is possible to send and receive money in a matter of minutes.

What makes BTC attractive for investors is described by Ciaian et al. (2016). Accordingly, first one is the risk and uncertainty that might affect the price of the BTC. Provided that BTC is a fiat currency and hence intrinsically worthless. Being intrinsically worthless means that there is no underlying values derived from consumption or its use in production process. Therefore, it makes sense to say that the value of BTC depends on the trust on its medium of exchange feature.

On the contrary, BTC, as a digital currency, is subject to cyber-attacks, which can deteriorate the price of the Bitcoin and undermine the trust developed against it. Moore and Christin (2013) examine 40 BTC exchanges[13] and found that 18 have closed down due to cyber-attacks.

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[13] There are currently numerous BTC exchanges around the world. Top exchanges are Bifinance, Bittrex, KuCoin, Huobi Pro, Bibox, Poloniex, Bitmex, Coinbase (GDAX), LocalBitcoins, Kraken, and Bitfinex. Please see https://coinsutra.com/best-bitcoin-exchanges/.

Table 2: 40 Known Bitcoin Currency Exchanges

Exchange	Origin	Dates Active	Daily vol.	Closed?	Breached?	Repaid?	AML	Risk Ratio
BitcoinMarket	US	4/10 – 6/11	2454	yes	yes	–	34.3	1.12
Bitomat	PL	4/11 – 8/11	758	yes	yes	yes	21.7	1.28
FreshBTC	PL	8/11 – 9/11	3	yes	no	–	21.7	2.01
Bitcoin7	US/BG	6/11 – 10/11	528	yes	yes	no	33.3	1.59
ExchangeBitCoins.com	US	6/11 – 10/11	551	yes	no	–	34.3	0.65
Bitchange.pl	PL	8/11 – 10/11	380	yes	no	–	21.7	0.61
Brasil Bitcoin Market	BR	9/11 – 11/11	0	yes	no	–	24.3	3.85
Aqoin	ES	9/11 – 11/11	11	yes	no	–	30.7	1.57
Global Bitcoin Exchange	?	9/11 – 1/12	14	yes	no	–	27.9	1.45
Bitcoin2Cash	US	4/11 - 1/12	18	yes	no	–	34.3	1.47
TradeHill	US	6/11 - 2/12	5082	yes	yes	yes	34.3	0.94
World Bitcoin Exchange	AU	8/11 – 2/12	220	yes	yes	no	25.7	1.80
Ruxum	US	6/11 – 4/12	37	yes	no	yes	34.3	1.24
btctree	US/CN	5/12 – 7/12	75	yes	no	yes	29.2	0.98
btcex.com	RU	9/10 – 7/12	528	yes	no	no	27.7	0.61
IMCEX.com	SC	7/11 – 10/12	2	yes	no	–	11.9	1.88
Crypto X Change	AU	11/11 – 11/12	874	yes	no	–	25.7	0.53
Bitmarket.eu	PL	4/11 – 12/12	33	yes	no	no	21.7	1.09
bitNZ	NZ	9/11 – pres.	27	no	no	–	21.3	1.14
ICBIT Stock Exchange	SE	3/12 – pres.	3	no	no	–	27.0	2.15
WeExchange	US/AU	10/11 – pres.	2	no	no	–	30.0	2.23
Vircurex	US?	12/11 – pres.	6	no	yes	–	27.9	4.41
btc-e.com	BG	8/11 – pres.	2604	no	yes	yes	32.3	1.08
Mercado Bitcoin	BR	7/11 – pres.	67	no	no	–	24.3	0.95
Canadian Virtual Exchange	CA	6/11 – pres.	832	no	no	–	25.0	0.53
btcchina.com	CN	6/11 – pres.	473	no	no	–	24.0	0.60
bitcoin-24.com	DE	5/12 – pres.	924	no	no	–	26.0	0.52
VirWox	DE	4/11 – pres.	1668	no	no	–	26.0	0.45
Bitcoin.de	DE	8/11 – pres.	1204	no	no	–	26.0	0.49
Bitcoin Central	FR	1/11 – pres.	118	no	no	–	31.7	0.91
Mt. Gox	JP	7/10 – pres.	43230	no	yes	yes	22.7	0.49
Bitcurex	PL	7/12 – pres.	157	no	no	–	21.7	0.76
Kapiton	SE	4/12 – pres.	160	no	no	–	27.0	0.80
bitstamp	SL	9/11 – pres.	1274	no	no	–	35.3	0.54
InterSango	UK	7/11 – pres.	2741	no	no	–	35.3	0.45
Bitfloor	US	5/12 – pres.	816	no	yes	no	34.3	1.45
Camp BX	US	7/11 – pres.	622	no	no	–	34.3	0.63
The Rock Trading Company	US	6/11 – pres.	52	no	no	–	34.3	1.14
bitme	US	7/12 – pres.	77	no	no	–	34.3	1.04
FYB-SG	SG	1/13 – pres.	3	no	no	–	33.7	2.23

Source: Moore and Christin (2013:2)

Note: "Origin" represents the jurisdiction under which the exchange operates, "AML," the extent to which the exchange's jurisdiction has implemented "Anti-Money Laundering and Combating the Financing of Terrorism" international standards. "Risk ratio" is the relative risk of exchange failure based on the Cox proportional hazards model

Table 2 presents that 18 of the BTC exchanges are closed down. Of them, nine exchanges are closed due to security breaches and other nine closures occurred but the reason of breach has not been disclosed to the public.

Another one is transaction cost, which is an important determinant of the price of the BTC. Investors' preferences may be affected by the presence of many alternative investment choices and search costs.

CHAPTER IV
EMPIRICAL ANALYSIS ON BITCOIN MARKET VOLATILITY

One of the biggest questions people ask these days about cryptocurrencies is that they are whether currency or commodity. Many people have different thoughts about it and its being debated a lot. In substance, it was created to be used as a currency for any transactions that we do with normal money. BTC was first declared as a P2P electronic payment system by Satoshi Nakamoto. So actually, the creator himself does not specifically say that it is a currency. It can be considered a new system of payment.

Capital Markets Board of Turkey says that it cannot be considered as a security because it is not a real/physical product. In addition, Turkish Central Bank does not accept it a currency. Therefore, if we have to fit it into a term the closest it would be considered as is a commodity. However, the answer to the question "commodity or currency" largely depends on geographic location and political influence.

A commodity such as livestock, salt, oil, and gold is defined as being a basic good used in trade for hundreds of years. Perhaps the most instructive illustration of BTC's likeness to commodities is the gold analogy. When viewed as a hard asset, BTC and gold have several key elements in common:

Scarcity: New quantities of gold or BTC are not easily added to existing supplies, ensuring their scarcity.

Finite supply: While gold's supply is assumed finite, BTC's is an absolute maximum of 21 million.

Inherent value: Both gold and BTC have value, which makes them assets as well as being viable means of trade.

In comparison to gold, BTC exhibits many of the common attributes of traditional commodities. These similarities have given rise to the official launch of BTC futures exchanges. Over time, the trade of BTC derivatives products may come to resemble that of traditional commodity-based asset classes.

For this reason with the Crypto's big rise in the past years many people invested in this as commodity or an instrument to profit from. However, this completely change and betrays the main purpose of this new technological invention. It started being sold and brought on cryptocurrency exchange markets much more than being normally used for P2P transactions. In light of this, it evolved more into a commodity then a creation purpose of being a currency. However, time will show what we will call it in the future and we will see if it can settle into our lives as currency.

4.1. Literature review

After its introduction in 2009, price of the BTC followed a stable path up to late-2012. As is readily seen from the Figure 6 below, the BTC has experienced a dramatic increase from $5.28 and ended at $388.55 in the sample period. This figure tells us a very important dynamic about the cryptocurrencies market, which is volatility.

Figure 6: Bitcoin Price to USD

Source: Baur et al. (2015:19)

BTC has shown very volatile rise and falls throughout its lifetime. It was peaked at $1,150.75 on November, 2013 and then dropped to a level of $545.53 December, 2013. Additionally, bigger fall happened on April, 2013 (Baur et al., 2015).

In recent years (for 2 years) BTC rate has shown sharply changes. The volatility of BTC prices has very rapid rise and falls. As is readily seen from the Figure 7 below, although the BTC is equal to almost 20.000 USD, nowadays price of bitcoin is around 6.500 USD. This graph shows us clearly that price of BTC has fallen sharply and volatility of BTC has been very sensitive in recent years.

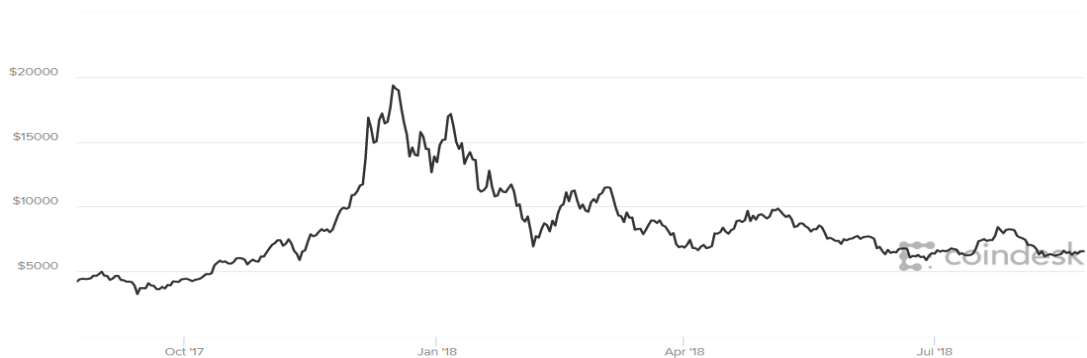**Figure 7:** Bitcoin Price to USD (2017-2018)

Source: https://www.coindesk.com/price/ (24.08.2018)

The popularity of BTC has encouraged researchers to investigate and provide a full-fledge position of BTC in the modern economy. Because, it is rather

controversial whether BTC is a currency. To properly address this, it makes sense to follow Mankiw's (2007) three criteria of currency:

- Medium of exchange,
- Unit of account, and
- Store of value

Yermack (2013) is one of the researchers who tried to address currency criteria of BTC. Accordingly, he concludes that BTC does not appear to have unit of account or a store of value features due to large risk that bitcoin imposes on the holders. This excessive risk arises from the wild volatility and low correlation with other currencies. Figure 8 exhibits volatility of the BTC-Dollar exchange rate from January 1 - November 29, 2013.
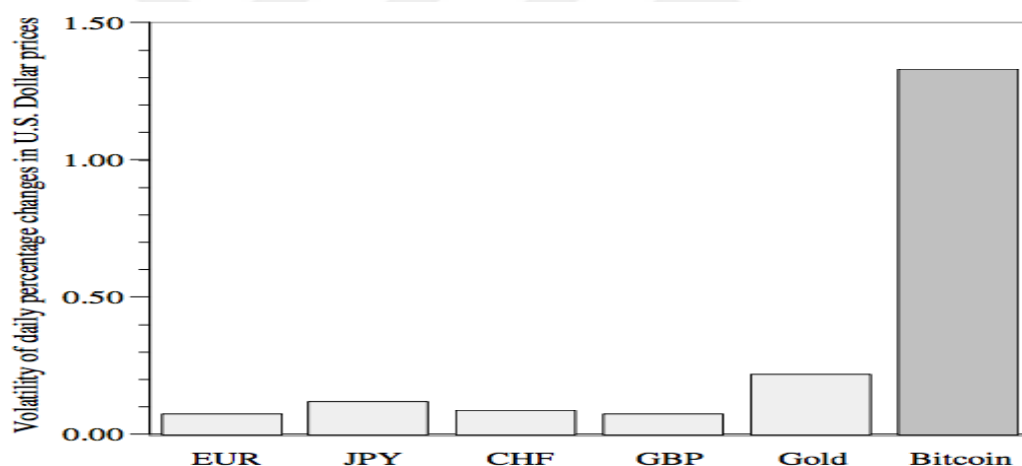
Figure 8: Volatility of Bitcoin and Other Major Currencies
Source: Yermack (2013:12)

To illustrate, volatilities of the exchange rates of the Euro, Yen, British Pound, and Swiss Franc as well as the price of gold are shown. BTC's volatility is so large that it is almost 10 times as high as other currencies. To be more specific, volatility of bitcoin is around 133% and the volatility of the rest of the currency fall between 8% and 12%.

In the same vein, Baur (2015) however BTC's intended purpose is being a medium of exchange but large majority of the BTC users do not use BTC as a medium

of exchange. So, as Yermack, BTC is held as investment purposes rather than transaction purposes.

Price formation of BTC is another issue widely discussed in the literature. Buchholz et al. (2012) stated that the interaction between BTC supply and demand is the key to the price formation process of the BTC. They added that demand for BTC is driven by its value as a medium of exchange. The supply of the BTC, on the other hand, is given by the stock of BTC in circulation, which is publicly known and is predefined in the long term.

According to Bouoiyour and Selmi (2017), the existing literature identify the determinants of the BTC price are:

- Fundamental, macroeconomic and financial sources
- Speculation and
- Technical contributors

They added the potential influence of the 2016 events as an additional determinant. They found three important BTC determinants. First group contains the most effective BTC determinants at the expansion of the market. These are uses of BTC in trade and the yuan deterioration, uncertainty about the Brexit and India's demonetization. At the normal state, BTC fundamentals is formed uncertainty around presidential elections and finally at the bear state of the market, BTC Fundamentals are velocity of BTC, the price of gold, and the increased fears over Venezuelan demonetization.

Lee (2014) studied the BTC's characteristics in a way to include speculations in the market. He showed that the positive and negative news contributed to the price of BTC. He further identified four periods which are:

- BTC gets a wave of positive press: As the number of BTC purchased increases then the price of it increases.

- The bubble pops, usually triggered by some kind of bad news: Subsequent to the bad news, BTC users flooded into the market and sell the BTC at their disposal which triggers a panic sell and result in falling prices.

These two periods indicate the characteristics of momentum effect. Momentum-strategy occurs if an investor desire to take a long position in an asset that has been upward trend and short position if an asset has been downward trend.

- BTC users who is inclined to panic-sell has done so, and the price bottoms out: After the shocks, price rise tend to create a new profit-taking period but in this case each price rise or fall is smaller than the one that preceded it.

- BTC's price stabilizes: Most of the BTC are in the hands of people who intend to hold them for the long term, so bitcoin price will be rather stable until the next book initiates.

Before moving to in-depth research on the volatility of the BTC market, it is of importance to determine the distribution of the return of bitcoin as well as other cryptocurrency. Chan et al. (2017) analyses the statistical features of the major cryptocurrencies. The cryptocurrencies used in this study are BTC, Dash, Dogecoin, Litecoin, MaidSafeCoin, Monero, and Ripple. Firstly, histogram of the logartihm of daily returns is provided so that frequency of the cryptocurrencies can be observed.

Histogram shows that there is a significant deviation from the normal distribution for all cryptocurrencies. For instance, BTC's return has gathered around the mean and very few observations in the tails. Moreover, the distribution is not symmetric and bell-shaped. One of the most striking observations is that all the cryptocurrencies have similar distribution except for MaidSafeCoin.
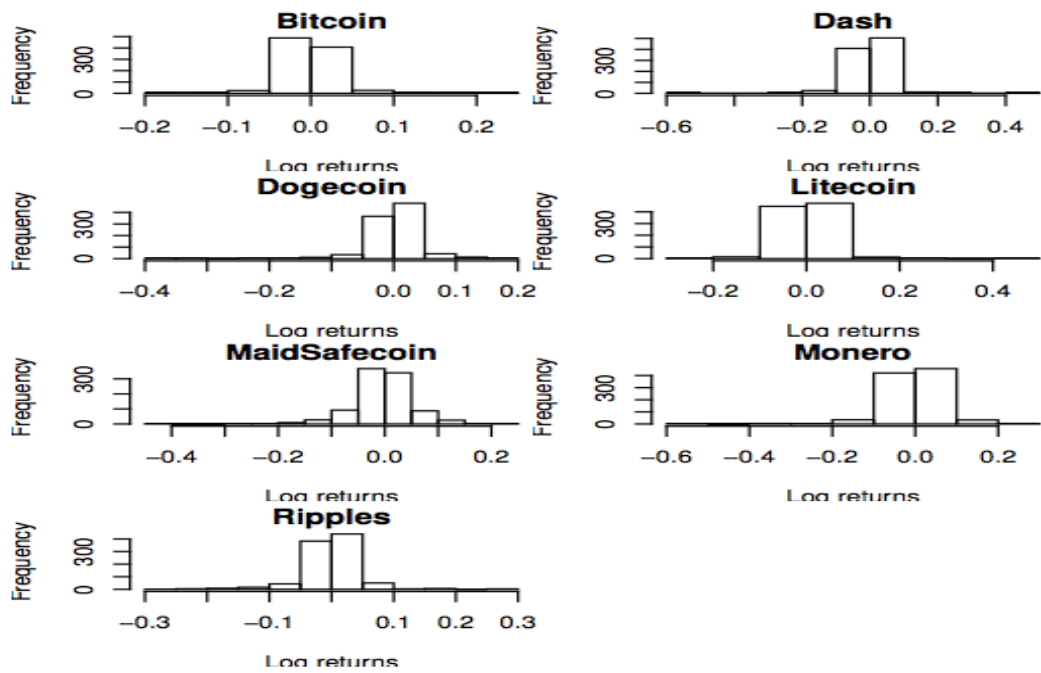
Figure 9: Histograms of Cyrptocurrencies
Source: Chan et al.(2017:6)

After analyzing histogram, in order to decide which distribution these cryptocurrencies are fit, Q-Q plots are given in the same study. Q-Q plot, or quantile-quantile plots, is a graphical examination to determine whether or not data comes from some theoretical distribution. Q-Q plot is subject to visual check so that deviation can be observed.

Accordingly, BTC's the best fitting distribution fits the middle and lower parts of the return data well but it is not true for the upper tail. As for Dogecoin and Ripple's best fitting distribution captures the middle part of the data but not properly capture the lower and upper parts. Dash and Litecoin's, on the other hand, distribution's middle, upper and lower parts captures the data well.

Dogecoin's distribution captures the middle part of the data and MaidSafeCoin's best fitting distribution captures the middle and upper parts of the data well.
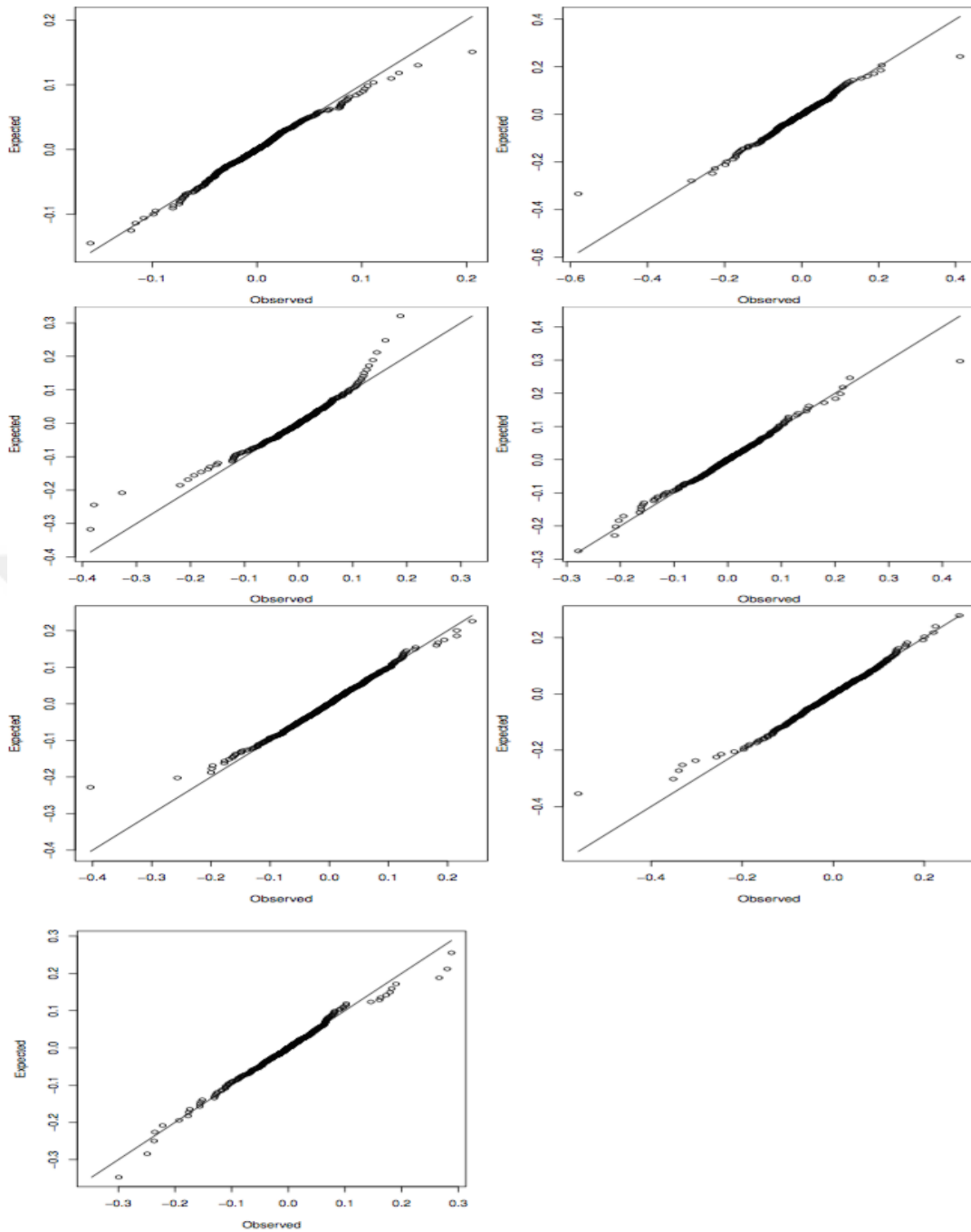
Figure 10: Q-Q Plots of Cyrptocurrencies

Source: Chan et al.(2017:15)

Note: The Q-Q plots of the best fitting distributions for daily log returns of the exchange rates of Bitcoin (first row, left), Dash (first row, right), Dogecoin (second row, left), Litecoin (second row, right), MaidSafeCoin (third row, left), Monero (third row, right) and Ripple (last row) from 23 June 2014 until 28 February 2017.

Therefore, they concluded that cryptocurrencies are not normally distributed in that they exhibit heavy tails.

According to the paper of by Brière et al. (2013) studied the diversification of benefit of BTC. But while doing this study, they stated that the average return and volatility are skyrocketed by 404% and 176% annually. Their dataset is weekly BTC exchange rate against the USD during 23 July 2010 to 27 December 2013.

Chowdhury (2014), on the other hand, improve the work of Brière et al. (2013) by extending the sampling period to include the months of August through January 2014 and adopting different method. He finds out that BTC has much more volatility compared to Euro, GBP, stocks, bonds, gold, oil, and real estate.

Studies of Brière et al. (2013) and Chowdhury (2014) shows that as the lack of BTC's fundamental value and lack of regulation in BTC market, BTC has different characteristics than many traditional assets.

Eisl et al. (2015) by adopting non-normal distribution of the bitcoin returns, and thanks to the low correlations between the bitcoin returns and currencies, stocks, bonds or commodities such as gold or oil, they conclude that BTC should be taken place in optimal portfolios. Other distinctive feature of this study is the empiric method they employed. Due to the non-normal nature of BTC returns, classical mean-variance cannot be applied. They, therefore, used Conditional Value-at-Risk that does not require asset returns to be normally distributed.

Dyhrberg (2015) set out that BTC can be used as a hedge against stocks in the Financial Times Stock Exchange Index by using GARCH methodology. So, bitcoin can be included into the portfolio mitigate the harmful effects of sudden shock.

Johansson and Tjernström (2014) by taking into account the different characteristics of BTC, conduct a comprehensive study to empirically observe the price volatility of BTC. The starting point of their study is to embrace the idea of Madhavan (2000) that information structure and informational efficiency of a market matters in determining the price formation. After carefully examination of literature and public news, they identify the relevant variables to be used in the empirical part. Variables are; information demand, trade volume, world market index, trend and six

specified events as dummy variables. According to the GARCH (1,1) model, information demand has statistically significant relation with the BTC volatility, which is, confirmed the theory developed by Madhavan.

Bourie et al.(2016) studied the price return and volatility changes and he reached a very interesting findings. Based on an asymmetric-GARCH framework, their study indicates that the direction of the relation changes before and after the price crash. Accordingly, authors concluded that, in the pre-crash period, BTC has a safe-heaven property similar to traditional asset such as gold but in the post-crash period it turns out that this safe-heaven feature disappears.

The relationship between bitcoin realized price (and volatility) and popularity of the cryptocurrency are examined via different researchers. Of them, Kristoufek (2013) and Davies (2014) stand out. Kristoufek (2013) showed that there exists strong bidirectional causal association between the prices and online searched conducted by Wikipedia and Google as well as correlation between these two variables.

Figure 11 shows the evolution of bitcoin price and search queries conducted via Wikipeadi and Google. It seems that there is high correlation between bitcoin price and search queries during 2012-2013.
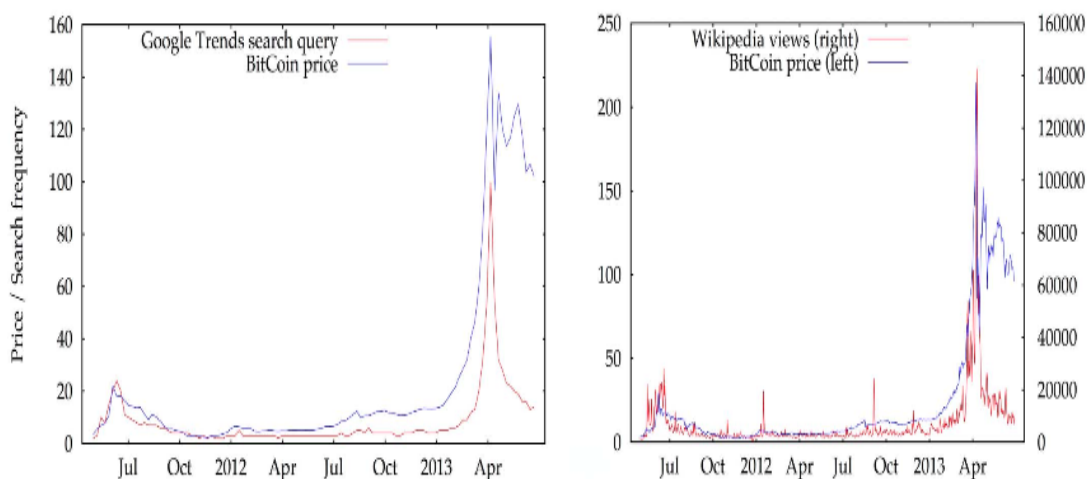

Figure 11: Evolution of Bitcoin Price and Search Queries
Source: Kristoufek (2013:2)

Davies (2014), by applying Vector Autoregressive model and Granger

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causality, concluded that Google Trends have an impact on the realized volatility of BTC. Applying the same logic, one can use this relation to forecast future volatility of BTC.

Cesar and Estrada (2017) examines the influence of the S&P-500 and VIX volatility as well as BTC's underlying technology, blockchain, on BTC's price. They employ Vector Autoregressive model. In their analysis no statistically significant Granger-causality is found when analyzing the time series of BTC and the S&P 500 and BTC and the VIX. However, the Granger causality test applied on the BTC volatility and S&P 500 time series show that BTC volatility Granger-causes S&P 500 at the 5% significance level. Therefore, BTC volatility provides some insight into the behavior of the S&P-500. Further, it is concluded that BTC price as a proxy of the volatility of the market.

Correlation between the price of bitcoin and S&P500 is 0.8099 indicating a positive and high correlation, which can be readily observable in Figure 12 below. Correlation, namely -0.4611, between bitcoin volatility and S&P500, on the other hand, turns out to be negative and lower compared to price of bitcoin and S&P500. In particular, after 2014, the S&P-500 goes up but the trend of the bitcoin realized volatility is on the decline.
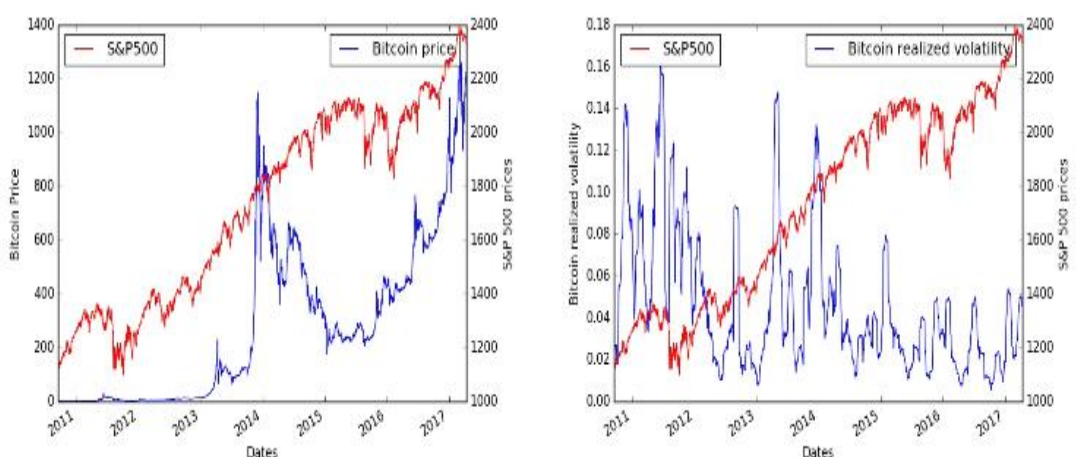

Figure 12: S&P-500 vs Bitcoin Price and Volatility
Source: Cesar and Estrada (2017: 9)

Then they visualize the Volatility Index of S&P-500 (S&P-500 VIX) and

Bitcoin price and realized volatility. The correlation coefficient of −0.4278 between S&P-500 VIX and BTC price indicating that there is these two variables are negatively correlated while the coefficient of 0.3055 amounts to positive and relatively low correlation between the S&P-500 VIX and BTC realized volatility. This is displayed in Figure 13.
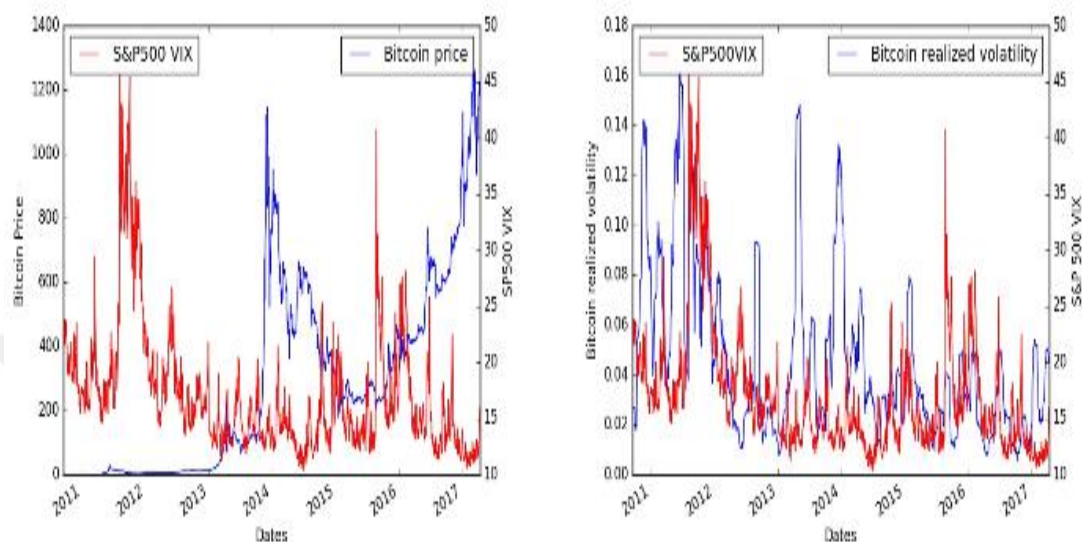
Figure 13: S&P-500 VIX vs Bitcoin Price and Volatility
Source: Cesar and Estrada (2017: 10)

4.2. Data and Methodology

We investigate whether BTC's price behavior is similar to a currency or a commodity. In this context, we compare BTC with major currencies, i.e. USD, EUR, GBP and JPY, and with major commodities, i.e. GOLD and OIL. All variables are presented in terms of natural logarithm and are on a daily basis for the period between 2010:07 and 2018:8. We translate all variables into USD. For instance, we look for the relationship between variables by using the USD transformation namely USD/BTC, USD/EUR, USD/GBP, USD/JPY, USD/GOLD, USD/OIL. In order to compare BTC with USD, we use the Dollar Index, DXY, as a proxy. Data are obtained from Bloomberg. Table 3 displays a brief description of variables used in this study.

Table 3: Variable Definition

Variables	Proxy
Bitcoin	USD/BTC
USD	DXY
EURO	USD/EUR
GBP	USD/GBP
JPY	USD/JPY
GOLD	USD/GLD
OIL	USD/OIL

Table 4 presents the descriptive statistics for the series.

Table 4: Descriptive Statistics

Statistics	USD/BTC	DXY	USD/EUR	USD/GBP	USD/JPY	USD/GLD	USD/OIL
Mean	-4,772	4,464	-0,213	-0,403	4,598	-7,206	-4,255
Median	-5,641	4,424	-0,229	-0,438	4,631	-7,169	-4,390
Max	3,006	4,638	-0,038	-0,186	4,833	-6,958	-3,279
Min	-9,870	4,290	-0,394	-0,540	4,328	-7,550	-4,734
St.Dev.	3,005	0,095	-0,092	0,091	0,154	0,132	0,344
Skewness	0,675	0,111	0,152	0,775	-0,395	-0,662	0,464
Kurtosis	2,812	1,520	1,701	2,325	1,724	2,478	1,912
Jarque-Bera	163,2*	197*	156,5*	251,6*	198,1*	178*	179,9*
Observations	2.111	2.111	2.111	2.111	2.111	2.111	2.111

As can be seen from Table 4, BTC is the most volatile [e.g. St. Dev is 3,005 and the range between Min (-9,870) and Max (3,006) figures is so large] instrument when compared to other currencies/commodities. Figure 13 and 14 shows the graphical representation of variables in level form.

Figure 14: BTC vs. Currencies
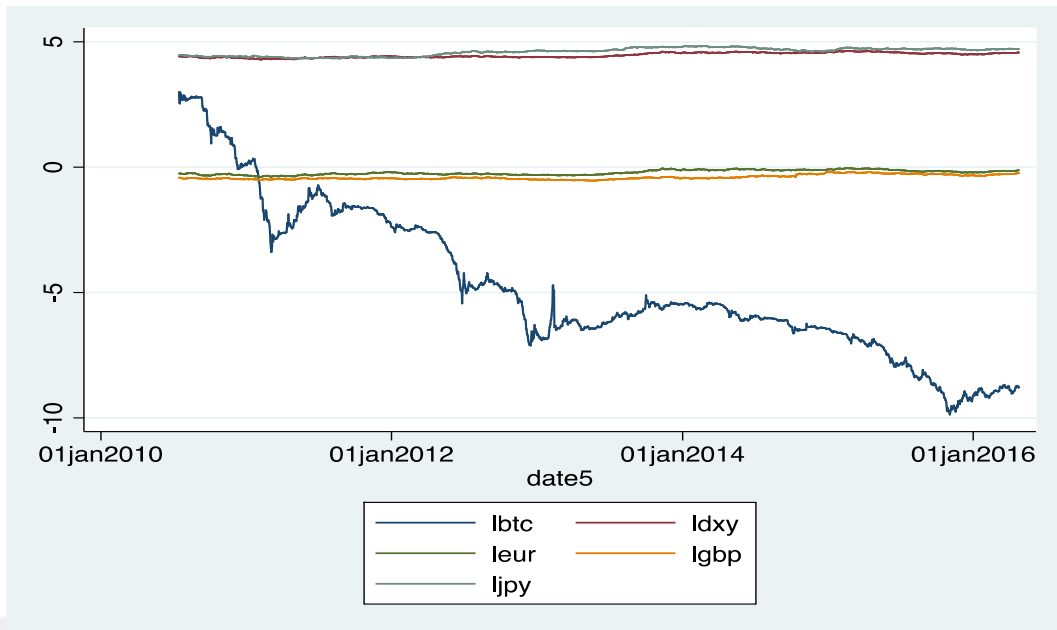

Figure 15: BTC vs. Commodities

We employ Johansen cointegration and Granger causality tests in our study. These tests require an examination whether variables are stationarity. Thus, we use Augmented Dickey-Fuller (Dickey and Fuller, 1979-ADF) and Philips-Perron (Phillips and Perron, 1988-PP) unit root tests to examine the stationarity of series. Relevant hypotheses are as follows:

H0: Series are not stationary (there is unit root)

H1: Series are stationary (there is no unit root)

The equations used in ADF (1) and PP (2) tests are provided below:

$$\Delta Y_t = \beta_0 + \beta_1 t + \delta Y_{t-1} + \sum_{i=1}^{m} \beta_i \Delta Y_{t-i} + u_t \tag{1}$$

$$\Delta Y_t = \alpha_o + \alpha_1 (t - T/2) + \alpha_2 Y_{t-1} \sum_{i=1}^{m} \Delta Y_{t-i} + \varepsilon_t \tag{2}$$

If unit root tests do not yield the same order of stationarity for the variables, they need to be repeated by using the first differences. The series should have the same order of stationarity so that the cointegration relationship can be investigated between series.

In this regard, we investigate the presence of a long-term linear relationship (cointegration) between the series by using the tests introduced by Johansen (1988) and Johansen and Juselius (1990). These tests provide trace and maximum eigenvalue likelihood ratios to make inferences. Hypothesis to be examined with Johansen cointegration test is presented below:

H0: There is no cointegration relationship between variables.

H1: There is cointegration relationship between variables.

In the presence of a cointegration relationship, the causality relationship is determined by Granger causality test performed in line with the vector error correction model (VECM) model, while the absence of a cointegration relationship requires that causality relationship should be determined by the standard Granger causality test. Standard equations regarding the VECM are as follows:

$$\Delta X_t = a_0 + \sum_{i=1}^{a} a_i \Delta Y_{t-i} + \sum_{i=1}^{b} \beta_i \Delta X_{t-i} + \lambda EC_{t-1} + u_{xt} \tag{3}$$

$$\Delta Y_t = \beta_0 + \sum_{i=1}^{a} a_i \Delta Y_{t-i} + \sum_{i=1}^{b} \beta_i \Delta X_{t-i} + \lambda EC_{t-1} + u_{yt} \tag{4}$$

In the models above, α and β indicate the parameters to be estimated, a and b coefficients indicate lag lengths, EC_{t-1} coefficient indicates error correction term, X and Y coefficients indicates independent or dependent variables.

Granger causality is also performed in order to determine the direction of the relationship between variables (Granger, 1969). The following model is estimated in order to determine the direction of causality:

$$Y_t = \alpha_0 + \sum_{i=1}^{k1} \alpha_i Y_{t-i} + \sum_{i=1}^{k2} \beta_i X_{t-i} + \varepsilon_t \tag{5}$$

$$X_t = \chi_0 + \sum_{i=1}^{k3} \chi_i X_{t-i} + \sum_{i=1}^{k4} \delta_i Y_{t-i} + v_t \tag{6}$$

In (5) and (6), k shows the lag length and it is assumed that error terms are independent from each other (white noise) (Granger 1969). If all of the coefficients in (5) are meaningless as a whole, and coefficients in (6) are meaningful as a whole, then there is a one-way causality from Y (independent variable) to X (dependent variable).

Lastly, we employ impulse response function (IRF) and forecast error variance decomposition (FEVD) analyses.

4.3. Empirical Findings

The results in Table 5 give the findings about the ADF and PP test results for our variables.

Table 5: Unit root tests

	Lags	ADF Constant	ADF Constant and Trend	PP Constant	PP Constant and Trend
Level					
USD/BTC	4	-2,474	-2,575	-2,617***	-2,640
DXY	2	-0,911	-2,431	-0,926	-2,414
USD/EUR	1	-1,302	-2,236	-1,314	-2,254
USD/GBP	1	-0,804	-2,449	-0,816	-2,424
USD/JPY	1	-0.954	-1,418	-0,963	-1,415
USD/GLD	1	-1,702	-2,861	-1,691	-2,816
USD/OIL	2	-1,241	-1,691	-1,260	-1,746
First Difference					
USD/BTC	3	-21,903*	-21,972*	-50,471*	-50,523*
DXY	1	-32,653*	-32,650*	-48,488*	-48,480*
USD/EUR	0	-46,609*	-46,599*	-46,609*	-46,599*
USD/GBP	0	-46,243*	-46,254*	-46,243*	-46,254*
USD/JPY	0	-46,126*	-46,116*	-46,126*	-46,116*
USD/GLD	0	-46,231*	-46,242*	-46,231*	-46,242*
USD/OIL	1	-33,296*	-33,289*	-47,475*	-47,463*

A quick examination will clearly show that all of the variables are non-stationary at level. However when we convert them into first differenced, they become stationary. They are all integrated of same order, i.e. I(1). Hence, we apply Johansen cointegration test and VECM for BTC with currencies and commodities respectively.

Table 6: Co-integration Results for BTC-Currencies (Trace and Max-Eigen Statistics)

	H$_0$	H$_1$	Eigenvalue	Trace Statistic	1%
0	r=0	r=1		60,882*	76,070
1	r≤1	r=2	0,014	31,548	54,460
2	r≤2	r=3	0,009	11,788	35,650

	H$_0$	H$_1$	Eigenvalue	Max-Eigen Statistics	1%
0	r=0	r=1		29,333*	38,770
1	r≤1	r=2	0,014	19,761	32,240
2	r≤2	r=3	0,009	7,993	25,520

Table 7 Co-integration Results for BTC-Commodities (Trace and Max-Eigen Statistics)

	H₀	H₁	Eigenvalue	Trace Statistic	1%
0	r=0	r=1		24,020	35,650
1	r≤1	r=2	0,007	8,889	20,040
2	r≤2	r=3	0,003	2,820	6,65
	H₀	**H₁**	**Eigenvalue**	**Max-Eigen Statistics**	**1%**
0	r=0	r=1		15,132	25,520
1	r≤1	r=2	0,007	6,068	18,630
2	r≤2	r=3	0,003	2,820	6,65

In line with the results given in Table 6 and Table 7, we cannot reject the null hypothesis that there is no cointegration among our variables. There are no cointegrating vectors and in the long run they do not move together.

In this regard, we employ Granger causality tests in order to infer about the short-run relationship between variables in both individual and collective terms. "df" stands for the lags selected. First differenced data is used in order to reflect stationarity in the tests. Table 8 presents the Granger causality test results:

Table 8. Granger causality tests (BTC-Currencies)

		Panel A		
Equation	Excluded	chi2	df	Prob>chi2
USD/BTC	DXY	0,956	3	0,812
DXY	USD/BTC	0,898	3	0,826
USD/BTC	USD/EUR	0,527	3	0,913
USD/EUR	USD/BTC	1,275	3	0,735
USD/BTC	USD/GBP	1,630	3	0,653
USD/GBP	USD/BTC	6,827	3	**0,078**
USD/BTC	USD/JPY	1,233	3	0,745
USD/JPY	USD/BTC	3,412	3	0,332
		Panel B		
df	Variables	USD/BTC (individual)	df	USD/BTC (together)
3	USD/BTC	-	5	-
3	DXY	-	5	-
3	USD/EUR	-	5	-
3	USD/GBP	->***	5	-
3	USD/JPY	-	5	-

Panel A of Table 8 shows that there is a slight Granger causality running from BTC to GBP unidirectionally. There is no causal relationship between currencies and BTC. Panel B of Table 8, displays the directions.

Table 9. Granger causality tests (BTC-Commodities)

		Panel A		
Equation	Excluded	chi2	df	Prob>chi2
USD/BTC	USD/GLD	23,025	4	**0,000**
USD/GLD	USD/BTC	17,880	4	**0,001**
USD/BTC	USD/OIL	0,561	3	0,905
USD/OIL	USD/BTC	0,255	3	0,968
		Panel B		
df	Variables	USD/BTC (individual)	df	USD/BTC (together)
3	USD/BTC	-	3	-
3	USD/GLD	<->*,*	3	<->*
3	USD/OIL	-	3	-
3	ALL/BTC		3	<-*
3	ALL/GLD		3	<-**
3	ALL/OIL		3	-

Results presented above show that BTC has a relationship between commodities rather than currencies. Most apparent relationship is the one between gold and BTC. They have a bi-directional Granger causality at a significant level of 1%. Though there seems no relationship between BTC and oil, oil and gold all together Granger cause BTC.

Our results suggest that BTC is acting like a commodity, especially gold. Impulse response function (IRF) and forecast error variance decomposition (FEVD) analyses are additionally performed.

Impulse-response functions (IRFs) can be used to estimate the effects of an exogenous shock to a single variable on the dynamic paths of all of the variables of the system. Therefore, we further characterize the IRFs between the variable sequences to analyze the short-term dynamic relationship between them. We observe the shock of one unit standard deviation and the observation period is arbitrarily selected as 20. Figure 16 shows the responses to a shock in one currency on the other.
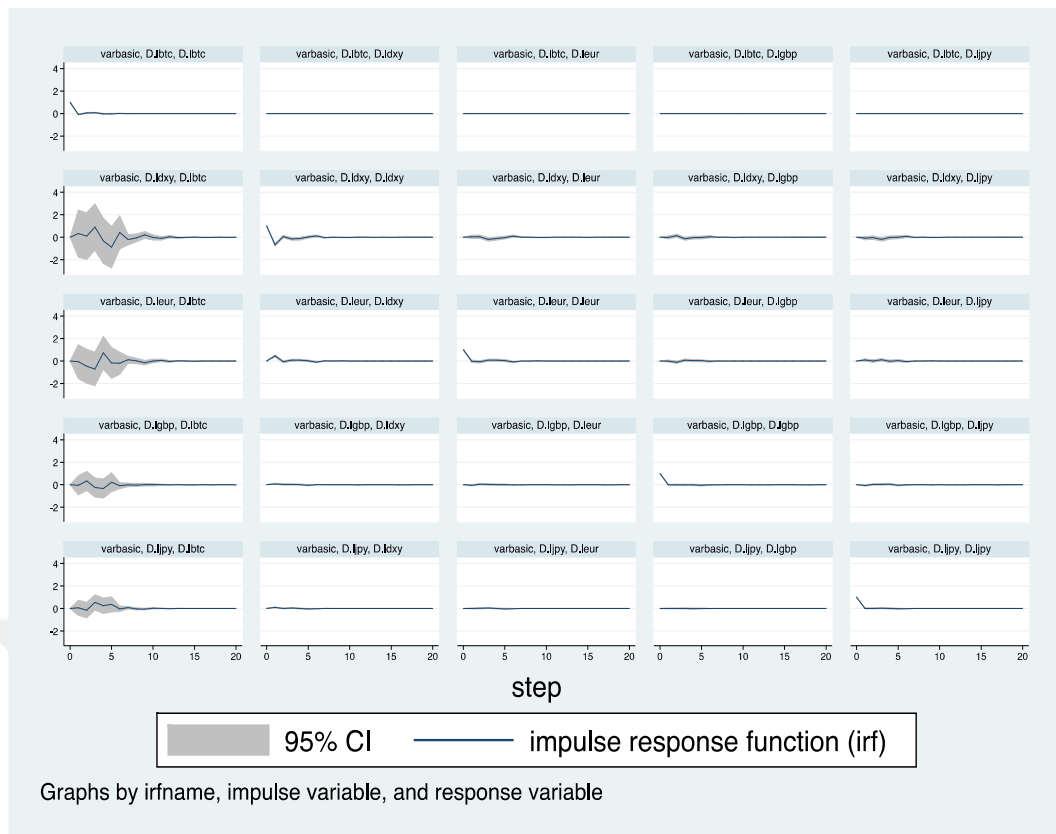
Figure 16: Impulse response function analysis (BTC-Currencies)

As one would expect given the parameter estimates and the Granger causality test results regarding BTC and other currencies, only a few linkages between the series are established here. The responses to the shocks to BTC are generally very small, except for the response of a variable to its own shock, and they die down to almost nothing after the first lag. On the other hand, the responses of BTC to other currencies are apparent. An increase in the shock to DXY, EUR, GBP and JPY causes a short series of increases in BTC that dies out after four or five periods.

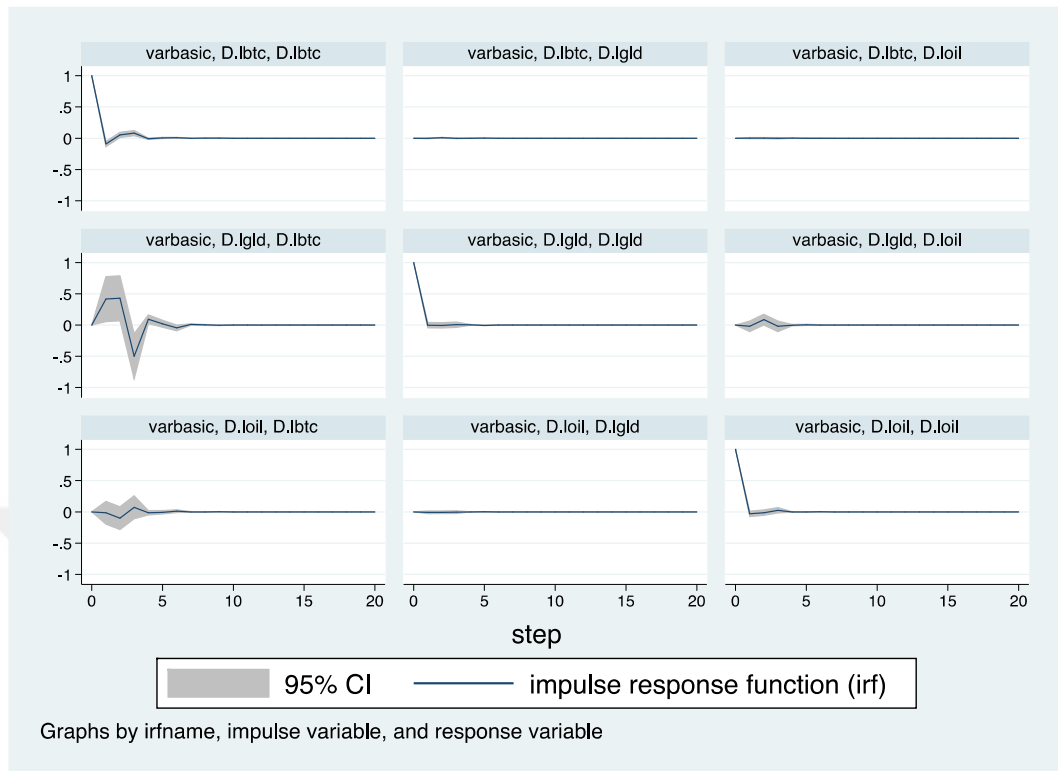Figure 17 shows the responses to a shock in one commodity on the other.

Figure 17: Impulse response function analysis (BTC-Commodities)

When commodities are considered, as it is displayed in Figure 17 above, again, the responses to the shocks to BTC are generally very small, except for the response of a variable to its own shock, and they die down to almost nothing after the first lag. On the other hand, the responses of gold to BTC are very clear. An increase in the shock to Gold causes a short series of increases in BTC that dies out after four or five periods.

IRFs measure the dynamic marginal effects of each shock on all of the variables over time. Variance decompositions examine how important each of the shocks is as a component of the overall variance of each of the variables over time. FEVD basically separates FEV into components attributed to each of these sources.

We apply the variance decomposition to the forecast error of the equation where BTC price is the dependent variable and the result is basically stable after the 20th period.
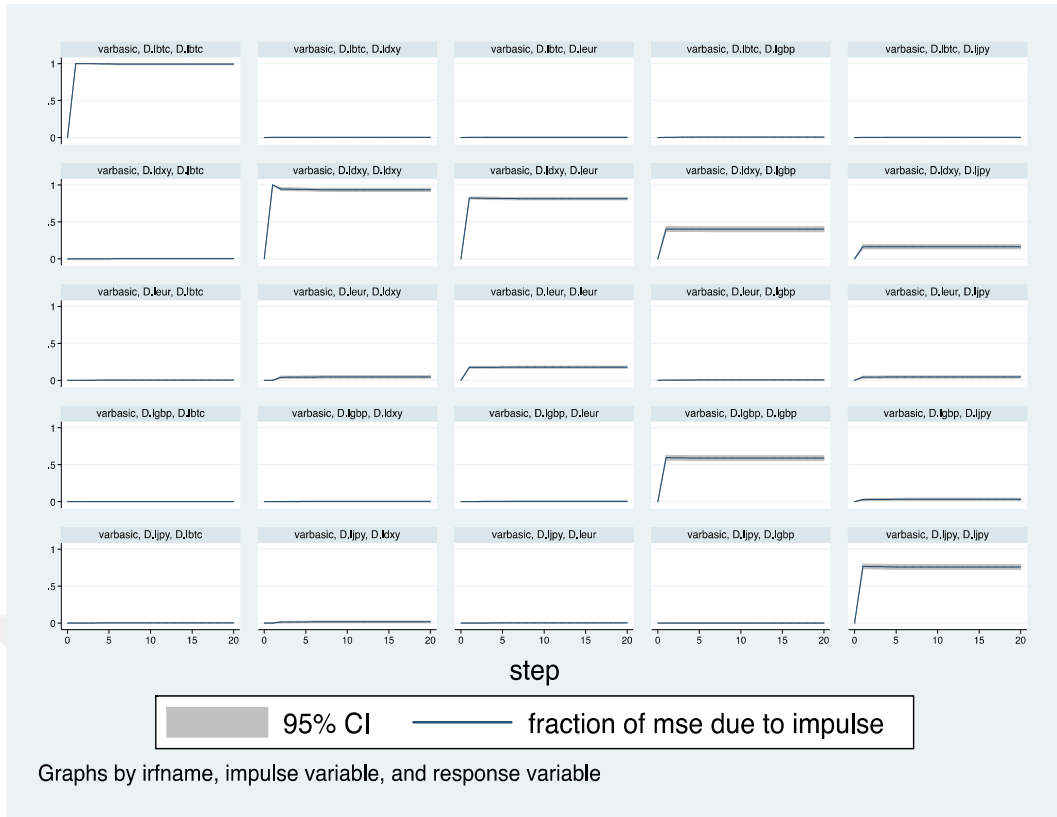
Figure 18: Forecast error variance decomposition analysis (BTC-Currencies)

Variance decomposition results show that, to the fluctuations of BTC price, almost 100% comes from BTC price's own standard error (top left of Figure 18). It indicates that the transmission effect of Bitcoin price itself so large that the impact of other currencies have almost no influence on Bitcoin price (the images at the left handside of Figure 18). Table 10 depicts the variance decomposition ratios:

Table 10. FEVD ratios (BTC-Currencies)

USD/BTC	DXY	USD/EUR	USD/GBP	USD/JPY	TOTAL
99,27%	0,27%	0,13%	0,12%	0,20%	100,00%

According to Table 10, variance contribution rate of DXY is 0,27%, EUR is 0,13%, GBP is 0,12%, JPY is 0,20% and the other 99,27% comes from Bitcoin price's own standard error, which is consistent with the results of IRFs.

Variance decomposition results of BTC with commodities are portrayed in Figure 19 below:
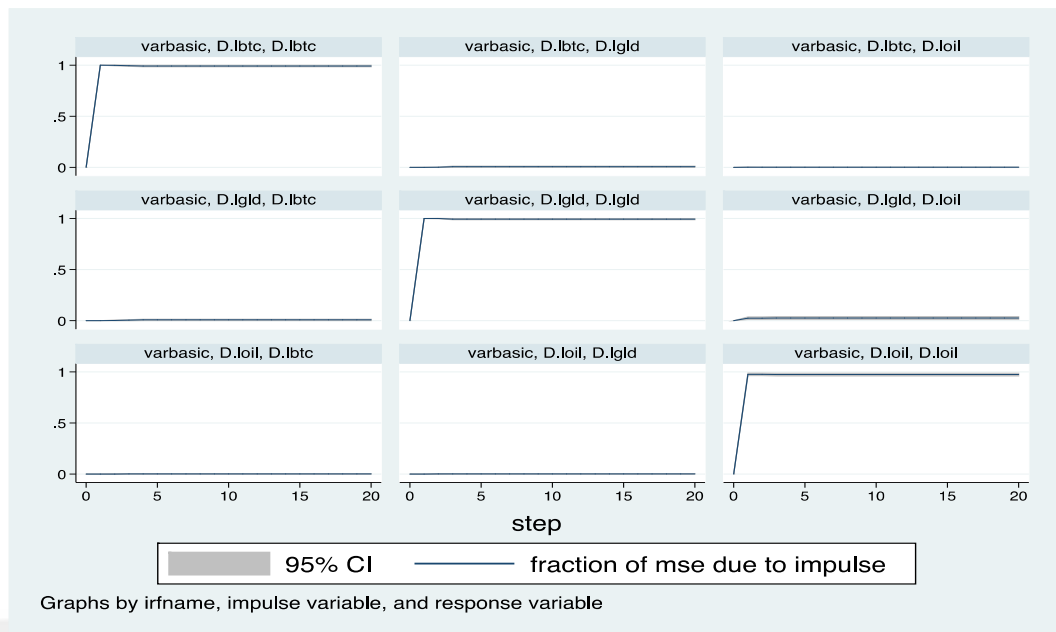
Figure 19: Forecast error variance decomposition analysis (BTC-Commodities)

Variance decomposition results show that, to the fluctuations of BTC price, almost 100% comes from BTC price's own standard error (top left of Figure 19). It indicates that the transmission effect of BTC price itself so large that the impact of other commodities have almost no influence on Bitcoin price (the images at the left hand side of Figure 19). Table 11 depicts the variance decomposition ratios:

Table 11. FEVD ratios (BTC-Commodities)

USD/BTC	USD/GLD	USD/OIL	TOTAL
99,11%	0,80%	0,09%	100,00%

According to Table 11, variance contribution rate of GLD is 0,80%, OIL is 0,09%, and the other 99,11% comes from BTC price's own standard error, which is consistent with the results of IRFs.

In this framework, although BTC volatility emerges from its own prices, gold is the most effective instrument that contributes to the volatility of BTC prices.

CHAPTER V
CONCLUSION

Bitcoin, emerged in 2008 with an article describing the basic functioning of the block chain, the technology behind it. Technically, it is a software, which it is fully operated, in a virtual environment and software related to the project is open source code. In this way, anyone on earth wants to be organized. Therefore, over a thousand virtual currencies have emerged from the emergence of bitcoin to the present day. However, almost all of them are using block chain technology.

Bitcoin's blockchain technology replaced trust with cryptographic evidence and it also replaced the trusted third party in financial transactions with the peer-to-peer network structure. At the same time, it also limits the maximum amount of Bitcoin that can be produced with Bitcoin's algorithm to 21 million and prevents it from being manipulated over Bitcoin's amount. In addition, the maximum amount that can be produced in bitcoin is not only limited, but also it has been determined beforehand how much time this production can be done. On average, 21 million bits of Bitcoins can be produced in 2140, thanks to the algorithm that allows a block to be added to a block chain every 10 minutes.

Bitcoin has gained attention and encouragement of users by ensuring that transactions can be performed very quickly at very low cost. In this way, it was able to accept itself as a new form of payment. In addition, the block chain attracted the attention of companies and governments. Many countries around the world are working to create their own virtual money and to integrate the block chain into administrative processes efficiently. The potential for resolving the blockchain's particular trust problem should not be ignored. From any point of view, bitcoin has increased its popularity and usability since it was first produced in 2009 and has been

a subject of many academic and non-scientific researches. There is a great potential for the development and efficiency of the areas where it can be used.

Therefore, both the concept of virtual money and the behind investing in technology and developing it is the wisest way to be seen today. However, it seems to be a result of people's speculative impulses rather than reflecting bitcoin today's market value.

Within this content as an initial step of the study, data which includes all variables for the date period between July, 2010 and August, 2018. The main hypotheses for the analysis are formed as *impression of currencies on the bitcoin market volatility and impression of commodities on the bitcoin market volatility*. Considering these hypotheses a suitable standard event study methodology was formed in order to efficiently summarize and evaluate the data.

Nowadays, the most controversial topic about cryptocurrencies is that they are whether currency or commodity. Many people have different thoughts about it and its being debated a lot. In this study, We employ Johansen cointegration, Granger causality, Impulse Response Functions and Forecast Error Variance Decomposition analyses in our study. Our results show that, Bitcoin does not have a long-run relationship with neither currencies nor commodities, but it has a short-run relationship with commodities, especially gold, which is a bi-directional one by and large. We, therefore, suggest that Bitcoin is acting like a commodity and gold is the most effective instrument that contributes to the volatility of Bitcoin prices.

The study which has been conducted through this thesis aimed to analyze the relation between the BTC - currencies and BTC - commodities. The findings of study were understandable within the broad content of researches on crypto currency, especially bitcoin. In order to deepen the understandings within the study area it is advised for the researchers to analyze the concept with different methodologies and models.

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