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ANALYSIS OF DEVELOPMENT AND FLUCTUATION IN THE BITCOIN PRICE WITH REGARD TO OTHER VARIABLES

Bachelor thesis

Author: Tomáš Fejt
Supervisor: Ing. Lukáš Augustin Máslo, Ph.D.
Year: 2018

I hereby declare on my honour that I wrote this bachelor's thesis independently, and I used no other sources and aids than those indicated.

Tomáš Fejt
Prague, 4. 5. 2018

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University of Economics, Prague
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Faculty of Economics

BACHELOR THESIS TOPIC

Author of thesis:	Tomáš Fejt
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Title of the thesis:	**Analysis of Development and Fluctuation in the Bitcoin Price with Regard to Other Variables**
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General content:

1. The main objective:
   The main objective of this bachelor thesis is to analyse development of Bitcoin price regarding other specific stock and commodity markets from January 2015 to June 2017, which is going to allow greater understanding of Bitcoins market prices.
2. Significance and the expected added value of the topic:
   Predicted benefits of this thesis is closely connected with different approaches to cryptocurrencies. To a certain degree this is analysis of impacts of different specific factors regarding their own fluctuations as well as determinants of trade fluctuations with this substitution currency. The relevance of the topic is given with the subject of research. The assumption behind this thesis is that bitcoin is a mean of exchange, just like other classic currencies or specific commodities. Due to the comparison of the dependent causes and consequences, attention is going to be paid to the intended functions and their actual impact on the implementation structure. The subject is still rather neglected by modern economic theories, although under certain assumptions could be used as a demonstration of a free market without state intervention. The current state of knowledge about this subject is inadequate also due to the scarcity of expert publications.
3. Characteristic of the theoretical part:
   In the theoretical part is going to be a characteristic of bitcoin in terms of its technological realization. As part of this analysis are the motives for creating this cryptocurrency and the intended consequences of this project.
4. Characteristic of the practical part:

In the practical part of the bachelor thesis, the emphasis will be placed on explaining the fluctuation of the market price of bitcoin using exogenous indicators. The focus of this characteristic will be the commodity and stock market, which will be compared to the bitcoin market.

5. Keywords:
   Bitcoin, cryptocurrency, commodity, market price, stock index, market

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Tomáš Fejt
Solver

Ing. Lukáš Augustin Máslo, Ph.D.
Thesis supervisor

prof. Ing. Robert Holman, CSc.
Head of department

doc. Ing. Miroslav Ševčík, CSc.
Dean NF VŠE

Abstrakt:

Hlavním zaměřením této absolventské práce je analýza trhu Bitcoinu a komodit, jež se dlouhodobě obchodují na burzách po celém světě, ve zvoleném období mezi lednem 2015 a června 2017 včetně. Tímto postupem mělo dojít k verifikaci hypotézy, totiž že Bitcoin je de facto novodobou komoditou, jelikož se chová prakticky identicky s výše popsanými statky. K tomuto zjištění bylo postupováno skrze obecné ekonomické teorie, zejména založené na tzv. rakouské škole a konkrétních monetárních krocích centrálních bank vybraných států, převážně tedy FEDu a ECB.

Ze zpracovaných souhrnných dat byl vytvořen model regresivní analýzy za použití metody nejmenších čtverců, ve kterém se zkoumala korelace mezi změnami tržních cen proměnných. Výsledky výše popsaného modelu byly pozitivní, avšak v podstatně menší míře, než bylo hypotézou předpokládáno. Obecně lze tedy dojít k závěru, že hypotéza byla potvrzena, pro její nezvratnou verifikaci se však doporučuje zkoumání delšího časového úseku, který by vyhladil extrémy, způsobené výraznou volatilitou na trhu Bitcoinu, která byla způsobena určitou trendovostí ve snaze rychle dosáhnout zisku nakupujícími a administrativními kroky, které se snažily trh naopak regulovat a stabilizovat.

Bitcoin tedy je ve své podstatě komoditou velmi podobnou chování zlata, lze tedy potvrdit obecně rozšířený termín „virtuální zlato“, avšak dle této studie se nejedná a díky potvrzení hypotézy ani nemůže jednat o měnu jako takovou.

Klíčová slova: Bitcoin, kryptoměna, komodita, tržní cena, akciový index, trh

Klasifikace dle JEL: A10, B25, C22, K20

Abstract:

The main objective of this bachelor thesis is to analyse the markets of the Bitcoin and commodities, which are traded on the markets all around the world already, in a chosen period of time between January 2015 and June 2017. This process constitutes the crucial part of the thesis, in order to verify the hypothesis, which states that the Bitcoin is de facto a new kind of commodity, given its very identical behaviour as the above stated goods. This conclusion can be supported by the monetary theory of the Austrian school of economics and also by particular actions taken by central banks of chosen countries, most importantly Fed and ECB.

Cumulative data were processed and then used to build a model of regression analysis with the use of ordinary least squares method, in which correlations were examined among changes in market prices of the variables. The results of this model were positive, however, on a rather lesser scale than the hypothesis expected. In general, the hypothesis was accepted, but for the hypothesis to be verified with greater certainty, it is recommended to examine longer periods of time, which would eliminate the extremes induced by significant volatility on the Bitcoin market caused by a certain trendiness originating in the buyers' pursuit of a quick profit and, at the same time, the administrative precautions whose purpose was to regulate and stabilize the market.

The conclusion of this thesis is twofold: 1) the Bitcoin is a commodity, in its basis, with a very similar behaviour as gold, which justifies a common term "virtual gold". 2) the Bitcoin is not a currency in its basis nature.

Keywords: Bitcoin, cryptocurrency, commodity, market price, stock index, market

JEL classification: A10, B25, C22, K20

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Introduction

Nowadays, the phenomenon of cryptocurrencies is a very hot topic, and its popularity is still rising rather sharply. Among these cryptocurrencies, none can compete with the popularity and status of the Bitcoin, which was introduced in 2008 as an alternative network outside the regular banking systems. The rise in demand for the cryptocurrencies raises important issues on how the governments and the policymakers should be reacting to this meteoric rise. There is a need to properly implement their perceptions of this phenomenon, mainly with regard to their monetary policies. Central banks all around the world are exploring their options, how to react to this new and fastly developing trend of cryptocurrencies.

The main purpose of this thesis is to provide a better understanding of the development of the Bitcoin price with regard to stock and commodities especially in the time period between January 2015 and June 2017. The reasons behind this chosen period are simple, around these dates a crucial development of the Bitcoin and its continuing stabilization occurred on the market. This should allow the deeper understanding of the Bitcoins market price changes with regard to other chosen variables. This knowledge is closely connected to the hypothesis of this thesis, which states that the Bitcoin should be perceived as a new kind of commodity rather than classifying it currency. This hypothesis is going to be examined from both the theoretical viewpoint and from the viewpoint of practical testing.

The thesis is divided into two parts, a theoretical and a practical part. These parts are going to provide the sufficient information to conclude this thesis.

In the theoretical part of the thesis, I am going to summarize information about Bitcoin for the readers, who are not familiar with the topic of Bitcoin and cryptocurrencies in general. Firstly, a specific vocabulary is going to be explained in a manner of brief explanations, with chosen examples being only the most necessary vocabulary terms such as mining or blockchain. Then the process of creation of Bitcoin is going to be examined with further implications for its history. Later the intentions behind the creation of this cryptocurrency are going to be discussed, with focus intended purposes of this cryptocurrency. This should provide a theoretical background for the practical part.

In the practical part of this thesis, the model of the relations between the Bitcoin and the commodities is going to be build using the regression analysis. The commodities chosen for this experiment are Gold, Silver, Platinum, Palladium and the S&P 500, which is the New York stock market index. These variables were chosen to mirror the most probable, already established commodities, with relations to the cryptocurrencies. They are going to be analysed by the changes in their exchange rates. The results are going to be analysed by the econometric and statistic verification. This is going to provide us with empirical evidence in favour of or against the hypothesis.

1. Bitcoin

1.1. Special Vocabulary

In our current stage of technological development, cryptocurrencies come with numerous special phrases which were nonexistent before their introduction. These terms are not only going to be explained as part of vocabulary but also from the technical point of view. This summary should be enough for anyone to be able to comprehend the nature of these terms along with their implications. The vocabulary is going to be explained only very briefly, due to the vast volume of additional knowledge that is simply not needed for this thesis. Some of them can be seen as similar with various other terms from our daily life but when in context of cryptocurrencies, have a very specific meaning that in case of these particular vocabulary terms is required for further study of these innovative technological wonders.

1.1.1. Cryptocurrency

Cryptocurrency is either a digital[1] or virtual[2] currency made in order to serve as a means of exchange. It uses encryption to ensure a secure transaction as well as to verify it. Cryptography also serves a significant role in the creation of new units of those currencies. Basically, cryptocurrencies are saved in special databases, which cannot be changed unless specific conditions are fulfilled. This way particular kind of safety is ensured.

First attempts at making cryptocurrencies, were made during the 90s tech boom but they failed on account of them being dependent on the third party which kept the servers. Such currencies were, for example, Digicash or Flooz. In time they all dissolved due to various problems. Later in 2009, this problem was overcome by so-called “peer-to-peer electronic cash system”, which was much less dependent on any particular third-party system. These

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[1] Digital currencies are all currencies that are stored and transferred solely electronically without psychical representation.

[2] Virtual currency is a specific type of digital currencies which is unregulated and generally controlled by its developer, with Bitcoin being an exception with its decentralized nature.

completely decentralized systems were possible with special encryption that made them untouchable by peers. This new system is called blockchain.

In this system, miners are authenticating transactions by solving cryptography puzzles and therefore marking them as legitimate and spreading them across the network. That essentially makes the cryptocurrency network a consensus of all the participants. There are certain pre-build rules programmed into the network to ensure a smooth running of operations. This enables the network to run in a similar fashion as currency does without being dependent on any institution.

1.1.2. Peer-to-peer (P2P)

In order to better explain this term, it is helpful to examine its importance in our world. The protocol made by Satoshi Nakamoto enables connection between a group of computers that establishes network without a structured institution that is associated with physical money or a trusted third party, which is the case of earlier cryptocurrencies and such portals as PayPal. These systems have similar weaknesses such as a need for "Big Brother" that has to be completely unbiased and administrate the network properly. Of course, the administration has to be a stable institution or firm. Those requirements are hard to fulfil and in the innovative thesis (Nakamoto, 2008), the author or authors[3] tackle these problems head-on with the peer-to-peer electronic cash system. In this network, there is no central institution and the responsibilities are distributed between all the participants. This system is mathematically less likely to be misused or even abused by one user or even a group of users.

When transactions of currency for goods take place, there is always a shadow of doubt present. In order to solve this people were often forced to rely on third parties which played a crucial role in foreseeing that the transaction goes through, but with the peer-to-

[3] Satoshi Nakamoto is a pseudonym used by a group or an individual behind the Bitcoin and a creator of peer-to-peer network well as the author of the most influential thesis connected to this phenomenon. Even to this day, the identity of this author is unknown, and his account contains more than a million units of the Bitcoin which, according to the current Bitcoin-USD exchange rate, is equivalent to a several tens of billions of US dollars.

peer network, this reliance is no longer necessary. These operations are verified by miners, this process is explained above. Every transaction is registered on block which also contains a link to previous set of transactions (also registered on block). These transactions are linked in this way together, making it very difficult to tamper with one block without changing them all which is virtually impossible. In comparison to our regularly known way of making transactions, the cost of verification is substantially lowered, and a virtually impenetrable level of security is reached without the involvement of third parties. As said in conclusion of Satoshi Nakamoto's thesis on peer-to-peer electronic cash system "We have proposed a system for electronic transactions without relying on trust. We started with the usual framework of coins made from digital signatures, which provides strong control of ownership, but is incomplete without a way to prevent double-spending. To solve this, we proposed a peer-to-peer network using proof-of-work to record a public history of transactions that quickly becomes computationally impractical for an attacker to change if honest nodes control a majority of CPU power." (Nakamoto, 2008, p. 8). As shown in this thesis the statistical probability of the system being abused is decreased drastically. This makes the peer-to-peer network most suitable for cryptocurrencies.

1.1.3. Blockchain

To provide a simple explanation, we could say that a blockchain is a chain of blocks, where each block contains a record of the transaction taking place and a link to the previous block which contains the previous transaction. These blocks are therefore linked together to form a complete history of operations. When in sufficient numbers they create a so called blockchain. Your ownership of this particular currency is the manifestation of simple private key, which will, upon entry, grant you access to your block inside a blockchain, which contains a record of all your transactions and allows you to make transactions. There is also a public key, which only enables others to see transaction records as well as allowing the sending of units. The information inside the blockchain is also publicly visible, because of the decentralized nature of cryptocurrencies.

Alternatively, a blockchain can be explained by the likeness to a ledger as the World Economic Forum defines it:" Blockchain or distributed ledger technology (DLT) is a technological protocol that enables data to be exchanged directly between different contracting parties within a network without the need for intermediaries. The network participants interact with encrypted identities (anonymously); each transaction is then added to an immutable transaction chain and distributed to all network nodes." (Tapscott, Tapscott, 2017) Which essentially means that a peer-to-peer network can be described as a ledger of information that is being formed constantly by numerous versions available from the users and more importantly the miners that constantly change the appearance of the system by approving operations. This system was chosen as the safest form of security with the probability of abuses very low. One of the few possible ways to abuse the system is, when majority of miners choose to cooperate in order to implement their versions on the system, with probable intentions of enrichment. This problem is going to be closely described below.

1.1.4. Mining

To start with, I would like to address a common misconception, that mining is not about creating new cryptocurrencies, it is a mechanism that allows a peer-to-peer electronic system to function. This mechanism creates a decentralized network that is used by Bitcoin and other cryptocurrencies as a medium of exchange. Miners simply validate transactions and record them on the blockchain. They must solve a difficult mathematical problem based on a cryptographic hash algorithm, therefore creating a Proof-of-work. In order to solve these complex algorithms a considerable amount of time and resources must be devoted by the miners. In return, a miner is rewarded by the newly created bitcoins[4] and in the form of transaction fees. Right now, the miners are mostly awarded newly created bitcoins for their efforts, but as time goes on, the reward of miners will progressively consist of larger quantities of transaction fees rather than newly created bitcoin units. In the beginning, every block was awarded 50 Bitcoins divided between miners. However, every 210 000 blocks the amount produced is reduced by half. In the year 2018 the amount is 12,5 bitcoins per block and around the year 2140, the creation of new units is going to cease altogether. To summarize, with the passage of time, less units will be rewarded for block mined and transaction fees received from operations will rise.

[4] The Bitcoin units are called bitcoins without the capital b, so now on every time it is used with minor b the individual units are being talked about not the currency altogether.

In the beginning, miners simply used their CPUs[5] calculative powers to earn Bitcoins, but as the popularity and price of Bitcoin increased so did the technology. The technology went from PC units with more graphics cards to increase processing powers to entire stations of application-specific integrated circuits build entirely for mining with less energy consumption. This trend means that it is generally less profitable for individuals to mine and making it more of an industrial business opportunity. A number of specialized mining facilities have opened up in China lately. These specialized mining facilities have shifted the national percentage of Chinese Bitcoin miners to incredible 75% worldwide. (Olagoke, 2018) This poses a threat from many perspectives, not only making a mining of the Bitcoin much more expensive for others, but more importantly, this could lead to formation of Chinese cartel that could even threaten the stability on the Bitcoins market. When the threat to stability on the Bitcoins market is stated, it is with regard to the term 51% attacks. This problem is going to be discussed closely in a next part so the problem of unprofitability of mining for casual miners is going to be brought into focus.

Profitability of Bitcoin mining is steeply decreasing, mainly due to the boom of specialized mining technologies. The calculations vary across the regions, in which the mining is conducted. According to article by Ryan Vlastelica, published by Dow Jones & Co. on the website Marketwatch, which tracks the pulse of markets for engaged investors with more than 16 million visitors per month, the electricity cost involved in mining a bitcoin in the USA varies from 3,224 US dollars in Louisiana to 9,483 US dollars in Hawaii. (Vlastelica, 2017) These costs are just the electricity used, not the cost of acquiring proper instruments for mining Bitcoins. This situation is gradually reaching the point, when the cost of mining is drawing near to the market price of the Bitcoin. To conclude this problem in the words of David Meyer ‘Mining’ Bitcoin is a notoriously expensive business—recent calculations by the lighting company Elite Fixtures suggest that it costs a fortune to mine one Bitcoin in some countries, with the cost being as much as $26,170 in South Korea. Now analysts at Fundstrat have said that it’s no longer particularly profitable to mine Bitcoin. ‘Bitcoin currently trades essentially at the break-even cost of mining a bitcoin,” the research house said in a Thursday report. ‘ (Meyer, 2018)

5 CPU stands for the central processing unit, more often referred to as a processor. This unit is responsible for executing most of the commands in a computer from other hardware or software components.

1.1.5. Problem of double spending

As I have stated above, the problem of double spending was one of the main difficulties that first cryptocurrencies faced in their early stages. Most efficient solution so far to the problems connected to double spending is a peer-to-peer network of Bitcoin. This problem is connected to non-physical nature of cryptocurrencies, which enables them to be simply copied and used more than once. This would create a mayhem on the market with considerable distrust in the network. Satoshi Nakamoto suggested solving this problem in his thesis by introducing a peer-to-peer network, which is institutes a certain kind of safety procedures to avoid these abuses of the system.

The transactions are connected to the blocks, which are created in around 10 minutes intervals. These transactions must be verified by miners, and when this happens the block is added to a blockchain and the ownership of a unit is transferred. This process eradicates later machinations with the Bitcoin due to the simple fact that when the exchange is completed the private key of the original owner ceases to exist and a new one is created for the new owner of the unit. This, in the end, solves this problem if the duplicate transactions are not in the same block. If they are made in the same window of time and set to the same block, then the one with more verifications is chosen as the right one and the other is discarded. This ultimately settles all the problems connected to a double spending problem that was such a major negative element in the past.

1.1.6. Problem of 51% Attacks

The problem of 51% attack, simply refers to an attack on a blockchain, usually the Bitcoins, in which a group of miners controlling more than 50_% of the network's mining computing power must cooperate. The attackers would be able to prevent new transactions from gaining confirmations, their dominance would allow them to halt payments between some or all users, essentially. They would also be able to reverse transactions that were completed, while they were in control of the network, meaning they could double-spend coins as we discussed above.

Almost certainly, they would not be able to create new coins or alter old blocks, because of the safety precautions implemented inside of the peer-to-peer electronic ash system, so a 51% attack would probably not be able to destroy the Bitcoin or another blockchain-based currency outright but would prove to be highly damaging the reputation of this system, therefore decreasing the market price drastically.

This situation even briefly occurred on the Bitcoins market, with the mining pool of ghash.io, briefly exceeding 50% of the Bitcoin's network computing power in July 2014, which made the ghash.io pool make a voluntary commitment to reduce its share of the network. According to a statement issued by CEX.io, the owner of Ghash.io said that it would not reach 40% of the total mining power in the future. (Hajdarbegovic, 2014)

1.2. History

1.2.1. Creation

In the beginning, when humanity started using medium of exchange instead of simply bartering goods, people used to pay each other in chosen commodities that according to them possessed value, most notably gold and silver in form of coins. But they were very difficult to transport and even harder to divide. This led to an invention of the paper money (fiat currency). Originally, they were a claim to gold in a bank vault. This proved to be much easier to transport and to be divided. But after some time, banks gave out more paper money than they had gold in the vault. This practice is now called a system of fractional reserves. By this practice, a generous profit was generated in the banking system, but the side effect of bank collapses was introduced as well. The bank collapses were the symptom of low liquidity among their assets.

In order to avoid such scenarios, the Central banking system was invented. Inside this system, Central banks would be lenders of last resort. So called “Runs on the bank”, were thus mitigated by banks guaranteeing each other’s deposits through a central bank. Unfortunately, even though the frequency of bank insolvency diminished their impact had increased greatly. This meant that banks would still get in trouble, but now with the banking system closely connected by central banks, if one bank got in sufficient trouble then the trouble would spread to all of them at the same time. The threat of global economic collapse forced governments to step in to bail them out. This was most notably observed during the Great economic crisis in 1920s.

The ties between the financial system and governments eventually led to banishment of gold reserves in 1971, when president of the USA, Richard Nixon, decided that the USD would no longer be exchangeable for a fixed amount of gold from the bank reserves. This exacerbated the problem, because now, there was effectively no limit on the amount of paper money that banks could create anymore. From this moment on, all money was created as credit. Money ceased to be supported by an asset. So, when the bank issues a loan, the loaned money are simply created in a central bank and through transactions eventually lend to people without any real asset reserves. To add insult into injury, further gradual decreases in reserve ratios are introduced.

This led to an immense rise in the money supply on yearly basis. According to the statistics on money circulation gathered by the European Central Bank (ECB) a yearly increase in the supply of the euro is about 5%. This constellation leads to yearly inflation rate in the 2% range. This depreciation forces people to take part in the banking system, in order to keep their wealth. Eventually, when the banks careless behaviour catches up, the ones who suffer the consequences are not the banks, but people whose taxes are used for banks bailouts. According to the supporters of the decentralised monetary systems, the absence of sound money was at the root of all these problems.

The Bitcoin was first mentioned in the self-published paper by author Satoshi Nakamoto back in 2008. It was described as a revolutionary purely peer-to-peer electronic cash system (Nakamoto, 2008, p. 1). This system is renowned for its limited supply of units[6]. There are even rumours that this function, as well as the decentralized nature of the Bitcoin, are Nakamoto's direct response to the economic crisis that transpired right around the time of the creation of the Bitcoin. Before Bitcoin, all electronic transactions were deeply reliant on a trusted third party, which was operating as an intermediary between participants in exchange. These systems were approving the transitions and making sure of both subjects sticking to the rules of transfer. These problems were ultimately solved by either original code or in subsequent patches released shortly after its creation.

The Bitcoin itself was released at the beginning of the year 2009 with first blocks released on third of January. At the beginning, due to the lack of transactions that would show the cost of the bitcoins, the price of the Bitcoin was counted from used electricity to mine those units. At this time, the price of the Bitcoin was estimated to be few cents of dollars.

6 As told above, the rate of supply of bitcoins is gradually decreasing every 21 000 blocks and in its final stage the whole supply should contain around 21 million of Bitcoin units and should finish around the year 2140.

1.2.2. Beginnings

The beginning was quite uneventful with the Bitcoin being mined and used solely by fans of this approach to media of exchange not as a manner of enrichment as it is today. Even the first real word transaction of this network came to be rather comical. It took place in May of 2010, when Laszlo Hanyecz, a programmer from Florida, posted an offer to exchange 10 000 bitcoins for 2 pizzas worth around 25 dollars (Yermack, 2013, p. 6). This offer was accepted by a volunteer from the United Kingdom. Astounding from today's point of view with 10 000 bitcoins being worth tens of millions of dollars, according to the current exchange rate.

Over some time, thanks to an increasing number of participants in this network, led by a significant number of cryptocurrency enthusiasts, the first Bitcoin exchange was created. It was called Mt.Gox. Before this exchange was created, the only ways to obtain bitcoins were mining them or to have them given to you by other users, but with this exchange, everyone was able to buy them for already established currency, namely US dollars. On the first day of Mt.Gox, the first real exchange rates were set with 20 bitcoins being sold and the price set on 4,95 US cents. (Yermack, 2013, p. 6).

This escalation in popularity of the Bitcoin brought it to the attention of numerous new users as well as hackers, who exploited few last loopholes in the system to hack it and cause mayhem in 2010. They have created large amounts of "fake" bitcoins, but a swift path fixed all loopholes in the system and deleted all falsely created bitcoins. This event is seen as a milestone because this increased encryption ensured that no more hacks or abuses have been successful since then. Even more, it is thought to be virtually unhackable by a former White House communicator Jamie Smith (Golumbia, 2016).

Even though the Bitcoin went through some problems during the time period after 2010, it experienced a break-out in the year 2011 when the Bitcoin reached parity with US dollar in February on Mt.Gox (Miller, 2014, p.27). It became even more glamorous when the renowned The Time Magazine wrote the first globally mainstream article about the Bitcoin and digital currencies in general in April of 2011 (Brito, 2011). This incredible increase in popularity of cryptocurrencies led to several conferences with the first one being held in

New York City in May 2011 and the first one situated in Europe, incidentally taking place in the Czech Republic that was held in Prague in November 2011 (Miller, 2014, p. 27).

1.2.3. Years 2012-2014

The year 2012 was a year of new opportunities for the Bitcoin, with numerous start-ups dedicated solely to the Bitcoin and cryptocurrencies such as CoinBase or Bitcoin-Central[7]. Coinbase focused on aiding nontechnical users in familiarizing them with Bitcoin (Stross, 2012). The CoinBase also created a well-known online wallet that was user-friendly and was considered a leap towards enabling common people to operate on this new market. Events like these brought about an enormous appreciation of the Bitcoin with respect to US dollar and other cryptocurrencies shortly followed. But it has also attracted the unforeseen attention from already established institutions, which perceived this new market as a threat which led to the events of 2013 that threatened the whole market.

Probably the greatest change brought, was the regulatory guidelines for "decentralized virtual currencies" established by FinCen[8]. These guidelines classified the Bitcoin miners and the Bitcoin exchange as Money Services Business, this classification requires them to be registered and to be subject to legal requirements such as disclosing large transactions or suspicious activities. These actions brought about numerous serious legal problems for Mt.Gox, which was not registered as Money Services Business in the USA. This led to the seizing around 5 million US dollars from Mt.Gox accounts by the U.S. Department of Homeland Security (Miller, 2014, p.28) in May 2013. When problems generated by, amongst other things, legal issues and visibly long delays in withdrawals became apparent, Mt.Gox experienced a depressing number of withdrawals from its clients that threatened its very existence. To illustrate its significance Mt.Gox was handling around 70% of the Bitcoins transactions (Vigna, 2014 p. 2), this meant that any issues connected to Mt.Gox

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7 French company Bitcoin-Central became the first bitcoin exchange to be licensed to operate as a bank. This meant that customers finances were kept under their real names rather than those used on an exchange.

8 The FinCen is short for Financial Crimes Enforcement Network, which is an institution in the USA entrusted with collecting and analysing transaction data in order to prevent financial crimes from happening.

were having serious consequences on the Bitcoin market. In the end, the Mt.Gox was forced to file for bankruptcy. Due to the fact that the Mt.Gox was situated in Tokyo, with Japan having no regulations over cryptocurrency exchanges, all the customers, who still had money in Mt.Gox were left without protection. As a result of these events, the Bitcoin market lost a lot of hard-earned trust and, of course, the Bitcoin exchange rate depreciated dramatically.

These dramatic events greatly overshadowed numerous positive ones that occurred during 2013, such as the first Bitcoin ATM, situated in Vancouver, which allowed users to directly withdraw their bitcoins in Canadian dollars or deposit their dollars to their online wallets. This even led to several companies such as most notably Overstock.com, Reddit, OKCupid, WordPress, Microsoft, Expedia and Virgin Atlantic (Acharya, Dunn, 2014, p. 2) to accept Bitcoin as a payment option. But probably the most important event that transpired during this time was the one that occurred towards the end of the year 2014, in which IRS[9] announced its treatment of the Bitcoin to be rather that of an asset than a currency. This meant that any capital gains from selling or "mining" the Bitcoin are treated in the same manner as capital gains from selling shares. [10] (IRS, 2014)

1.2.4. Years 2015-2017

The year 2015 was significant year for a great rift between visions on the Bitcoin in the European Union and the USA. In the USA, institutions such as FED, continued its quest to regulate the Bitcoin as a commodity on a market most obviously in the way of making a "BitLicence" in New York, where Benjamin Lawsky, superintendent of the New York State Department of Financial Services, was the first statesmen that ever targeted the regulations directly on the Bitcoins businesses. (Higgins, 2015) These actions led to an upheaval among the users and directly disadvantaged users from this area. This was further supported by the Commodity Futures Trading Commission, which issued an order that

9 The IRS is short for The Internal Revenue Services, which is an institution in the USA entrusted with collecting taxes and is one of the most important Government agencies answering directly to The Department of Treasury.

10 This information was extracted from IRS report on cryptocurrencies, which can be found on: https://www.irs.gov/pub/irs-drop/n-14-21.pdf

states “In this order, the CFTC for the first time finds that Bitcoin and other virtual currencies are properly defined as commodities.” (Kawa, 2015)

On the other hand, in Europe things were moving in the opposite direction, with the European Court of Justice ruling that the exchange of Bitcoin and "virtual currencies" are not to be subjected to value-added-tax (VAT) in the European Union, therefore classifying the Bitcoin as well as other cryptocurrencies as actual currencies. (Clinch, 2015) This variance in definition stands to this day with virtually nobody being able to rule one of these decisions as superior to the other. With this thesis inclining to the USA view of the Bitcoin as a commodity rather than currency, we will state the reasons for this view later. These actions led to even more sights being set on the Bitcoin, even reaching the front page of the renowned British publication The Economist. This article was mainly focused on the blockchain technology, which was described as a possible means of introducing “cheap, tamper-proof public databases”. (The Economist, 2015)

The year 2016 was a rather quiet year for the Bitcoin in contrast with all the other news, for example, the victory of Donald Trump in the US presidential election and other more pressing news. This year can be summarized as a constant rise of the Bitcoin, with few important events which are going to be covered very shortly. The most important of them being the opening of OpenBazaar, which was the first decentralized marketplace that aimed to accommodate peer-to-peer transactions without the middleman, fees or trading restrictions, where common goods can be traded using the Bitcoin. (Price, 2016)

The year 2017 began with a rapid growth in the price of the Bitcoin and continued in similar fashion facing a probable split of the Bitcoin into the Bitcoin and the Bitcoin Cash. This separation was inevitable with the community being split in its opinion about the amount of information that one block should contain. Originally it was 1mb of the information, but according to a clear majority of community this was not enough, and they demanded its limit to be increased to 8mb of the information. This led to the creation of Bitcoin Cash and drastic increase in the Bitcoin price. This was mainly due to the manner of the split: if you owned 10 bitcoins before the split, after it you wouldn’t just have 10 bitcoins, but you would own 10 units of the Bitcoin Cash as well. But there were other serious events happening with the most important one being Japans recognition of the

Bitcoin as a payment method that was even passed in the legislation as a law, making sure that the same incidents as the crash of Mt.Gox wouldn't happen anymore. (Keirns, 2017)

This was a summary of the Bitcoins history to the point at which this thesis's datasets end.

1.2.5. Shadow behind the Bitcoin

The decentralized manner of the Bitcoin is highly praised among the libertarians, but on a negative side, it also creates the ideal environment for illegal operations as well. There have been several incidents that undermined the popularity and the trust of the Bitcoin, which have connected it to the illegal activities such as money laundering and drug-trafficking. All these actions are the side-effects of its decentralization. The Bitcoin transactions are not taxed in any way and are very hard to track with virtually anyone able to set up accounts anonymously, partially because Bitcoin wallets are not connected to the name or identity of the owner. This makes them perfect for making illegal transactions without any supervision.

The most famous incident was the one of so-called "Silk road" darknet market. This online black market specialized in drug-trafficking, money laundering and was commonly known as a place where you can buy anything[11]. This site dealings were exceeding 1,2 billion of US dollars' worth of business[12], consisting mostly of selling drugs, according to the Federal Bureau of Investigation (FBI). This site was then shut down by the FBI and all the assets, including several tens of thousands of bitcoins, were seized by the FBI. The owner of the Silk Road darknet site, Ross Ulbricht[13], was then sentenced to a life in prison. (Miller, 2014, p.29)

---

11 Even though darknet was so profoundly involved illegal services, usually some rules are instituted in advance in order to make them appear as a "lighter" sort of darknet with bans on child pornography, stolen credit cards, assassinations, and weapons of any type.

12 According to Federal Bureau of Investigation, this business equates to around 600 million US dollars in taxes that go unpaid.

13 He was the owner of the site, the infamous "Dread Pirate Roberts". Which is a name from a very well-known film called The Princess Bride, where the title "Dread Pirate Roberts" worked as a renowned title or a position of leader that was transmitted between pirates in charge.

But it is very improbable that this was a unique incident. It is generally accepted that a number of similar abuses of the network are still in operation. This statement can be further supported in thesis of Sean Foley, Jonathan R. Karlsen and Tālis J. Putniņš. In their thesis is stated: “We find approximately one-quarter of Bitcoin users and one-half of Bitcoin transactions are associated with illegal activity. Around $72 billion of illegal activity per year involves Bitcoin, which is close to the scale of the US and European markets for illegal drugs.” (Foley, Karlsen, Putninš, 2018, pp. 34-35)

1.3. The theory behind the Bitcoin

1.3.1. Theory of the Bitcoin in view of Austrian school of economic thought

To justify the Austrian school of economic thought and specifically their view on the Bitcoin it is necessary to know that the idea of decentralized currencies is the core of the Austrian school's economic theory. The importance of this view was even recognized in 2012 by a study from the European Central Bank (ECB), when they published a study of the decentralized cryptographic money, in which it is stated that "the theoretical roots of Bitcoin can be found in the Austrian school of economics". (European Central Bank, 2016)

But the first part we must look through, is the famous Austrian school's theory of the business cycle. This theory suggests, that the occurrence of business cycles in the economy is caused by the central banks and the fractional reserves rather than it being a natural phenomenon. With this taken into account, it is easy to see the consequent continuation of this theory, that the business cycle is a consequence of the government's manipulations with the money supply and conscious lowering of the interest rates below the appropriate free markets rate. These operations are, according to Ludwig Von Mises, to blame for the "false" signals. These signals then promote bad investment, which causes the downward slope in the business cycles. (Mises, 1998, pp. 752-776) These actions are the causes of the global economic crises such as the one from 2008, which was fuelled by the malinvestments and overconsumption, which resulted in the inability to pay the loans.

Most of the problems that are essential to the theory of the business cycles are directly connected to the mistakes of the central monetary institutions and their practices. The direct hypothetical answer to this are the cryptocurrencies, most importantly the blockchain mechanic behind them. Thanks to peer-to-peer network, the Bitcoin and other similar cryptocurrencies are independent on these institutions and are corrected by a standard set algorithm that takes care of all the necessary actions otherwise procured by the central monetary institutions, such as central banks. These network-based actions are the closest the mankind has gotten to the free market equilibrium in all its history.

1.3.2. Arguments for the Bitcoin not being a currency

There are many arguments against the Bitcoin being a currency, with most of them pointing to the fact that Bitcoin is classified as a commodity. To fully summarize these arguments, it is imperative to look at this problem from the perspective of the Austrian school of economics. According to majority of the Austrian school's economists, the Bitcoin cannot be a currency, because it is not generally accepted as a method of payment. Even though Austrian economists don't accept the Bitcoin as money, they still regard it a medium of exchange. This is resolved by calling the Bitcoin a secondary medium of exchange. Rothbard is calling this secondary medium of exchange quasi-money, goods that are so liquid that they become money from a practical standpoint (Rothbard, 1962, p. 827).

There is also a huge problem of volatility within the Bitcoins price changes. In a not so distant past there were changes within the range of approximately thousand percent on daily basis. Even though we have observed gradual stabilization in recent years, the volatility can still reach several tens of percent. Therefore, in our current situation the Bitcoin cannot be a currency due to its volatility.

1.3.3. Arguments for the Bitcoin being a commodity

Arguments for the Bitcoin being a commodity are many and are greatly supported by the practice of numerous countries, most notably the USA, in trade and regulations, which are the same as the ones applied to the commodities. There are even some strong similarities between Bitcoin and commodities such as gold and others. The price of Bitcoin behaves very similarly to the price of regular commodities, the higher the demand for Bitcoin, the higher its price. In the principle, same holds true for any economic good, whether it is an asset or a medium of exchange. An asset, though, unlike a medium of exchange, should display a certain immunity to changes in real value caused by inflation, because the nominal value of the asset follows the general price level, the real value of the asset doesn't change. In that regard, Bitcoin does not differ so much from the gold since both Bitcoin and gold are scarce and the supply of both Bitcoin and gold is limited (by non-human factors) at any given time. It also is not true that Bitcoin, in opposition to other commodities, has no value outside its cost as it is commonly perceived. The Bitcoin does have an inherent value in its function, for example exchanging property online without the transaction costs associated with doing so through traditional intermediaries and also giving “power”[14] to an individual inside its community. This “power” is largely consistent of the possibilities of users, more notably miners, to influence the versions of the system as it was mentioned above. This power can even rise to being considered threat to independent division of significance among users and can rise to the point of the 51% Attack situation. Due to this community “power”, we can say it holds inherent value even if it has ceased its functions as a medium of exchange. This might not look even remotely valuable to outsiders, but for the users inside these communities, it holds tremendous value since it grants them in ideal distribution certain level of freedom and equity inside the peer-to-peer electronic cash system. To fully understand this inherent value, it can be related to a situation inside a parliament, when one side has a majority of at least 51%, they are able to ratify any legislation that is desired by them. Basically, turning the holders of majority of power into dictators that can change any component that is not suited for their purposes.

So, in this manner the Bitcoin cannot be considered a currency, in the interest to assign a term for the Bitcoin, we can use widely used term “virtual gold” or more conservatively a new kind of commodity easily relatable to a position of gold.

[14] “Power” is referring to the influence that you have over the Bitcoin community as a direct result of controlling a large share of units. For example, other cryptocurrencies such as steemit even have the “power“ to multiply their wealth based on your behaviour within the community and creation of content.

2. Practical Part

2.1. Model

We will use an ordinary least square regression model, also known as linear regression of one independent variable in our case the Bitcoin and multiple dependant variables, to further analyse and find correlations between the changes in prices of the Bitcoin and chosen commodities. This way we will be able to add the final nail in the coffin of the discussions whether the Bitcoin is a currency or a commodity. We will use the R-script to find these correlations and we are going to be using the daily data. The intervals for the price data starts from January 23, 2015 and ends by the July 1, 2017. The reason for this selection is that the January 2015 is first step in stabilization, therefore being the ideal starting point for the thesis to be tested. The final date is the date of a final data collection for this thesis. The length of the interval is too big for overall processing, so the decision to halve the interval at the date of March 29, 2016 was taken. These two intervals are going to test if the chosen thesis can be statistically proven even in these early stages of the Bitcoins transformation.

2.1.1. Variables

The chosen variables are the price of the Bitcoin and a chosen bunch of commodities consisting of Gold, Silver, Platinum, Palladium and the New York stock market index called S&P 500.

The price of the Bitcoin was collected from website called coinmarketcap.com, which is the most popular site for checking the price of the Bitcoin and thus it is considered as reliable. The data on Bitcoin price is being monitored in terms of US dollars. The reason for choosing this variable is obvious, it is our dependent variable.

The prices of the commodities, with the exception being the stock market index, all were collected from the London Metal Exchange. The data, however does not contain weekends, because the London Metal Exchange closes on Friday and opens on Monday, therefore there was a need to implement this to the model. The choice of these commodities was mainly for their supposed similarities with the Bitcoin. Gold and Silver served a similar role, as the Bitcoin, in the past as a media of exchange. The reasons for picking the Palladium and Platinum is their use in modern technologies, which we can relate to the rise of their price and usage with the modern technologies, similar to how the Bitcoins rose up thanks to the addition of modern technologies.

The last part of the chosen variables is the New York stock market index, S&P 500, this index is a very important economic indicator connected to the stock market, furthermore is widely used in econometric models for their high correlations with other variables. The main reason for the inclusion of this stock market index is the nature of the Bitcoin that is very often compared to the nature of the stock.

In order to make this model a time series, we need to add the time variable t. This variable is going to linearly increase during the sequences of this model.

2.1.2. Model preparation

Firstly, this model is created in R-script, which is a free software that is using commands to use the language R in statistical computing and graphics. In order to be able to use the script properly we need to download and install packages with the commands and statistical tools that are necessary for this model.

```
install.packages("ggplot2")
install.packages("vars")
install.packages("tseries")
install.packages("sandwich")
install.packages("het.test")
install.packages("nlme")
install.packages("car")
library("ggplot2")
library("vars")
library("tseries")
library("sandwich")
library("het.test")
library("nlme")
library("car")
```

The command install.packages is used to download needed packages with functions for the model and the command library enables their use in this model.

Then it is needed to import our two prepared datasets into the programme as Dat1 and Dat2. As another step it is needed to attach the names of the variables to the script, which then recognizes them as usable data.

```
names(Dat1)
attach(Dat1)
names(Dat2)
attach(Dat2)
```

This sets up the script for the model. We will continue with our two set-up datasets so that it is possible to get the results.

2.1.3. The first period of the model

Firstly, we set-up our models desired regression to find the correlations between our variables.

```
reg1=(lm (Bitc~Sp500+Pall+Plat+Silv+Gold+t, data = Dat1))
summary(reg1)
```

Now if the regression is run we will get the first set of information from the command summary. From the results we mainly look at the p-value, which is stating whether the variable is significant. The estimates which tell us the strength of influence of our variables are our secondary target.

```
Residuals:
    Min      1Q  Median      3Q     Max 
-95.914 -28.973  -4.989  27.724 102.092 

Coefficients:
             Estimate Std. Error t value Pr(>|t|)    
(Intercept) -237.54902  113.70736  -2.089  0.03754 *  
Sp500          0.22721    0.04826   4.708 3.83e-06 ***
Pall          -0.20400    0.07849  -2.599  0.00981 ** 
Plat           0.04509    0.14229   0.317  0.75152    
Silv         -17.32905    8.52074  -2.034  0.04285 *  
Gold           0.29433    0.15536   1.895  0.05911 .  
t              0.57992    0.13212   4.389 1.58e-05 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 43.24 on 301 degrees of freedom
Multiple R-squared:  0.696,	Adjusted R-squared:  0.6899 
F-statistic: 114.8 on 6 and 301 DF,  p-value: < 2.2e-16
```

As we can see most of our variables are significant on different p values, but we must test these results to know whether the results are correct according to statistical principles. We start with the functions Acf (Autocorrelation Function Estimation) and Pacf (Partial Autocorrelation Function Estimation). The function Acf computes an estimate of the autocorrelation function of a time series and the possibility of the multivariate. Function Pacf computes an estimate of the partial autocorrelation function of a time series with the possibility of multivariance. We run both the commands and the results are going to be in the form of figures in 20 chosen periods.

acf(reg1$residuals, xlim=c(1,20) ,main="ACF")

pacf(reg1$residuals, xlim=c(1,20) ,main="PACF")

From these commands we get the two figures.

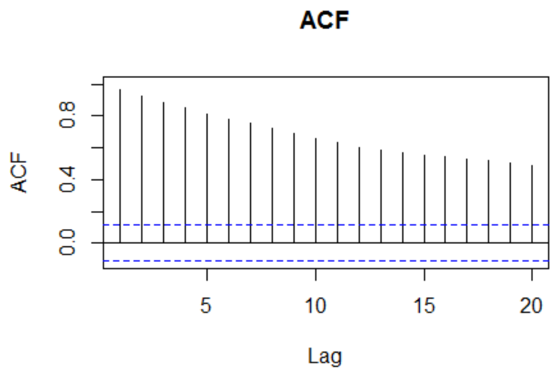

Figure 1.

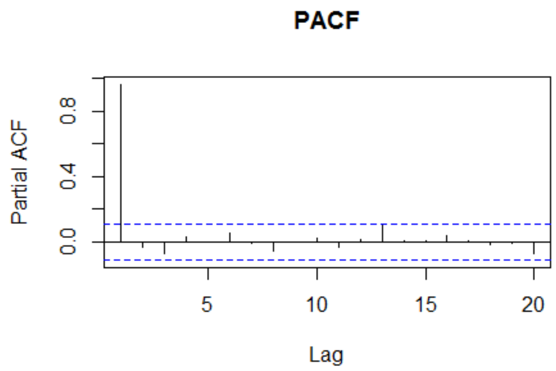

Figure 2.

These figures tell us that the results are corrupted with multivariance, therefore we need to change our variables to get the clear results. The chosen solution is to use natural logarithmic differences. This method is called a “Log-Log” Regression Specification. In principle, any log transformation (natural or not) can be used to transform a model that’s nonlinear in parameters into a linear one. All log transformations generate similar results, but the convention in applied econometric work is to use the natural log. The practical advantage of the natural log is that the interpretation of the regression coefficients is straightforward. We need to set up our new regression with the same commands as before with the addition of logarithms this time.

reglnd1=lm (lndBitc~lndSp500+lndGold+t+lndPall+lndPlat+lndSilv, data = Dat1)

summary(reglnd1)

```
Residuals:
      Min        1Q    Median        3Q       Max
-0.112070 -0.012643 -0.002344  0.013647  0.125999

Coefficients:
              Estimate Std. Error t value Pr(>|t|)
(Intercept)  9.987e-04  3.443e-03   0.290   0.7720
lndSp500    -1.733e-02  1.752e-01  -0.099   0.9213
lndGold     -6.383e-01  3.144e-01  -2.030   0.0432 *
t            8.610e-06  1.931e-05   0.446   0.6560
lndPall      1.285e-01  1.181e-01   1.088   0.2773
lndPlat      1.498e-01  2.032e-01   0.737   0.4615
lndSilv      9.868e-02  1.721e-01   0.573   0.5669
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.02994 on 301 degrees of freedom
Multiple R-squared:  0.02149,   Adjusted R-squared:  0.001982
F-statistic: 1.102 on 6 and 301 DF,  p-value: 0.3613
```

This brings rather less positive results, although our variable lndGold is still significant on the level of P value of 5%. The strength of prediction was decreased since with change of 1 in lndGold making -6.383e-01 difference in lndBitc. Regardless of this we still need to test this regression to prove its reliability according to statistical principles. Again, we will start with the functions of Acf and Pacf.

```
acf(reglnd1$residuals, xlim=c(1,20) ,main="ACF")
pacf(reglnd1$residuals, xlim=c(1,20) ,main="PACF")
```

This brings us the new figures.

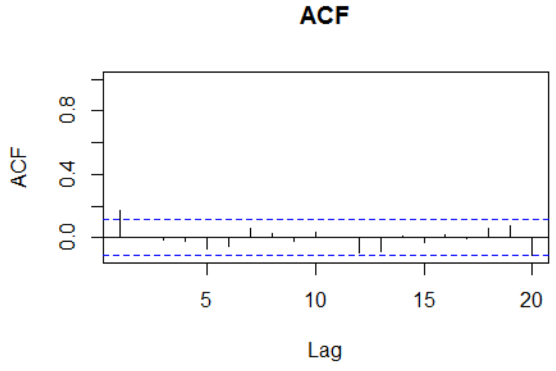

Figure 3.

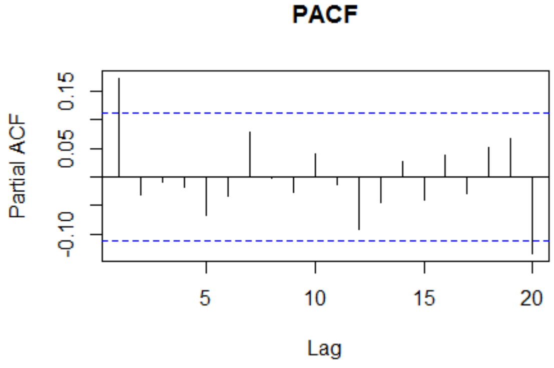

Figure 4.

As we can see from the figures we have got rid of the most problematic results, but still some of the results are around the border, to test these border situations we use specialized Breusch-Godfrey test. This test is used to assess the validity of some of the modelling assumptions inherent in applying regression-like models to observed data series. In particular, it tests for the presence of serial correlation that has not been included in a proposed model structure and which, if present, would mean that incorrect conclusions would be drawn from other tests, or that sub-optimal estimates of model parameters are obtained if it is not taken into account.

```
bgtest(reglnd1, order = 1, order.by = NULL, type = c("Chisq", "F"),
    data = list(), fill = 0)
```

```
Breusch-Godfrey test for serial correlation of order
           up to 1

data:  reglnd1
LM test = 9.3809, df = 1, p-value = 0.002193
```

These results clear our border situations and we allow us to continue with our tests according to the Ordinary Least Squares method.

Firstly, according to OLS, we need to test our model for normality. Before we test the normality with Shapiro–Wilk test we will plot the results to see the graph of our regression.

qqPlot(reglnd1)

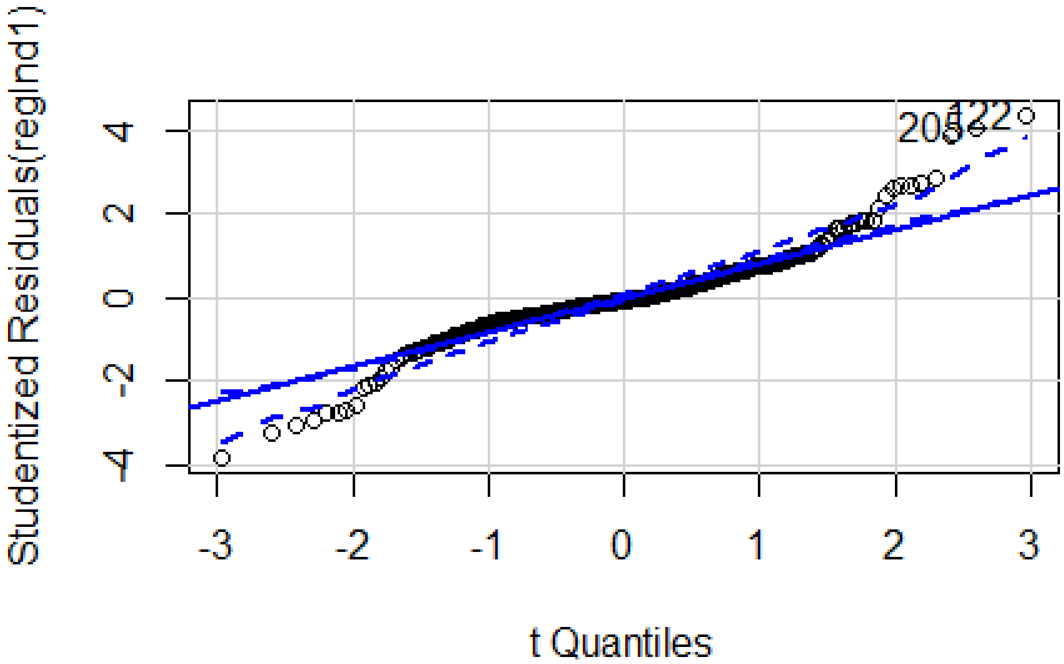

Figure 5.

The Figure 5. suggests our model is acting very similarly to a normal distribution, but we are still going to test it with the Shapiro–Wilk test for normality. The Shapiro-Wilks test for normality is one of three general normality tests designed to detect all departures from normality. The test rejects the hypothesis of normality when the p-value is less than or equal to 0.05. Failing the normality test allows us to state with 95% confidence the data does not fit the normal distribution. Passing the normality test allows us to state that no significant departure from normality was found. This test was found to have the best power for given significance in testing the normality according to Monte Carlo simulation.

shapiro.test(reglnd1$residuals)

Shapiro-Wilk normality test

data: reglnd1$residuals
W = 0.92775, p-value = 4.571e-11

With the result we can confidently say that our model does possess normality. This result is needed for the continuation of our model.

Next step is to test our model for the presence of collinearity and more importantly multicollinearity. These phenomena can be described as a situation in which one predictor variable in a multiple regression model can be linearly predicted from the others with a substantial degree of accuracy. We are going to test for the presence of collinearity and multicollinearity with the Variance Inflation Factors. Variance inflation factors range from 1 upwards. The numerical value for VIF states, in decimal form, what percentage the variance (i.e. the standard error squared) is inflated for each coefficient. For example, a VIF of 1.9 tells you that the variance of a particular coefficient is 90% bigger than what you would expect if there was no multicollinearity, in other words, if there was no correlation with other predictors. The scale is set to with 1 not correlated at all. The interval between 1 and 5 is moderately correlated, which is acceptable for OLS testing. But the problem is when the coefficient is greater than 5, in this case it is highly correlated and not usable for our purposes.

vif(reglnd1)

```
lndSp500  lndGold        t  lndPall  lndPlat  lndSilv
1.049692 2.519323 1.012375 1.533367 2.357353 2.246399
```

Now we test these values using the square root using the rules of VIF test. To graphicly see the results of the test. We set our square root to flag the problem, if the correlation is bigger than 2 to avoid border situations.

sqrt(vif(reglnd1)) > 2

```
lndSp500  lndGold        t  lndPall  lndPlat  lndSilv
   FALSE    FALSE    FALSE    FALSE    FALSE    FALSE
```

According to the VIF testing our model is clear of collinearity and multicollinearity.

This leaves us with one last test for the heteroscedasticity. This term simply refers to the state in which the variance of variable is unequally distributed across the range of values that are similarly predicted by other of our variables. We will test the residuals of our variables by the Breusch-Pagan test. The Breusch-Pagan test is one of the most common tests for heteroskedasticity. It begins by allowing the heteroskedasticity process to be a function of one or more of your independent variables, and it's usually applied by assuming that heteroskedasticity may be a linear function of all the independent variables in the model. First, we need to set up our residuals in new regression called res1.

```
res1<-reglnd1$residuals^2
summary(lm(res1~lndSp500+lndGold+t+lndPall+lndPlat+lndSilv, data = Dat1))
```

```
Residuals:
      Min         1Q     Median         3Q        Max 
-0.0013886 -0.0008684 -0.0005853 -0.0001027  0.0147928 

Coefficients:
             Estimate Std. Error t value Pr(>|t|)    
(Intercept)  1.001e-03  2.357e-04   4.245 2.92e-05 ***
lndSp500    -1.604e-02  1.200e-02  -1.337    0.182    
lndGold     -2.808e-02  2.152e-02  -1.305    0.193    
t           -8.300e-07  1.322e-06  -0.628    0.531    
lndPall     -7.403e-03  8.083e-03  -0.916    0.360    
lndPlat     -8.213e-04  1.391e-02  -0.059    0.953    
lndSilv      1.561e-02  1.178e-02   1.325    0.186    
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.00205 on 301 degrees of freedom
Multiple R-squared:  0.0191,	Adjusted R-squared:  -0.000451 
F-statistic: 0.9769 on 6 and 301 DF,  p-value: 0.4409
```

As we can see from the results none of our variables possesses this trait, but still we will test it by the Breusch-Pagan test to be certain.

bptest(reglnd1, varformula = NULL, studentize = TRUE, data = Dat1)

studentized Breusch-Pagan test

data: reglnd1
BP = 5.8834, df = 6, p-value = 0.4364

The results prove that our model does not possess Heteroscedasticity. Therefore, homoscedasticity is present, this states that all random variables in the sequence have the same finite variance. It is important for the statistical principles that our model possesses this trait, because otherwise we could have overstated the fit of our variables to the regression.

This concludes our tests according to the OLS method. As it can be seen in our reglnd1 we get one positive result in LndGold, which proves the relation between the Bitcoin and Gold. According to statistical principles this testing should be sufficient enough and I consider it to be successful, due to the volatile state of the Bitcoin especially in our time frame.

2.1.4. The second period of the model

As we did with our first period we will set up our regression model for the second dataset.

reg2=(lm (Bitc~Sp500+Pall+Plat+Silv+Gold+t, data = Dat2))
summary(reg2)

As shown above this gives us information about the regression model. The primary focus is again on the p-value with regard to our secondary focus on the estimates.

```
Residuals:
    Min      1Q  Median      3Q     Max 
-344.89  -91.89  -27.56   74.90  696.03 

Coefficients:
             Estimate Std. Error t value Pr(>|t|)    
(Intercept) -6922.1542   581.8761 -11.896  < 2e-16 ***
Sp500          2.7847     0.2861   9.735  < 2e-16 ***
Pall          -2.1431     0.3158  -6.785 6.18e-11 ***
Plat           0.2067     0.3922   0.527    0.599    
Silv        -146.4671    17.4553  -8.391 1.92e-15 ***
Gold           3.9748     0.3385  11.741  < 2e-16 ***
t              3.0019     0.4870   6.164 2.28e-09 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 146.1 on 300 degrees of freedom
Multiple R-squared:  0.8645,	Adjusted R-squared:  0.8618 
F-statistic:   319 on 6 and 300 DF,  p-value: < 2.2e-16
```

As can be seen from the results, most of our variables are significant on 0,1% p values, which is a very good result, but we must test these results for the autocorrelation again. We will move forward with the functions Acf and Pacf. This should let us know whether we should alter our function as before or continue.

```
acf(reg2$residuals, xlim=c(1,20) ,main="ACF")
pacf(reg2$residuals, xlim=c(1,20) ,main="PACF")
```

This is a visual representation of our results in figures.

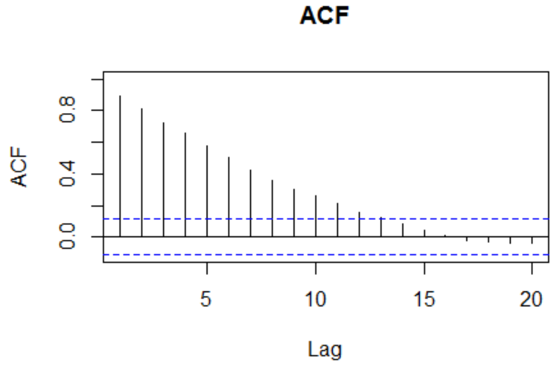

Figure 6.

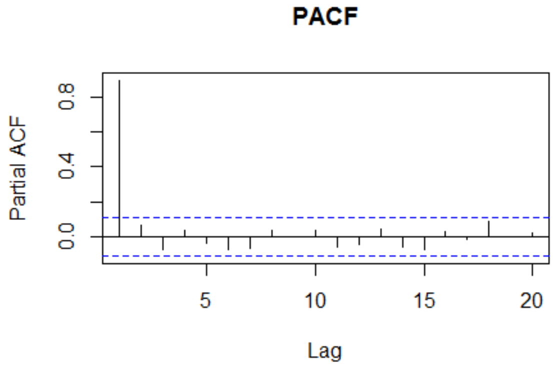

Figure 7.

Based on these results, there is also a need to use the natural logarithmic differentiation method. This should provide us with the sufficient regression for the OLS method. Therefore, we run the altered regression with same commands.

reglnd2=lm (lndBitc~lndSp500+lndGold+t+lndPall+lndPlat+lndSilv, data = Dat2)

summary(reglnd2)

Residuals:

Min	1Q	Median	3Q	Max
-0.157520	-0.008587	0.000038	0.011678	0.148633

Coefficients:

	Estimate	Std. Error	t value	Pr(>|t|)
(Intercept)	6.413e-04	3.463e-03	0.185	0.853
lndSp500	-2.018e-02	2.993e-01	-0.067	0.946
lndGold	1.847e-01	3.534e-01	0.523	0.602
t	3.215e-05	1.951e-05	1.648	0.100
lndPall	-9.318e-02	1.309e-01	-0.712	0.477
lndPlat	-1.245e-01	2.256e-01	-0.552	0.582
lndSilv	8.678e-02	1.696e-01	0.512	0.609

Residual standard error: 0.03015 on 300 degrees of freedom

Multiple R-squared: 0.01477, Adjusted R-squared: -0.004934

F-statistic: 0.7496 on 6 and 300 DF, p-value: 0.6102

This, unfortunately, yields us negative results with none of the variables being even close to our wanted p-values, closest is the LndPall with 47,7%. Regardless of that, we will continue with our regression. We will start with the functions of Acf and Pacf.

```
acf(reglnd2$residuals, xlim=c(1,20) ,main="ACF")
pacf(reglnd2$residuals, xlim=c(1,20) ,main="PACF")
```

This provides us with the new figures.

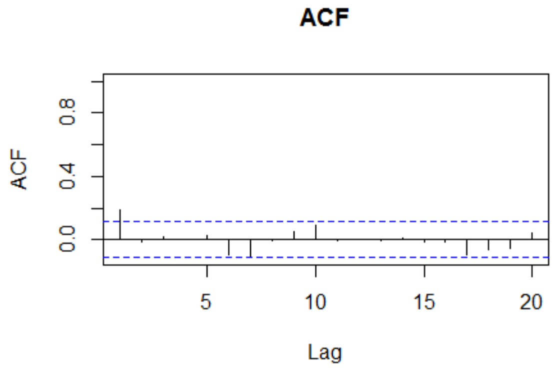

Figure 8.

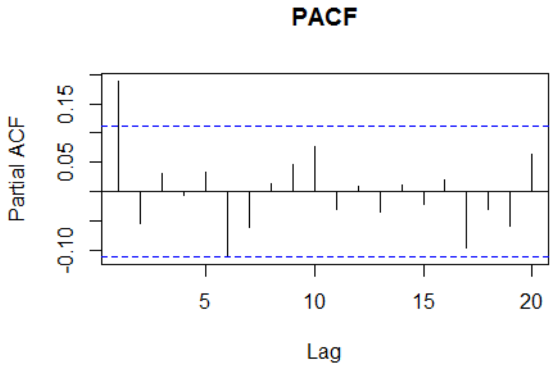

Figure 9.

As the figures suggest we got rid of the most problematic areas of results, but still some of the results are visible again around the border, to test these border situations we use specialized Breusch-Godfrey test, as we did before.

```
bgtest(reglnd2, order = 1, order.by = NULL, type = c("Chisq", "F"),
      data = list(), fill = 0)
```

```
Breusch-Godfrey test for serial correlation of order
            up to 1

data:  reglnd2
LM test = 11.111, df = 1, p-value = 0.0008582
```

These results clear our border situations and enable us to continue with our tests according to the Ordinary Least Squares method.

Before we proceed in accordance to OLS, we will first test our model for normality. Before we test for normality with Shapiro-Wilk test we will plot the results to see the graph of results from our regression.

qqPlot(reglnd2)

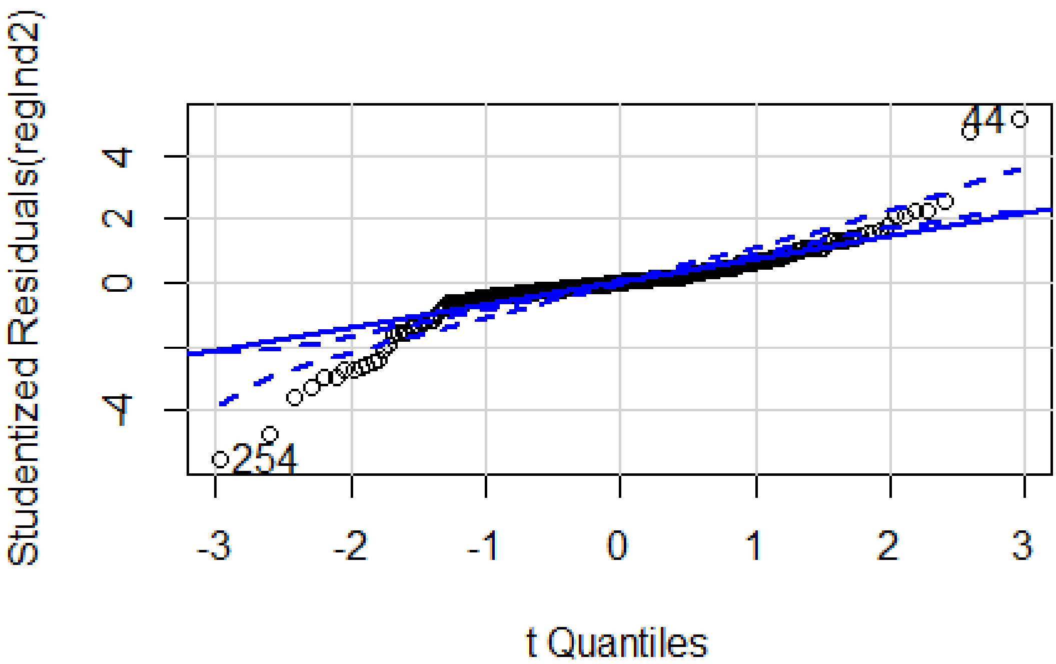

Figure 10.

The Figure 10. tells us that our model is acting very similarly to a normal distribution, but there is still the need to test it with the Shapiro-Wilk test for normality.

shapiro.test(reglnd2$residuals)

Shapiro-Wilk normality test

data: reglnd2$residuals

W = 0.84547, p-value < 2.2e-16

With the result we can confidently state that our model does possess normality.

Next step in the OLS methodology is to test the second model for the presence of collinearity and more importantly for the multicollinearity. We will once again use the VIF method to test the presence of collinearity and multicollinearity.

vif(reglnd2)

```
lndSp500  lndGold        t  lndPall  lndPlat  lndSilv
1.083636 2.932615 1.010077 1.465371 2.591398 2.491875
```

Now we will use the square root of these values with the aim of the results being less than 2 with regard to the VIF rules.

sqrt(vif(reglnd2)) > 2

```
lndSp500  lndGold        t  lndPall  lndPlat  lndSilv
   FALSE    FALSE    FALSE    FALSE    FALSE    FALSE
```

According to the VIF methd our model is clear of collinearity and multicollinearity.

This leaves us with the last test for the heteroscedasticity. We will be using the Breusch-Pagan test for the residuals of our variables. Fist we need to set up our residuals in new regression called res2.

res1<-reglnd1$residuals^2

summary(lm(res1~lndSp500+lndGold+t+lndPall+lndPlat+lndSilv, data = Dat1))

```
Residuals:
       Min         1Q     Median         3Q        Max 
-0.0022348 -0.0009139 -0.0006258 -0.0001501  0.0231506 

Coefficients:
              Estimate Std. Error t value Pr(>|t|)  
(Intercept)  5.328e-04  3.156e-04   1.688   0.0924 .
lndSp500     2.399e-03  2.729e-02   0.088   0.9300  
lndGold      6.396e-02  3.221e-02   1.986   0.0480 *
t            2.351e-06  1.779e-06   1.322   0.1872  
lndPall     -4.385e-03  1.193e-02  -0.368   0.7135  
lndPlat      7.781e-03  2.057e-02   0.378   0.7055  
lndSilv     -2.648e-02  1.546e-02  -1.713   0.0878 .
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 0.002748 on 300 degrees of freedom
Multiple R-squared:  0.02644,	Adjusted R-squared:  0.006964 
F-statistic: 1.358 on 6 and 300 DF,  p-value: 0.2315
```

As we can see from the results some of our variables possess this trait, but we will still test it by the Breusch-Pagan test to be certain of it.

bptest(reglnd2, varformula = NULL, studentize = TRUE, data = Dat1)

```
studentized Breusch-Pagan test

data:  reglnd2
BP = 8.1156, df = 6, p-value = 0.2298
```

The results prove that our model is clear of heteroscedasticity.

This concludes our testing according to the OLS method. As it can be seen in our reglnd2 we were unable to get a positive result in this period as it was an even more unstable time for the Bitcoins price levels, but this still does not disprove the relation between the Bitcoin and our chosen commodities, just proves what a turbulent state this was for the Bitcoin during this time frame.

3. Conclusion

The main objective of this thesis was to analyse a development of the Bitcoin price with regard to stock and commodities from January 2015 to June 2017, at both a theoretical and empirical level. The theoretical section focused on the broad introduction of cryptocurrencies in general, predominantly, with special regard to the Bitcoin. This introduction was necessary for the readers to see the theoretical background of the Bitcoin.

The Bitcoin was then closely evaluated from the viewpoint of the Austrian school of economics. The main influence for this evaluation originated in the teachings of the late Ludwig von Mises and his late disciple Murray Newton Rothbard. The examination from this point clearly confirmed our assumptions about the Bitcoin not being currency from economic viewpoint of Austrian school of economics.

To prove our hypothesis that the Bitcoin is acting predominantly as a commodity, we have identified the Bitcoin as an asset with inherent values, mainly their beneficial abilities inside a Bitcoin community connected to the manner of the peer-to-peer electronic cash system, in which the transactions are decided by majority of users, mainly by the miners that have to confirm all transactions on the network.

Another point, supporting the thesis claim, is the majority of governments' perception of the Bitcoin as a commodity rather than a currency, with the most important one, from my point of view, being the perception of the USA on this matter. This theoretical background is sufficient to establish our hypothesis accepted from the theoretical point of view.

In the practical part of this thesis, the model to prove the connections between the Bitcoin and chosen commodities was prepared. Unfortunately, the turbulent state of the Bitcoin prevented me from establishing stronger relations, but I was able to establish the relation between changes in market prices of the Bitcoin and Gold. This result should be, nevertheless, conceived as a proof that the Bitcoin has a status of a commodity rather than currency. Furthermore, the statement that the Bitcoin is a "virtual gold" is supported by the results.

In order to conclude this thesis, we must address the hypothesis. Ultimately, we were able to support our hypothesis by the empirical results with additional theoretical support from the Austrian school of economics. But the recommendation for more practical tests to take place must be issued, in order to fully understand the broad consequences of the cryptocurrencies creation and their position on the current markets.

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