Connections between Stock market and Bitcoin market

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Abstract

During the recent years digital currencies have gained an outstanding popularity, allowing users to avoid to use fiat currencies and promising to revolutionize the entire financial system. This uprise was led mainly by Bitcoin. Bitcoin relies on a peer-to-peer network where transactions must be approved by the users who joined the network, aiming to give transparency to the whole process. As a result, Bitcoin is deemed as a decentralized currency, where no any central authority or entity control the mechanisms which lie behind. Another perk of the bitcoin consist in a low transaction cost when it comes to trade and an extremely user-friendly usage through virtual wallet. On the other hand, high security standard are granted through complex algorithms which require the computational powers of other users to take in place. This phenomenon is known as “mining”, where users which contribute to encrypt each transaction are rewarded with bitcoin. On the other hand, a negative aspect comes to light. Indeed, the quality of anonymity of its users during the transactions, might allow criminals to trade and invest in Bitcoins for illegal purposes.

As per this rise in popularity and usage, Bitcoin have started to be seen as speculative asset gaining attention for its performance compared to other asset. Bitcoin is a risky investment, due to its unpredictable volatility subjected to relevant upwards and downwards in a matter of hours. On the logical ground, these unique features match the preference of a risk lover investor. Indeed, a risk lover investor is focused on gaining extra profit through highly risk investments with high volatile environment. As a result, the paper investigates if a decrease in VIX might lead to an increase in the Bitcoin Market Capitalization, meaning that investor might have allocated resources from stock market to Bitcoin. Similarly, in order to underpin this hypothesis, the study wants to inspect whether an increase in Bitcoin volatility corresponds to a rise in Bitcoin market capitalization. Firstly, The results partly confirm the research question. In fact, risk lover traders appear to tread Bitcoin and the stock market impartially, switching their investments where the profitability increases more, regardless the risk. Secondly, Stock market capitalization appeared to have a great magnitude on influencing the Bitcoin market capitalization.
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Reference
Chapter 1 - Introduction & background

1 Introduction

New technologies have driven the way to pivotal and concrete changes in the structure of our economic systems. The establishment of these new decentralized peer-to-peer technologies, namely cryptocurrencies, enables to initiate a new economy, which goes beyond the traditional bank investments (p.1, Banking beyond Banks and Money). Indeed, as Skinner (2014) stated in his work: “For half a millennia, retail banks, retail bankers have worked on the basis of physical distribution. For half a century, that model has been challenged to move towards electronic distribution”. The rise in popularity of Bitcoin steams from 2008, in the beginning of the so-called worst world financial crisis occurred in the 21st century, after the historical stock market crash in 1929. One of the major consequence of the financial crisis has been the loose in credibility of traditional banks and the way they led the savings of investors to profitable investments. This has led some investors to think alternatively, far from the centralized traditional bank system. Consequently, new way of investments and exchange of money arose through the years. One of the big players in this field is the well known Bitcoin. Nowadays, Bitcoin is one of the most exchange digital currencies with several benefits, but also downsides. Indeed, Bitcoin is a decentralized system, which is traded anonymously in the blockchain by the investors. What drags plenty of investors to invest in Bitcoin and in digital currencies in general, is the undoubtedly high profitability of these investments, due to the common high volatility of the cryptocurrency investments. Nevertheless, we can accurately identify a trade-off between profitability and risk. Indeed, excessive profits correspond to a higher risk to take in the investments, due to the high level of volatility. Under those circumstances, some investors might be appealed to these peculiar risky characteristic. These investors are named risk-seeking investors, who are attracted by this risk, in
order to make excessive profits. In fact “Risk seekers are more interested in capital gains from speculative assets than capital preservation from lower risk assets.” (Investopedia, 2018).

1.1 Statement of the problem

Considering the stock market with a plethora of companies available, investors should be already satisfied, trading in this environment. Indeed, in 2008, when Bitcoin was taking the first steps in to the financial world, “the world stock market had a capitalization of 35.0 trillion dollars. Of that total, the U.S. stock market had a share of only 33.6 percent” (p. 73, R. C. Marston, 2011). Despite the large availability of trading opportunities, it seems that some investors are eager to experience new ways of investments, regardless the risk. Under those circumstances, Bitcoin has become a big player across this type of investors. Indeed, since the last economic recession in 2008, governments injected money in to the market, in order to stop the slumping economy. This caused a sharp decline in the stock market (Xiaolian Zheng, Ben M. Chen, 2013). On the other hand, the value of Bitcoin should only increase due to its scarcity overtime (M. Miller, 2014). One substantial difference between stock market and Bitcoin lies in the discrepancy of volatility in these markets. Indeed, stock market has been experiencing a stable level of volatility across the years. In fact, as written in Paul Kupiec’s work (1991), he argued that “it is apparent that volatility during periods of normal market conditions has not changed much.” In comparison, Bitcoin has been witnessed to a deep fluctuation in the volatility. In Baur and Dimpfl’s paper (2018), the authors pointed out that the volatility of Bitcoin prices is greater 30 times in contrast to the major currencies in the study period between January 2014 and January 2017. Since the volatility is the main factor, which influences the investors’ decisions, this could be a potential reason, which might determine a switch from the stock market to the Bitcoin. Indeed, the investors taken into account for this study, are the risk-seeking investors, who might be attracted by the excessive profit, allocating their investments in the digital currency. The reason why they might prefer to invest in Bitcoin could be a
speculative purpose, due to the high variation of the volatility in the Bitcoin market. As aforementioned previously, Jose E. Gomez-Gonzalez and Julian A. Parra-Polania claimed in their paper (2014): “The lack of support from any government reinforces a vicious circle in which the Bitcoin is mainly demanded as an asset for speculative purposes rather than as a medium of exchange, thereby generating high volatility in its value, which in turn dissuades people from using the Bitcoin as medium of exchange”. Behind this logic, the risk-averse investors should prefer to maintain their investments in the stock market, in a hypothetical scenario of low volatility. Meanwhile, the risk-seeking investors, might switch their investments in Bitcoin investments due to the presence of low volatility in the stock market. Firstly, the purpose of this study is to explore the existence of this trend, analyzing the causes which determine the risk-seeking investors change from the stock market to the Bitcoin. In this study, the low volatility in stock market has been assumed as the pivotal factor, which might lead to a change in the investments of the risk-seeking stockholders. Secondly, this study wants to provide the relationships and links between these two markets, (namely stock market and Bitcoin). Thirdly, we want to clarify whether the traditional investment behaviors can and might be modified in the future, in favor of these new technological financial instruments. The result of this study can be useful for developing new insights about the behavior of the risk-tolerant investors, when they are facing a particular scenario in the stock market (low volatility) and they have other investment opportunities in a different market namely the Bitcoin market. Having said that, the thesis will acknowledge the following research question: “do investors switch to Bitcoin market when stock markets are quiet with low returns and low risks?”.

This statement is supported by continuous changes in Bitcoin volatility, which might appeal risk-tolerant investors. Although some previously works have already discovered connections between stock market and Bitcoin market, this thesis will focus more on the role of volatility and use Bitcoin market capitalization in order to study hypothetical switches of the risk-tolerant investors. Since the thesis will rely on the model of CAPM, it makes sense give a little bit of context around the risk-
tolerant investors. Indeed, according to CAPM, the risk does not play a relevant role. On the other hand, the return is pivotal in the model. This is in line with the idea of the investors seeking for extra profit. As a result, all the investors will invest regardless the risk. However, among these, there will be a portion of them more interested in gaining extra profit, which might correspond to risky assets as Bitcoin investments.

1.2 Structure of the thesis

The study is displayed in five chapters. Chapter I includes the introduction, the statement of the problem and the significance of this study. Chapter II illustrates the theoretical support, the literature review and the research question together with its hypothesis. Chapter III presents the methodology used for this research study and it includes the data collection, the data analysis procedures. Chapter IV identifies the result and findings including the test of the research question and the analysis of the three regressions with different independent variables. Chapter V gives an overview of this research study, including a discussion of the results given by the analysis in chapter IV.

Chapter 2 - Theoretical foundation

2.1 The rise of cryptocurrency

The past decade has been witnessed to the growth of popularity of the cryptocurrencies. In 2008, Satoshi Nakamoto created the first cryptocurrency namely Bitcoin. In fact, Satoshi Nakamoto lays the foundation stone for the beginning of an important revolution in the financial system. Indeed, through the years, it has grown in popularity, becoming internationally recognized as the “bitcoin system”. Nowadays, we have been witnessed to the creation of new digital currencies, which are traded on a daily basis. Although, Bitcoin is the most established digital currency recently, among the other crypto currencies implemented through the years, it was not the first
attempt. In fact, several attempts have been realized before the establishment of the Bitcoin and other many virtual currencies. Indeed, steps back in time have to be done. In 1996, one of the first digital currency was created, known with the name “E-Gold”, which was backed by real gold-bullion. Furthermore, in 1998, another impressive website called “beenz.com” was created. The new website was meant to generate cryptocurrency, namely Beenz, by the users, in order to implement a plenty of activities such as buying online goods and services. Simultaneously, other countries such as China tried to develop their own digital currency. In 2002, In China was launched an instant messaging service called QQ by the Chinese Internet Provider Tencent, which gave the possibility to the customers, through their internal virtual currency known with the name of Q Coins, to shop several virtual goods and services. However, these attempts across the years have smoothed the way to Bitcoin system and other many virtual currencies, as they are known nowadays. In January 2009, the first bitcoin transaction was generated. However, it took several months to get used to this new tech transitions and different releases of Bitcoin were made. In 2012, the currency exchange rate was already exponentially increased: “Slashdot come up with the stats of the global users of bitcoin. There was a huge surge for the bitcoins at that point of time, showing promise for the investors to see from a wide perspective. By July 2012, the growth of the bitcoin was out of proportions. The currency exchange rate was ten times more than what is began with at 2009” (p.2, Introbooks, 2018).

2.2 The characteristics of Bitcoin

The Bitcoin and the other cryptocurrencies hold some peculiar characteristics. For instance, it is decentralized. However, before introducing this terminology, a centralized system has to be discussed. Indeed, it is defined centralized, a system where all the banking transactions are backed by a central authority or institution in a country (or a group of countries under the same
currency), and, therefore, it oversees the activities of the users. In fact, in most developed countries, the nation’s central bank serves as the primary settlement agent for payment transactions. The central bank provides the operational and liquidity advantages of centralized settlement (p.9, R. Listfield et al., 1994).

Whereas, it is meant decentralized, a system in which transactions and data are not collected by any central entity, but they are transmitted to all the participants. These connections, or more specifically known as nodes, compose the so-called network. The core of a decentralized system is therefore the named “blockchain”. More specifically, the blockchain works as follows: Every time a participant needs to transfer cryptocurrencies to other participants of the network, the transaction will be transcribed in a digital ledger. This ledger system ensures a high level of security, by applying a complex algorithm to encrypt the transaction. In details, in order to be effectively registered in the ledger database, some complex algorithm have to be solved for preventing the network to be hacked by external parties. Therefore, the participants of the network are called for solving the these jigsaw puzzles, by sharing the computational power of their computers. As per this contribution, the participants are rewarded in Bitcoins. In the Bitcoin scene, the technical term to define this process is known as “mining”. Mining has become quite popular across the digital currency’s community as a means of obtaining bitcoin as well as encouraging participants to collaborate together. As a result, today miners usually group them in “mining pool” which comprise a series of miners willing to share their computers together and rewarded accordingly.

The decentralized systems offer a variegated benefits, but they also hide several drawbacks. First and foremost, one of the advantages worth to mention is that the cryptocurrencies use a “cryptography security” (p.32, F. Bunjaku et al., 2017), which enables safe money transactions, preventing from hacking and making it extremely hard to counterfeit and manipulate.
As aforementioned, cryptocurrencies are not regulated by any central institution and, therefore, they are not influenced by any central entity or institution, but all the transactions are collected and formed the network. Moreover, the network (blockchain) facilitates the exchanges and the transactions between two users of the platform, making them rapid, avoiding a third party as it works using the conventional banks. Indeed, the participants of the network can transfer money unlimited times and anywhere to the counterparts.

Another factor to point out is the transaction fee in cryptocurrency’s systems. While the traditional banks charge a remarkable transaction cost, in several virtual currencies systems it is close to 0%. As a result, the users of the platform are not obliged to the payment of a fee to third parties, namely traditional banks or other institutions.

Furthermore, the transparency plays a crucial role in these brand new systems. In fact, every owner of virtual currencies’ wallets can observe the financial transactions of all the other participants of the platform. On the other hand, in the conventional bank systems, people are only informed about their transactions and their banking account. Indeed, authors such as Flamur Bunjaku (et Al.) claim that although these brand new system are not backed by any central institution, “the high level of transparency makes cryptocurrencies acceptable for its users”. Another benefit of transparency might lie in fostering new type of businesses, where public available information can be at everyone disposal. Indeed, as argued in Ian De Martino (2018) in his work: “According to Minor, Uphold’s motto is “What our members do with their money is their business, but what we do with their money is everyone’s business”. The reserve chain is the technological embodiment for that. […] As it turns out, there are all kinds of businesses that actually want to have transparency as part of their business model. […] Verifiable transparency is important for regular investors too.”
Another advantage of cryptocurrencies is that the users who hold cryptocurrency’s portfolios, are anonymous. Indeed, although all the transactions and the crypto wallets are visible and available for all the users of the platform, the information of the owners remain secret, maintaining the anonymity of the participants in a transaction. This contributes to prevent identity thefts. On the other hand, this system might encourage criminal organizations to use Bitcoin with the aim of being untraceable. This phenomenon has been identified with the name of “Deep Web”. The Deep Web and contributes to the increase in the illegal business by the criminal organizations. Indeed, “the Deep Web provides an anonymous home to a whole raft of nefarious individuals - ranging from narcotics online, child pornography, weapons, fake passports and fake currency. Bitcoin has provided a way for anonymous payments for the above goods” (p.30, A. Baxter et Al., 2014).

To conclude the description of the main characteristics of the virtual currencies and more specifically of Bitcoin, the non repudiable definition has to be analyze carefully. The non repudiable aspect remarks once again upon the security in Bitcoin transactions, through the use of cryptography language in order to prevent from hacking or thefts. This mechanism ensures the transaction of Bitcoins between two parties. Under these circumstances, once the Bitcoin transfer is processed, there is no chance that the Bitcoin amount transferred will get back to the sender, unless the recipient of that sum is willing to send it back. This method warrants the received of the money transfer, avoiding any claim from the respondent. To clarify it, the respondent cannot promote any request in the attempt to scam the sender of the transfer by declaring that she/he has never received any Bitcoin.
2.3 Fiat money currency

For the completeness of this dissertation, a definition of the “fiat money currency” has to be provided. Fiat money is a currency, which is legally recognized by a government, which its intermediators are banks and the central bank of a country. Fiat money currencies do not detain an intrinsic value and cannot be converted into anything physical which owns an intrinsic value, since when the gold standard system had been quit. The gold standard was a system in which fiat money currency could be transformed into anything physical, such as gold. This system has been used several times in the History. In particularly, the gold standard system, known also as gold exchange standard, was introduced after the Second World War by the Bretton Woods agreements. Under the gold exchange standard system, the fiat currencies exchange rates of many countries were fixed to the US dollar. Once the foreign currencies were exchanged for US dollars at a fixed rate, the central bank could converted the US dollar capitals into gold. Nevertheless, fiat money currencies hold a nominal value, which is represented by the paper money. In other words, “the sole use of money is to purchase things which have intrinsic value” (S. M. Focardi, 2018). It is worth to point out another pivotal characteristic of fiat money currencies, which revolves around the “unit of account”. More specifically, consumers perceive the fiat money currencies as numerate when it comes to purchase or compare two goods. Indeed: “For instance, a cup of coffee that costs $4.00 in one café is quickly understood to be twice as expensive as a cup of coffee selling for $2.00 at another café down the street” (p.11, D. Yermack, 2013). Furthermore, fiat money currencies can be deemed as a means of deferred payment. Indeed, fiat money currencies (through traditional banks) grant people to borrow a certain amount of money and pay it back in the future. These two characteristics previously mentioned are not applicable when it comes to Bitcoin or other cryptocurrencies.
2.4 Trade off Risk-Return in Bitcoin and Stock market

For the sake of the comparison, in recent years stock market has been offering depressed levels of profitability compared to Bitcoin. Indeed, many researchers have tested the same capitals allocated in bitcoin and stock market investments, which came out with deep differences in terms of returns. As Andrew Detzel and his colleagues (2018) investigate in their work, the results obtained highlight a substantial discrepancy between bitcoin and stock market investments. In fact, “Bitcoin is no doubt one of the most speculative assets in the history of finance. Its rapid price increase surprised even the most optimistic of market observes an early investors. One dollar invested in Bitcoin on October 27, 2010 grew to $103,453 by January 31, 2018, while the same investment in the S&P500 stock index grew to only $2.65 over the same period.” The reason for this discrepancy lies with the different volatility. The relation between expected return and variance has already been treated widely by researchers, for instance in the CAPM model. Before taking any investment decision it is essential to analyze the trade off between risk and return on an investment. For this reason, several models, in particular the capital asset pricing model, knowing as CAPM model, have been the theoretical foundation for the financial markets. The capital asset pricing model and many theoretical models take into account the trade-off between risk and expected return. More specifically, they highlight that the expected returns are proportional to the risk taken in a particular investment. Therefore, investors will decide whether to allocate funds in a particular asset or stock in order to gain higher returns, expecting a corresponding risk. Furthermore, studies have been keen to test those models into the empirical world. “We find evidence that the expected market risk premium is positively related to the predictable volatility of the stock returns” (French et Al., 1987, Expected stock returns and volatility). In other words, the more the investors predict to earn back from an investment, the higher will be the risk.
In order to give a general meaning, the volatility taken into consideration for this research refers to the realised volatility, widely known as the standard deviation of the actual returns of an asset over a defined timeline. In addition to what has been mentioned before, the volatility will be used as a proxy, in order to mimic the risk of an investment. This assumption is partly in line with previous studies by Bekaert et al. (2013), where realised volatility and implied volatility have been used to infer on investors’ attitude towards risk.

As Anne Opschoor (2013) highlights in her work that volatility has been always object of study in econometrics and specifically in time-series analysis. Indeed, “volatility is defined as average magnitude of fluctuations observed in some phenomenon overtime” (p.1 A. Opschoor, 2013). The interpretation of volatility can be strictly correlated to the definition of a random component of a variable in time-series analysis. Indeed, “typical examples in finance are returns on assets, such as individual stocks or a stock index like the S&P 500 index” (p.1, A. Opschoor, 2013). Furthermore, volatility gives an important contribution in terms of evaluating risk in traded investments and it is taken into account by private investors, institutional investors, policy makers, in order to take financial decisions and actions.

Hence, volatility plays a huge role in determining the market risk premium. Market risk premium can be defined as the difference between the expected rate of return of the asset and the rate of return of a bond. Moreover, market risk premium depends on several factors.

For the sake of this study, only the volatility risk premium will be taken into account, in order to investigate the main core of the thesis’ research. Indeed, volatility risk premium is affected by three main factors: The behavioral biases of investors, economic and structural factors aspects. The first factor concerns about the behavior of the investors in the financial market. The investors’ behavior might assumed different aspects, namely risk seeking and risk adverse behavior. Thus, these behaviors influence the economic and financial sector. The risk seeking and risk adverse,
together with the definition of volatility, are crucial aspects, in order to shape and explain what and how this research will proceed in the further chapters. Hence, additional concepts and evidences will be given, before processing the empirical section of the study.

2.5 Investors’ behaviors: different attitudes in the financial market

Moreover, as reported in this paper, “During calm (low volatility) periods more risk-averse investors remain in the market because they are the only investors interested in assuming such risk levels, decreasing risk premium demanded during these periods” (Maria Angeles Fernandez-Izquierdo et al., June 2013). Under those circumstances, risk-seeking investors are more lured by a higher volatility environment, in order to gain excessive profit. This theory is consistent with the latest studies which point out that Bitcoin is driven by buyers and sellers leading to a highly speculative market compared to S&P 500. (C. Baek & M. Elbeck, 2014).

Furthermore, across the years, several financial studies argued about the low level of volatility in the stock market: “The world appeared to be in a low volatility environment” (Philip Best, p.138, Implementing value at risk, 2000). As a result, investors might prefer the bitcoin environment due to its fluctuating volatility. In fact, in cryptocurrency markets with high volatility, investors who are less risk averse might be more interested investing in them. First and foremost, a definition of risk-seeking investor must be provided in this section, in order to define his/her peculiar characteristics and to investigate about the actions he/she might prefer. As stated in this paper, “Risk inclined trader is one who enjoys the excitements and challenges. Big position and a longer time of holding a position are easier for risk inclined traders” (V. Nosko and M. Burkov, 2019). Thus, a risk-seeking investor is willing to risk more in a period of high volatility. This behavior is supported theoretically by the characteristics underlined for the “sensation seeking” profile in which the risk seeking investor can be comprised. Indeed, “sensation seekers live for the
moment and their tendencies led to risky behavior [...] They find trading entertaining and tend to trade more than others [...] for them a single trade offers very little stimulus [...] it is the perceived risk associated with trading that makes entertaining to them [...] they indulge in action oriented gambling.” (M. Sulphey, 2014). Thus, a risk seeking investor theoretically will experience more excitement in a Bitcoin variegated and fast-paced environment. In addition, some studies pointed out that this digital currency has been deployed primarily as means of speculation, which certainly appeals risk-seeking investors. In fact, “the new users tend to trade bitcoin on a speculative investment intention basis and have low intention to rely on the underlying network as means for paying goods or services” (G. Florian et al., 2014). Furthermore, to better understand the differences among investors’ behavior, the utility function curvature is able to capture the divergent risk attitudes of traders.

2.6 Behavior of risk-tolerant investors in the stock market

For the sake of this analysis, only the risk tolerant investors will be taken into consideration. Furthermore, it is crucial to explain the attitude of these investors in the stock market, in order to proceed further in the next sections, where the research question will be introduced and justified. Indeed, in this section, some insights about the behavior of this peculiar type of investors, the frequency which they trade and what drives them to trade frequently in the stock market will be provided.

First and foremost, risk-tolerant investors tend to trade more frequently than other typologies of traders. Indeed, “Investors with higher levels of risk perception are more likely to trade, have higher turnover, have lower buy-sell ratios and hold riskier portfolios” (p.1, Hoffmann et Al., 2015).

1 Further insights about the utility theory are provided in the appendix.
Secondly, the literature suggests some factors, which may lead some investors, including risk-tolerant investors, to allocate frequently their assets in the stock market. One key element noteworthy to mention is the risk seeking. Indeed, some investors are driven by this factor as a sensation of excitement, as taking part in a lottery with high uncertainty and small chances to win a high amount of money. Indeed, as H. Kent Baker et al. (2017) reports in his work: “The sensation-seeking motive focuses on how the act of trading, with all its uncertainties, provides the stimulation and novelty some people may feel they need to keep their life exciting”.

Moreover, the risk-tolerant investors are appealed by short term investments. In other words, they are interested in gaining high profits in a short period of time. Thus, their aim is a speculative purpose, based on short term positions in the stock market, rather than holding a long position in order to preserve their capital. In other words, a short-term position is a trading position in the stock market, which lasts a short period of time. The short-term trading usually revolves around different timelines such as daily and weekly. More specifically, these kind of traders usually do not hold these positions overnight.

Having said that, it is quite hard to delineate a portfolio, which might represent this segment of traders. However, some indications can be extrapolated concerning portfolio construction of risk-tolerant investors. Without going into details, investors might be appealed to invest in certain segments, namely commodities, metal, power indexes, banks (p.59, G. Chakrabarti et al., 2013).

2.7 Reasons why risk tolerant investors might switch in to the Bitcoin market

The reason behind a hypothetical switch from stock market investments to bitcoin investments might be the pursue of higher profits. Indeed, over the years the stock market has been witnessed to low and steady volatility, which might have encouraged risk-tolerant investors to
explore new markets, in order to keep receiving the excitement while investing in assets with high returns. Furthermore, this has developed and expanded new ways of doing business in the financial market. Moreover, new technologies have empowered the financial system, making it more and more interconnected and accessible to a vast plethora of investors. As mentioned beforehand, the risk-tolerant investors seek the excitement, as in a gamble where the expected utility is negative and the probabilities of winning a huge amount of money are scarce. Therefore, the Bitcoin market might be a presumed market with all the elements and key factors, which risk-tolerant investors pursue in an investment.

2.8 Typical trading strategies in the Bitcoin market

First of all, since that this field is still quite unexplored and new, we need to make an assumption that a risk-seeking investors will always prefer risky and short-term strategies. Following this line of reasoning, this typology of investors is not likely to hold a bitcoin over a long-term horizon, hoping that the price will increase in the future. Conversely, she/he will engage daily/weekly strategies with huge profits but higher risks. Furthermore, the investors are eager to speculate rather than investing. In order to support this assumption made previously, it is reported an extract of Jose E. Gomez-Gonzalez and Julian A. Parra-Polania’s paper (2014): “The lack of support from any government reinforces a vicious circle in which the Bitcoin is mainly demanded as an asset for speculative purposes rather than as a medium of exchange, thereby generating high volatility in its value, which in turn dissuades people from using the Bitcoin as medium of exchange”.

Consequently, some adopted strategies in the Bitcoin can be introduced. The daily trading is a strategy in which investors close their positions at the end of the day. Indeed, they do not tend to keep their positions overnight. This strategy can bring profits between 1-3% per day. However, the
daily trading can become very tricky for non good and well-prepared day-traders (John Clark, 2018).

Since the lack of regulation from any governments, we cannot avoid to mention the use of the pump and dump strategy in crypto currencies markets. Indeed, the pump and dump is a strategy where a group of traders start to pump money in the market, making rise the value of Bitcoin. Therefore, traders noticing this sharp and increasing change of value, start to invest into the market. In a short-time horizon, the group of traders start to short bitcoin and subsequently the value experiences a dramatic downfall. Although this strategy is widely used into cryptocurrencies markets, it is not legal (Ian de Martino, 2018).

2.9 Research question and hypothesis

The purpose of this research is to some extent to enlarge the knowledge by inspecting the degree to which risk seeking investors might switch from the stock market investments to bitcoin investments, in presence of low volatility in the stock market. For the sake of the study it is noteworthy to mention that investor can also going backward from Bitcoin to stock market. However, since the core of the paper revolves around risk seeking investors, we acknowledge to neglect this phenomenon due to the more excitement and risky behaviors experienced in the Bitcoin market which is in agreement with the profile of the risk seeking investor aforementioned. Therefore, for the sake of this topic, the research addresses the following question:

“Do investors switch to Bitcoin market when stock markets are quiet with low returns and low risks?”
In order to assess the research, two hypotheses are given:

Hp1: If a decrease in the amount of VIX occurs in the stock market, the bitcoin capitalization might increase, while the stock Capitalization decreases. To put it differently, we expect a situation in which, when the opportunity of making profit in the stock market diminishes, the investors with a risk seeking behavior might prefer to allocate their budgets in bitcoin investments with higher returns but with a higher risk. Indeed, the volatility can be a good indicator of risk preference in the market;

Hp2: If the volatility of bitcoin increases, we expect that the bitcoin capitalization increases due to the fact that risk seeking investors have more possibility to have a higher return with a higher risk.
Chapter 3 - Data and Methodology

3.1 Literature Review

In this section, it will be analyzed concretely the process for collecting the data, the variables used for building the model and the process by which the research question will be assessed. First of all it is worth to mention that the literature over the linkage between stock market and Bitcoin is quite scarce. Indeed, the major aim of this thesis is to set a milestone over this topic and to encourage further studies. Having said that, a prior research has tried a similar methodology but shifting the focus more towards the factors which might influence Bitcoin Price (M. Schut, 2017). For the sake of this paper, it is noteworthy to remind that the bridge between S&P 500 and the Bitcoin price has already been proved (M. Schut, 2017). Along similar lines, Savvas Vassiliadis et al. (2017) point out similar variables which influence Bitcoin price. However, they found out that also popularity strongly affect Bitcoin price. As per this correlation, Bitcoin seems to bring more benefits than risks into an investment portfolio. In particular, it is capable to offset the risk: “Even though there is no place for Bitcoin within the global minimum-variance portfolio, there are benefits to adding Bitcoin in an investment portfolio, if the investor’s risk appetite allows it” (p.32, M. Schut, 2017). Furthermore, in Alexander Eisl et al.’s paper (2015), they demonstrate that Bitcoin should be added in optimal portfolios. Indeed, “Even though an investment in Bitcoin increases the Var of a portfolio, this additional risk is overcompensated by high returns leading to better risk-return ratios” (p.1, A. Eisl et al., 2015).

On the other hand, Tony Klein et al. (2017) argue that the hedging capabilities of Bitcoin used as a portfolio component are highly insignificant. Moreover, David Yermarck (2015) came up with the same conclusions, underlining the inefficiency of Bitcoin in terms of hedging risk.
Although, our aim is not to investigate towards the factors which affect Bitcoin price, a general background was due in order to raise awareness of the possible linkages between Bitcoin and other components and steer the way for our research question.

3.2 Data

In relation to what has been discussed beforehand, this study is interested in finding the linkage to which the risk-seeking investors are willing to switch to bitcoin investments, considering as hypothetical scenario the low volatility in the stock market. Indeed, this research examines and tests the aforementioned research question: “Do investors prefer to allocate their investments into riskier bitcoin investments, when there is a period of low volatility in the stock market?”.

Firstly, all the data related to the Bitcoin will be retrieved from Coinbase, which is one of the most popular and used by the users in order to exchange bitcoins. Furthermore, Coinbase is a pretty secure environment since all the currencies are fully insured (D. Michelson, 2017). As a result, Coinbase is one of the top choices for trading Bitcoin. Moreover, the period taken into account ranges from 2013 to 2019. The choice behind it is that the timeline comprises the latest available data, as well as the historical dataset. Consequently, such extended time span will serve as solid scenario when it comes to test our regression and hypothesis. The Bitcoin value used for the analysis is the USD Bitcoin.

Whereas, in order to mimic the behavior of the stock market, it will be taken into consideration the S&P 500 Index. The data related to the S&P 500 Index will be acquired from the official website of Standard and Poors 500, with the same timeline (2013-2019) for the bitcoin dataset. The same time line has been maintained for keeping consistency across the variables.
As far as the VIX index is concerned, the data will be retrieved from the official website of Cboe VIX, since they implemented and applied the VIX formula for the first time in 1992. Moreover, the same timeline will be take into consideration (2013-2019).

Another variable to take into account in the analysis is the risk free interest rate, which will be comprised in the regression. Indeed, it will rely on the data taken from the official site of the FED with the same timeline acknowledged in the paper. The risk free rate taken into consideration will be based on the 10-years US Treasury Bills.

3.3 Hypothesis

Primarily, we want to give evidence, in order to support the first hypothesis. Before going any further, the variables have to be introduced and explained. The first variable used is the VIX, which is a proxy in order to mimic the implied market volatility and it has been using since 1993. Furthermore, “The VIX is implied by the current prices of S&P 500 (or other indices) index options and represents expected future market volatility over the next 30 calendar days” (p.11, B. Thielen, 2016). For the sake of the analysis, the change of the absolute value of the VIX will be taken into account. If there is a scenario with low volatility in the stock market, we expect the VIX to barely change. Thus, we assume that the stock market will experience a low profitability. Following this line of reasoning, the stock market capitalization might decrease due to a low volatility in the stock market, which means a lower risk rate, resulting in an inferior rate of return. If this scenario might occur in the market, there may be a switch into digital currency investments. Indeed, our attempt is to test whether or not this market condition might lead the investors to prefer Bitcoin. In fact, we suppose that if this relation holds, the Bitcoin capitalization will increase. With having said that, the stock market capitalization is notoriously influenced by the risk free interest rate. Indeed, interest rate is proved to have a negative relationship with the share price (Uddin &
Alam (2007), which directly impacts the stock market capitalization afterwards. Thus, the study implements an extra level of degree of control over the stock market capitalization introducing this variable in the regressions. The risk free interest rate, which will be introduced, will rely on the data taken from the official site of the FED with the same timeline acknowledged in the paper.

Secondly, in order to support the last hypothesis and provide consistency to the risk-seeking investors, we want to investigate, whether or not, the fluctuation of the volatility of the Bitcoin might lead to an increment in the Bitcoin capitalization, through better and profitable investments. In order to strength this study and proof the hypothesis, several regressions have to be build. Since this study can be deemed as avant-garde in its field and due to the fact that there is a lack of scientific studies around Bitcoin, the methodology revolves around three regressions. This approach allows to easily compare the outcome in order to investigate which factors play a determinant role in influencing risk seeking investors and Bitcoin capitalization and scrutinize the hypothesis.

3.4 Methodology: The choice of a three regressions analysis

The reason of adopting three regressions and comparing their results lies with the lack of findings over this topic. Indeed, the literature provides different variegated opinions about some relations regarding the variables included in the analysis. Therefore, it is pivotal for our analysis trying to disentangle these relationships and give a more precise output, in order to support our hypothesis.

3.5 The first regression

The first regression considered for this study is the following:

\[ \text{Bitcoin Capitalization} = B_0 + \Delta \text{VIX} + \text{StockMarket Capitalization} + \sigma_{\text{Bitcoin}} + \text{Risk}_\text{free}_\text{rate} \]
Firstly, the dependent variable considered in the first regression is the Bitcoin capitalization. We chose to put Bitcoin capitalization as dependent variable, since it gives an actual idea of the USD value of Bitcoin traded in the period between 2013 and 2019. Moreover, it has been proved by previous analysis, that a correlation between Bitcoin price and VIX index exists. Indeed, a fluctuation in the VIX index corresponds to a change in the Bitcoin price in the opposite direction. Since that the Bitcoin capitalization coincides with the total USD value of Bitcoin multiplied by the daily average market price, it turns out that any modification to the Bitcoin price will affect Bitcoin capitalization. Stockmarket capitalization has been added as independent variable. Indeed, it is pivotal in order to understand the switch of risk-seeking investors from stock market to Bitcoin. In fact, the relation between Stockmarket capitalization and Bitcoin capitalization could be interpreted as a proxy for risk-seeking investors who are appealed more from Bitcoin, and therefore, eager to switch into a riskier Bitcoin investment. Since the S&P 500 is built on the free float market capitalization weighted this means that the market capitalization has been already taken into account. As a result, we acknowledge that the value of S&P 500 is a better proxy of the Stock market capitalization. Therefore, the S&P 500 index value will be taken into account for assessing the value of the independent variable of the Stock market capitalization. Indeed “ The weight of a stock in a float-weighted index equals its market cap weight multiplied by a free float adjustment factor” (p.261, CFA Institute, 2018). \( \sigma \) Bitcoin stands for the volatility of Bitcoin. This independent variable is crucial in order to explain, whether or not, risk lovers are willing to allocate their funds into Bitcoin. Indeed, if there is a positive correlation between Bitcoin capitalization and Bitcoin volatility, it could mean that more traders invest in the Bitcoin market.

However, the volatility of the Bitcoin is not provided in the dataset. Thus, it will be calculated using the formula below. Indeed, we need to follow this formula:
Where:

\[ \sigma_t = \sqrt{\sum_{i=1}^{N} (\text{Bitpx} - \overline{\text{Bitpx}})^2} \]

\( \sigma_t \) is the volatility level on the \( t \) daily;

\( N \) is the number of trading days

\( \overline{\text{Bitpx}} \) is the average daily bitcoin price return;

\( \text{Bitpx}_i \) is the bitcoin daily price return on day \( i \);

At first glance, the monthly Bitcoin volatility was the best option to give a better interpretation of the relationship. However, we have chosen to maintain the daily Bitcoin volatility since the Bitcoin history is quite recent (2013) and, therefore, there is a shortage of historical data set. Indeed, using a monthly data set might have created misleading results and not reliable conclusions. Furthermore, in order to calculate the Bitcoin volatility, the Bitcoin daily closing prices are taken into account.

Lastly, the Risk_free_rate variable has been comprised in the regression as independent variable. The risk free rate expresses the hypothetical rate of return of a trade with zero risk. The reason behind the choice to add the risk free rate, as independent variable, is due to the relevant influence on the stock market capitalization. Thus, the risk free rate acts as a factor of control of the stock market capitalization. Indeed, “ […] Both lower risk premiums and risk free rates would drive up stock valuation and market cap even if the underlying fundamentals or issuance remain unchanged” (p.2, D. Kuvshinov, 2018).
3.6 The second regression

The second regression is the following:

\[ StockMarket\ Capitalization = B_0 + \Delta VIX + Bitcoin\ Capitalization + \sigma_{Bitcoin} + Risk\_free\_rate \]

Consequently, the stock market capitalization is used as dependent variable, whereas the Vix index, Bitcoin capitalization, the Bitcoin volatility and the risk free rate have been added as independent variables.

Indeed, the aforementioned regression serves as an exploratory examination about the relationship between Bitcoin and Stock Market Capitalization. In particular, prior studies seem to come out with contradictory results: Vasilladis et al. (2010), reveals a strong correlation between bitcoin and stock market indices. Meanwhile, others (Baur et al, 2018) argue that such linkage is not proven and that Bitcoin is uncorrelated with traditional asset classes, for instance stocks, bonds and commodities. Under those circumstances, the multiple regressions want to shed the light around this relationship with the aim to give a terms of comparison with the results.

3.7 The third regression

Along similar line, a third regression has been deployed:

\[ Bitcoin\ Capitalization = B_0 + \Delta VIX + \sigma_{Bitcoin} + Risk\_free\_rate \]

The purpose of the above regression is to evaluate the result without including Stock Market capitalization in order to evaluate to what extent the Bitcoin is influenced. Indeed, the stock
market capitalization variable has been dropped out from the analysis, due to possible correlations with the other independent variables and, therefore, to enhance and give a better interpretation to the relationship with the Bitcoin capitalization. In particular, this approach allows to assess the presence of multicollinearity among two or more independent variables.

Last but not least, the outcome of the three regressions will be carefully compared.

3.8 The problem of non stationarity

The stationarity is an essential characteristic in order to hold stability in a regression model when it comes to time series. As a methodology for assessing the presence of non stationarity, the Dickey-Fuller test has been applied to each variable of the data set.

<table>
<thead>
<tr>
<th>dfuller BitcoinMarketCap</th>
<th>Figure 1.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dickey-Fuller test for unit root</td>
<td>Number of obs = 1540</td>
</tr>
<tr>
<td>Test Statistic</td>
<td>1% Critical Value</td>
</tr>
<tr>
<td>Interpolated Dickey-Fuller</td>
<td></td>
</tr>
<tr>
<td>Z(t)</td>
<td>-1.910</td>
</tr>
<tr>
<td>Mackinnon approximate p-value for Z(t) = 0.3276</td>
<td></td>
</tr>
</tbody>
</table>

As shown in figure 1, the dependent variable BitcoinMarketCap has been tested, in order to verify its stationarity. Indeed, the absolute value of the t-statistic is smaller than the absolute 5% Critical Value. Therefore, the test failed to reject the Null hypothesis. As a result, the Bitcoin market capitalization variable is not stationary. Furthermore, multiple Dickey-Fuller tests have been run in order to look for stationarity in the variable.

\(^2\) A definition of non-stationarity problem and further details are illustrated in the appendix section.
In figure 2, the first lag of the variable and a noconstant drift have been added to the Dickey-Fuller test. Indeed, as illustrated in the table, the absolute t-statistic is greater than the absolute 5% Critical Value. This means that, the variable has been corrected and it is now stationary.

In order to correct the model for stationarity, all the variables have been inspect with the Dickey-Fuller test, for identifying possible non stationarity problems.

```
.dfuller BitcoinMarketCap, reg noconstant lag (1)

Augmented Dickey-Fuller test for unit root
Number of obs  =  1539

--------------------------------------------------
               Interpolated Dickey-Fuller        
              Test  1% Critical  5% Critical  10% Critical
Statistic Value Value Value Value
--------------------------------------------------
Z(t)    -2.035   -2.580   -1.950   -1.620

--------------------------------------------------
            D.                     
  BitcoinMarketCap |  Coef.  Std. Err.  T  P>|t|  [95% Conf. Interval]
--------------------------------------------------
          L1. | -.0032107  .0015774  -2.04  0.042  -.0063047  -.0001166
          LD. | -.0007593  .0254736  -0.03  0.976  -.050726   .0492073
```

In figure 2, the first lag of the variable and a noconstant drift have been added to the Dickey-Fuller test. Indeed, as illustrated in the table, the absolute t-statistic is greater than the absolute 5% Critical Value. This means that, the variable has been corrected and it is now stationary.

In order to correct the model for stationarity, all the variables have been inspect with the Dickey-Fuller test, for identifying possible non stationarity problems.

```
.dfuller VolBitcoin

Dickey-Fuller test for unit root
Number of obs  =  1539

--------------------------------------------------
               Interpolated Dickey-Fuller        
              Test  1% Critical  5% Critical  10% Critical
Statistic Value Value Value Value
--------------------------------------------------
Z(t)    -21.068   -3.430   -2.860   -2.570

MacKinnon approximate p-value for Z(t) = 0.0000
```
In the figure above (figure 3), the volatility of the Bitcoin has been tested, proving that VolBitcoin is stationarity. In fact, the absolute t-statistic is ten times greater than the absolute 5% Critical Value.

The graph listed above (figure 4) represents the Dickey-Fuller test for the stock market capitalization. Indeed, it can be clearly seen that, the variable is not stationary. The absolute t-statistic is smaller than the absolute 5% Critical Value. Thus, further adjustments in the Dickey-Fuller test have been done, in order to solve the non stationarity problems.

```
.dfuller SP500                      Figure 4.
Dickey-Fuller test for unit root   Number of obs  =  1540
-----------------------------------
         Interpolated Dickey-Fuller
-----------------------------------
        Test   1% Critical  5% Critical  10% Critical
        Statistic      Value      Value      Value
-----------------------------------
       Z(t)     -1.022    -3.430     -2.860     -2.570
-----------------------------------
MacKinnon approximate p-value for Z(t) = 0.7453

 Figure 5.
.dfuller SP500, reg noconstant lag (2)
Augmented Dickey-Fuller test for unit root   Number of obs  =  1538
-----------------------------------
         Interpolated Dickey-Fuller
-----------------------------------
        Test   1% Critical  5% Critical  10% Critical
        Statistic      Value      Value      Value
-----------------------------------
       Z(t)     -1.980     -2.580     -1.950     -1.620
-----------------------------------
D.SP500 |   Coef.     Std. Err.     T     P>|t|   [95% Conf. Interval]
-----------------------------------
    SP500 |         +
        L1. |  -.0004136  .0002089   -1.98  0.048    -.0008234   -3.86e-06
        LD. |   -.012579   .0254931   -0.49  0.622     -.062584     .037426
        L2D. |  -.0374018  .0254989   -1.47  0.143    -.0874182    .0126145
```

In the figure above (figure 5), the first two lags of the variable and a noconstant drift have been included in the test. Indeed, the test shows that the absolute t-statistic is now greater than the absolute 5% Critical Value and the SP500 variable is stationary.

\[\text{dfuller RiskFreeRateNum} \]

<table>
<thead>
<tr>
<th>Test Statistic</th>
<th>1% Critical Value</th>
<th>5% Critical Value</th>
<th>10% Critical Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Z(t))</td>
<td>-14.230</td>
<td>-3.430</td>
<td>-2.860</td>
</tr>
</tbody>
</table>

MacKinnon approximate p-value for \(Z(t) = 0.0000\)

The table above (figure 6) describes the Dickey-Fuller test for the risk free rate variable. Indeed, the RiskFreeRateNum variable is stationary, showing an absolute t-statistic remarkably greater than the absolute 5% Critical Value.

\[\text{dfuller DiffVix} \]

<table>
<thead>
<tr>
<th>Test Statistic</th>
<th>1% Critical Value</th>
<th>5% Critical Value</th>
<th>10% Critical Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Z(t))</td>
<td>-40.848</td>
<td>-3.430</td>
<td>-2.860</td>
</tr>
</tbody>
</table>

MacKinnon approximate p-value for \(Z(t) = 0.0000\)

Lastly, the figure above (figure 7) highlights the Dickey-Fuller test for the \(\Delta Vix\). The results identify that the variable is stationary. Indeed, the absolute t-statistic is much higher than the absolute 5% Critical Value.
To sum up, as shown in the Dickey-Fuller test, the Bitcoin volatility, the risk free rate and $\Delta Vix$ are already stationary. Moreover, we have demonstrated that also the Bitcoin market capitalization and the S&P500 have become stationary adjusting for their lags and for a noconstant drift. However, the adjustments for the Bitcoin market capitalization and the S&P500 will be not taken into consideration, since that otherwise we should change the three regressions previously discussed and therefore, change the economic interpretation of the model.

3.9 The problem of autocorrelation

The autocorrelation problem consists in the violation of one of the essential assumption of the OLS, which states that the values of the error term must be not correlated. Indeed, this issue is more likely to appeared in time series analysis. Furthermore, there is a level of uncertainty around the causes which lead to autocorrelation. Some argue that one of the major causes which could result in an autocorrelation problem lies with predictor missing. However, others claim that a possible cause might be cluster sample in the population.

For the sake of the analysis, the Durbin-Watson test has been deployed to assess whether or not, a problem of autocorrelation might be the case. Indeed, the Durbin-Watson test is performed in order to give evidence whether the data set experiences a first-order autoregressive process. This means that if autocorrelation is present in the model, it will be immediately spotted at $t - 1$.

```
estat dstatistic( 5, 1540) = .6318441```

Figure 8.
As shown in the Durbin-Watson table (figure 8), the d-statistic corresponds to 0.6318441. In order to discover the presence of autocorrelation, Dl and Du have been found in the Durbin-Watson 5% Critical Value table. Moreover, the number of observations (1540) has been approximated to 1550 in order to simplify the test, since the reference table does not contain the exact number. The corresponded values for Dl and Du are respectively 1.91132 and 1.92167. Since the d-statistic equals to 0.6318441, we must reject the null hypothesis. Thus, the Durbin-Watson test confirms the presence of positive autocorrelation. Moreover, the same positive autocorrelation problem has been displayed in testing the second and third regression.

Difference solutions are available in order to deal with autocorrelation. One of the most used solutions to cope with autocorrelation is the Prais-Winsten. Nevertheless, for the sake of the paper, none treatment will be assessed to eliminate the autocorrelation problem. In fact, we acknowledge that giving an economic interpretation in line with the results is way more important than the statistical one.

---

3 The Durbin-Watson 5% Critical Value table used for the test can be found in the following website page: https://web.stanford.edu/~clint/bench/dw05d.htm
Chapter 4 - Results

4.1 Results first Regression

In line with the analysis in chapter 3, the first regression analyzed is the followed:

\[
\text{Bitcoin Capitalization} = B_0 + \Delta VIX + \text{StockMarket Capitalization} + \sigma_{\text{Bitcoin}} + \text{Risk_free_rate}
\]

As illustrated, the Bitcoin capitalization is taken as the dependent variable, whereas \(\Delta Vix\) (namely the absolute change of Vix index), stock market capitalization, the Bitcoin volatility and the risk free rate are taken as independent variables. In order to inspect the relationships between the dependent variable and the independent variables, a regression table has been provided below (figure 9).

<table>
<thead>
<tr>
<th>Source</th>
<th>SS</th>
<th>df</th>
<th>MS</th>
<th>Number of obs = 1540</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model</td>
<td>4.0377e+24</td>
<td>4</td>
<td>1.0094e+24</td>
<td>F(4, 1535) = 1430.01</td>
</tr>
<tr>
<td>Residual</td>
<td>1.0835e+24</td>
<td>1535</td>
<td>7.0589e+20</td>
<td>R-squared = 0.7884</td>
</tr>
<tr>
<td>Total</td>
<td>5.1213e+24</td>
<td>1539</td>
<td>3.3277e+21</td>
<td>Adj R-squared = 0.7879</td>
</tr>
</tbody>
</table>

| Source | P>|t| | [95% Conf. Interval] |
|--------|-----|-----------------|
| BitcoinMarketCap | 1.24e+08 | 4304668 | 28.80 | 0.000 | 1.16e+08 | 1.32e+08 |
| SP500 | 9.64e+07 | 208123 | 46.34 | 0.000 | 9.24e+07 | 1.01e+08 |
| DiffVix | 1.49e+09 | 4.64e+08 | 3.21 | 0.001 | 5.82e+08 | 2.40e+09 |
| RiskFreeRateNum | 1.76e+10 | 1.61e+09 | 10.96 | 0.000 | 1.45e+10 | 2.08e+10 |
| cons | -2.24e+11 | 5.13e+09 | -43.58 | 0.000 | -2.34e+11 | -2.14e+11 |
The table above (Figure 9) points out significant and positive relationships between the Bitcoin capitalization (BitcoinMarketCap) and the several dependent variables. Firstly, the stock market capitalization (SP500) has a significant p-value level (0.000). Hence, the stock market capitalization has a noteworthy influence on the dependent variable (Bitcoin capitalization). The positive coefficient means that when the stock market capitalization increases of 1 unit, the Bitcoin capitalization (BitcoinMarketCap) increases of 9.64e07. On the logical ground, investors tend to allocate their investments in both the markets. In particular, investors do not completely abandon the stock market. Indeed they keep holding their funds in the stock market, but they might allocate some investments in the Bitcoin Market, in order pursue higher returns. More specifically, they might tend to use Bitcoin as strategy in order to hedging the portfolio. Thus, the more risk-tolerant traders might invest in the Bitcoin market, but holding their positions in the stock market. Nevertheless, others authors found out divergent results. Indeed, Julio Cesar Soldevilla Estrada (2017) pointed out a negative but not significant coefficient between Bitcoin price and S&P500. Furthermore, in Van Wijk’s paper (2013), the researcher found out a correlation between the value of the Bitcoin and the change in the value of the Down Jones.

As far as the change in the value of the Vix index (DiffVix) is concerned, we can clearly seen a significant p-value (0.001). Indeed, as shown in figure 9, the coefficient has a positive value and in comparison with the stock market capitalization (SP500), it is less positive influent (1.49e09). This means that the stock market capitalization (SP500) shows a greater influence on the Bitcoin market capitalization, compared to the Vix index (DiffVix). More specifically, this is in line with the CAPM theory, in which investors are more interested in returns than risk. This result is in contrast with previous papers. Indeed, Mariana Breja (2018) highlights the presence of a negative and significant relationship between Vix index and Bitcoin values.
Lastly, the Bitcoin volatility, namely DiffVolbitcoin, has a positive and significant influence on the Bitcoin market capitalization. However, the stock market capitalization (SP500) has still a greater and positive influence on the Bitcoin market capitalization comparing with the Bitcoin volatility and the Vix index. Hence, this enforces the thesis that traders are more concerned about the returns, regardless the risk.

4.2 Results second Regression

With regard to the second regression illustrated, the same methodology has been applied as in the first regression. For simplicity, it has been reported the second regression:

\[
\text{StockMarket Capitalization} = B_0 + \Delta \text{VIX} + \text{Bitcoin Capitalization} + \alpha \text{Bitcoin} + \text{Risk_free_rate}
\]

As shown, the stock market capitalization has been taken as dependent variable. Therefore, a regression has been displayed, in order to capture the main relationships.

<table>
<thead>
<tr>
<th>Source</th>
<th>SS</th>
<th>df</th>
<th>MS</th>
<th>Number of obs = 1540</th>
<th>F(4, 1535) = 795.55</th>
<th>Prob &gt; F = 0.0000</th>
<th>R-squared = 0.6746</th>
<th>Adj R-squared = 0.6737</th>
<th>Root MSE = 210.36</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model</td>
<td>140821409</td>
<td>4</td>
<td>35205352.2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Residual</td>
<td>67927839.2</td>
<td>1535</td>
<td>44252.664</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>208749248</td>
<td>1539</td>
<td>135639.537</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| SP500 | Coef.     | Std. Err. | t     | P>|t| | [95% Conf. Interval] |
|-------|-----------|------------|-------|-------|----------------------|-------------------|
|       | 6.05e-09  | 1.30e-10   | 46.34 | 0.000 | 5.79e-09 - 6.30e-09 |
| VolBitcoin | -4.317825 | 0.0408415  | -10.57 | 0.000 | -5.118934 - 3.516715 |
| DiffVix | -9.800472  | 3.680214   | -2.66 | 0.008 | -17.01925 - 7.481692 |
| RiskFreeRateNum | -22.95402 | 13.20761 | -1.74 | 0.082 | -48.86089 - 3.952849 |
| cons | 2062.856 | 30.32724 | 68.02 | 0.000 | 2003.369 - 2122.343 |
In the table above (Figure 10), it is described the results of the regression, with the stock market capitalization (SP500) as dependent variable. As the table pointed out, changing the dependent variable, we can clearly seen some significant relationships. Indeed, there is a positive and significant relationship between the stock market capitalization (SP500) and the Bitcoin market capitalization (BitcoinMarketCap). Hence, this reinforces the thesis that investors do not completely switch from the stock market to the Bitcoin market (and vice versa), but they tend to maintain investments in both markets, undergoing for hedging strategy for the portfolio. However, comparing the figure 9 and 10, we can acknowledge that an increment in the stock market capitalization has a greater impact on the Bitcoin market capitalization (9.64e07), than the Bitcoin market capitalization on the stock market capitalization (6.05e09). In light of this, we can assume that more risk-tolerant investors switch from the stock market (but holding the positions) to the Bitcoin market, rather than from the Bitcoin Market to the stock market. This can be possible since that it is more likely that in a short-time frame the Bitcoin market might experience higher variations of the Bitcoin price which can lead to higher returns.

With regard to Bitcoin the volatility (VolBitcoin), the variable has significant but negative influence on the stock market capitalization (SP500). Indeed, an increment of 1 unit of Bitcoin volatility brings to a limited drop in the stock market capitalization. This means that, there is a portion of more risk-tolerant investors, who are interested in the volatility and, therefore, they totally switch from the stock market to the Bitcoin market, in order to pursue more excitement in trading.

Lastly, the Vix index (DiffVix) has a negative and significant impact on the stock market capitalization (SP500). Indeed, if the Vix index increases of 1 unit, the stock market capitalization decreases of -9.800472. More specifically, this makes logical sense, since that the majority of investors tend to be risk-averse. Thus, in period of fluctuation of volatility, they will invest less.
4.3 Results third Regression

Lastly, a third regression has been run in this study, applying the same methodology as the previous ones. Indeed, the third regression is the following:

\[
\text{Bitcoin Capitalization} = B_0 + \Delta \text{VIX} + \sigma\text{Bitcoin} + \text{Risk_free_rate}
\]

This regression has been introduced, in order to assess the impact of dropping the stock market capitalization (SP500). In particular, by doing this, the importance of this factor over the model can be better understood. Furthermore, adopting this approach, it will be shed the light on whether it is more relevant the stock market capitalization (SP500) or the Vix index (DiffVix) in influencing the Bitcoin capitalization.

<table>
<thead>
<tr>
<th>Source</th>
<th>SS</th>
<th>df</th>
<th>MS</th>
<th>F(3, 1536) = 496.68</th>
<th>Number of obs = 1540</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model</td>
<td>2.5218e+24</td>
<td>3</td>
<td>8.4058e+23</td>
<td>Prob &gt; F = 0.0000</td>
<td></td>
</tr>
<tr>
<td>Residual</td>
<td>2.5995e+24</td>
<td>1536</td>
<td>1.6924e+21</td>
<td>R-squared = 0.4924</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>5.1213e+24</td>
<td>1539</td>
<td>3.3277e+21</td>
<td>Adj R-squared = 0.4914</td>
<td></td>
</tr>
</tbody>
</table>

| Coef. | Std. Err. | t     | P>|t| | [95% Conf. Interval] |
|-------|-----------|-------|------|----------------------|
| DiffVix | 1.31e+09 | 7.19e+08 | 1.83 | 0.068 | -9.78e+07 | 2.72e+09 |
| VolBitcoin | 1.98e+08 | 6195691 | 31.88 | 0.000 | 1.85e+08 | 2.10e+08 |
| RiskFreeRateNum | 3.70e+10 | 2.40e+09 | 15.37 | 0.000 | 3.22e+10 | 4.17e+10 |
| cons | -5.91e+10 | 5.74e+09 | -10.30 | 0.000 | -7.03e+10 | -4.78e+10 |
As illustrated in the table above (figure 11), we can confirm the significant and positive relationship between the Bitcoin volatility (VolBitcoin) and the Bitcoin market capitalization (BitcoinMarketCap). As far as the Vix index is concerned (DiffVix), the table points out that, dropping the stock market capitalization (SP500) out of the model, the variable (DiffVix) becomes insignificant. Indeed, this proves the idea that the risk-tolerant investor is looking at the profits, rather than betting on the change in volatility. In conclusion, this hypothesis is consistent with the CAPM model, where risk does not play a huge role.
Chapter 5 - Conclusions

5.1 Summary and Conclusion

This chapter starts with enhancing the aim and the structure of this study, giving a summary of the theoretical framework. The research question and its related hypothesis will be addressed by analyzing the major findings came to light in chapter 4. Finally, the major findings will be argued and contrasted together with the theory and the findings of other previous studies.

The purpose of this study was to validate the hypothetical shift, in which, in a scenario of low volatility and low returns in the stock market, risk-tolerant investors prefer to allocate their investments in the Bitcoin market rather than in the stock market. This study is grounded on a theoretical background. In 2008, the instability of the financial sector and, consequently, the loose in credibility of the institutions and banks have driven the way to think alternatively. Indeed, this has allowed investors to assume new ways to allocate their investments, far from the centralized systems, namely traditional banks and institutions. Consequently, different forms of investments and exchange of money arose through the years. One of the big players in this sector is the Bitcoin. Bitcoin is the most well-known digital currency and a pioneer of this new way of trading and investing money. Bitcoin and the digital currencies in general have some perks but also disadvantages. Indeed, Bitcoin is a decentralized system, where users trade anonymously with transactions costs close to 0% and also it exits transparency among the wallets detained by the traders. On the other hand, the anonymity might lead to trade money for illegal purposes. One of the major characteristic of these digital currency systems is the high profitability of their investments, due to the high fluctuation of the volatility. In this study, the volatility has been used as a proxy to measure the risk in the market. Furthermore, a trade-off between profitability and risk has been already proved. Indeed, higher profits correspond to higher risk to take from investors. Nevertheless, not all the investors would take more risk for higher profits and, therefore, several
different investors’ behaviors can be spotted. In fact, the risk-tolerant investor, as reported in this work, “[…] is one who enjoys the excitements and challenges. Big position and a longer time of holding a position are easier for risk inclined traders” (V. Nosko and M. Burkov, 2019). Thus, a risk-seeking investor is eager to take more risk in a period of high volatility. Following this line of reasoning, during periods of low volatility in the stock market, the risk-seeking investors might be appealed to allocate their investments in the Bitcoin market, in order to gain excessive profits regardless the risk. Indeed, as Maria Angeles Fernandez-Izquierdo et al. (2013) stated in their paper, “During calm (low volatility) periods more risk-averse investors remain in the market because they are the only investors interested in assuming such risk levels, decreasing risk premium demanded during these periods”. Under those conditions, risk-seeking investors are more tempted by a higher volatility environment, in order to earn extreme profit. This theory is in line with the latest analysis, which illustrates that Bitcoin is driven by buyers and sellers leading to a highly speculative market compared to S&P 500. (C. Baek & M. Elbeck, 2014).

The study addressed the following research question: “Do investors switch to Bitcoin market when stock markets are quiet with low returns and low risks?”. The hypothesis acknowledged by the thesis revolves around an increment in the Bitcoin market capitalization with a consequent decrease in the Vix index, followed by a downfall in the stock market capitalization. In the same manner as the first hypothesis, this paper introduced a secondary assumption consisting in a rise of the Bitcoin market capitalization due to a spike in the Bitcoin volatility.

With regard to the first hypothesis, the results partly agree with this intuition. However, some relevant insights and relationships came out with the analysis. Indeed, it has been registered a significant positive relationship between Bitcoin capitalization (BitcoinMarketCap) and stock market capitalization (SP500). More specifically, when the stock market capitalization registers an increment of 1 unit, the Bitcoin makers capitalization increases of $9.64e^{07}$. This proves that, the
more risk-tolerant investors do not completely switch from the stock market to the Bitcoin, but they hold their positions in the stock market. In light of this, they might use the Bitcoin investments for hedging the portfolio. Moreover, they are more interested in the returns rather than the risk. In fact, they might invest in some Bitcoin investments in order to pursue higher returns, regardless the risk. Under these circumstances, the analysis has spotted a significant and positive relationship between \(\Delta Vix\) (DiffVix) and Bitcoin market capitalization (BitcoinMarketCap). Indeed, we can clearly see that the change in the value of Vix index has less influence on the Bitcoin market capitalization, comparing the massive impact of the stock market capitalization on the Bitcoin market capitalization. This is the proof that, investors are more interested in the returns than the risk.

As far as the second hypothesis is concerned, the test of the first regression has shown a positive and significant relationship between the Bitcoin volatility (VolBitcoin) and the Bitcoin market capitalization. Therefore, the hypothesis is confirmed. However, we can clearly see that the Bitcoin volatility has less influence on the Bitcoin market capitalization, in comparison to the relevant positive impact of the stock market capitalization on the Bitcoin market capitalization. Indeed, we can support the fact that, when it comes to invest, investors’ decisions are more affected by the returns rather than the risk.

Changing the dependent variable from the Bitcoin market capitalization to stock market capitalization (see chapter 4.2), some insights can be extrapolated. Indeed, in the second regression analysis we confirm the positive and significant relationship between Bitcoin market capitalization and the stock market capitalization. Indeed, the risk-tolerant investors tend to maintain investments in both markets. However, comparing figure 9 and 10, we can notice that the stock market has greater impact on Bitcoin market capitalization, than the Bitcoin market capitalization on the stock market capitalization. Consequently, we might consider the fact that the more risk-tolerant investors switch (but not completely) from the stock market to the Bitcoin market, rather than from the
Bitcoin market to the stock market. In other words, this can be the case since it is more likely that in a short-time horizon the Bitcoin market might experience high variations of the Bitcoin price, which can lead to high returns.

Moreover, we have analyzed the volatility of stock market and Bitcoin market. Indeed, the Bitcoin volatility (VolBitcoin) has a negative impact on the stock market capitalization (SP500). However, this relationship causes a limited downfall in the stock market capitalization. Indeed, it can be acknowledge that the some risk-tolerant investors might totally switch from the stock market to the Bitcoin market, in order to pursue more excitement in trading. With regard to the Vix index (DiffVix), the results show a negative relationship with the stock market capitalization (SP500). A possible reason of this could be the tendency of investors to be risk-averse. Thus, in a situation of high volatility in the stock market, they will invest less.

Lastly, we have dropped the stock market capitalization (SP500) out of the model, in order to test and verify the influence of this variable. What has emerged from the analysis is the strong influence of the stock market capitalization on Bitcoin market capitalization. Indeed, the change in the value of Vix index (DiffVix) has become not significant, after the stock market capitalization has been left out. Again, this can prove that the risk-tolerant investors are appealed by the profits, rather betting on the change in volatility. This last result is in line with the CAPM model, where risk does not play a crucial role.

In a nutshell, risk lover traders tend to maintain the investments in both markets. However, some patterns can be spotted. In particular, the stock market capitalization has a strong and positive influence on the Bitcoin market capitalization, indicating that more risk-tolerant investors seem to switch to the Bitcoin market, seeking more chances to gain extra profit, but maintaining their positions in the stock market. On the other hand, the Bitcoin market capitalization leads to an
increase in the stock market capitalization. However, the first relationship is stronger, due to the fact that the risk-tolerant investors might be appealed by high returns in a limited time frame.

In conclusion, these findings might deserve further investigations, due to the relevant linkage between stock market and Bitcoin capitalization. Indeed, a better understanding of the mechanisms which lie behind this relationship could shed the light on the future of Bitcoin itself.

5.2 Limitations of the thesis

Although this paper relies on some common statistical methodology a certain amount of nuances needs to be discussed. In particular, the model does not totally tackle the problem of autocorrelation. Indeed, using the first difference it would have addressed the autocorrelation issue. On the other hand, we would have changed the three regressions accordingly. However, this could have limited the economical interpretation of the factors, loosing the target of the research question.

Furthermore, further research might be considered, the same methodology but using different crypto currencies or stock indexes, which might steer the way for a more comprehensive view.
Appendix

The Utility Function

In order to provide evidences to the multiple profiles of the investors, which operate and interact in the stock market, it is decisive to introduce the utility theory. Indeed, the risk preferences of the investors depend on this peculiar theory. Specifically, the utility function is useful to investigate and learn about the behavior of an investor. In order to be consistent, the utility function is held by some assumptions.

The first attribute is known as “non satiation”, which in literature represents the idea that more is preferred to less. More deeply, “the utility of more (X + 1) dollars is always higher than the utility of less (X) dollars” (p. 246, E. J. Elton et Al., 2009). Indeed, an individual will decide to choose the investment with more outcome rather than the one less profitable. In addition, in terms of “wealth”, it will be always preferred more to less. Indeed, if utility grows as wealth grows, the first derivative of the utility function, with respect to wealth, is positive (p. 246, E. J. Elton et Al., 2009).

In saying that, the second assumption of the utility function introduces the behavior of investors regarding risk choices when they have to choose among several investments. Indeed, investors can be averse to risk, they can be neutral to risk or they might seek for risk. These behaviors are defined in the literature respectively “risk averse”, “risk neutral”, “risk loving” or “risk seeking”. To clarify, the risk averse investors are individuals who are reluctant to take risk. Indeed, between two investments, they will choose the one less risky. On the contrary, the risk neutral investors are indifferent to risk when deciding between two or more investments. Nevertheless, the mindset of an investor might be different comparing the two behaviors aforementioned. Indeed, the risk lovers, or more commonly known as risk seekers, are investors who enjoy taking risk in an investment. In other words, they are interested in capital gains rather
than preserving their capital with low risky investments. Indeed, as deeply argued in the previous sections, they are willing to take higher risks, in order to gain extra profit.

These mindsets can be illustrates and analyzed, by using a fair gamble. In a hypothetical scenario, we consider a gamble, where investors have 50% probability to win $50,000 and 50% probability to win $150,000. Thus, the expected utility will be $100,000, while the certainty equivalent, which is the difference between the expected utility and the amount who an investor will pay in order to not undergoing for the lottery, will be $90,000, considering an initial wealth of $10,000. Considering a hypothetical risk averse investor, she/he will be willing to pay $10,000 in order to obtain a certain amount of $90,000 for sure, rather than going towards the gamble. Indeed, the certainty equivalent will be lower than the expected utility of the lottery. Moreover, the risk averse investors have a diminishing marginal utility of wealth, which means that the satisfaction increases but at decreasing rate. In fact, they will get more satisfaction obtaining $2 with an initial wealth of $1, rather than gaining $200 with an initial wealth of $100. Thus, the utility function will be concave (figure 1). Under the same scenario, taking into account the risk neutral investors, they are indifferent whether or not undergoing for the lottery. Indeed, the expected value of the lottery will be equal to the certainty equivalent. Furthermore, the risk neutral investors have a constant marginal utility of wealth. Therefore, the utility function will be a constant increasing line (figure 2). With respect to the risk seeking investors, striking differences comparing the previous investors, are notable. Indeed, the certainty equivalent will be higher than the expected utility of the lottery, since they get more satisfaction going for the lottery. Furthermore, they have an increasing marginal utility. Thus, the utility function will be convex, as shown in figure 3. (Advanced behavioral finance, Professor S. Zeisberger, 2017).
Non-stationarity problem

Generally, the non-stationarity problem is common issue when we deal with time-series datasets. Indeed, “Stationarity is the formal mathematical concept corresponding to the stability of a time series of data. A series is said to be (weakly) stationary if: The $E y_t$ does not depend on $t$; the covariance between $y_s$ and $y_t$ depends only on the difference between time units, $|t - s|$” (p.236, E. W. Frees, 2010). In a nutshell, mean and variance are not affected over time. If this assumption does not hold, the result might be misleading, steering the way to unreliable conclusions. Thus, a non stationarity problem could be present into the model. In fact, when it comes a non stationary data set, it might lead to spurious regressions (p.319, C. Brooks, 2008).

The more direct and easier way in order to test and verify the presence of non stationarity is the use of Dickey-Fuller test. Indeed, the paper acknowledged the use of Dickey-Fuller test as main proxy for stationarity. The Dickey-Fuller test usually comprises two hypothesis: The Null hypothesis revolves around the presence of unit root (non stationarity), while the other one consists in accepting the presence of stationarity.
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