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Relation between Bitcoin and its orks: empirical investigation on price movements and their respective volatilities

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Relation between Bitcoin and its Forks: Empirical Investigation on Price Movements and their Respective Volatilities

A Thesis submitted to

The Department of Management

In partial fulfillment of the requirements for

the degree of Master of Science in Finance

by

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Outline:

Abstract:

Cryptocurrencies gained increased interest recently with concern in various economic and financial related issues. Many investors made lots of money from cryptocurrency and others lost huge money from the same investment. The understanding of how this currency behave is thus crucial. This thesis aims to study the relation between Cryptocurrency and its forks. Specifically, we examine the effect of the forks of Bitcoin returns on the returns and volatility of Bitcoin and vice versa. Our sample includes prices of Bitcoins and portfolio of 17 forks for the period 2010-2017. We study the volatility of Bitcoin and its forks using the Dynamic GARCH model. Our model indicated that there is a strong positive relation between Bitcoin returns and the return of the forks of Bitcoin. However, from the volatility side the forks of Bitcoin has no effect on the Bitcoin returns.

1. Introduction:

Financial markets have developed enormously in a historical retrospective. In this respect, the financial instruments used have also changed and evolved in line with the needs of the markets in order to facilitate trade transactions. The tools used to intermediate the exchange of goods are called money. Most economists define money as an exchange medium, an accounting unit, and a store of value. Money is an exchange medium in the sense that we all agree to make transactions. Merchants agree to accept cash for their goods; employees agree to accept cash for their work. As an accounting unit, money provides a simple tool to identify and communicate value. In other words, money allows us to store the value of a long, tough workweek in a clean little cash stack. We set aside the compensation we receive for later use via money. From the start of barter to commodity money, metal and coins, to gold and silver, to new monetary systems and checks, and to the recent developments in the world currency, such as the introduction of cryptocurrencies known as Bitcoin and Ethereum, years passed. In each corresponding period, every type of money has played an integral part in the payment operation. However, society in general and economies in particular developed, more sophisticated instruments for the exchange of goods were required. Thus, the introduction of cryptocurrencies reshaped the electronic payment system in a scale that was unspeakable just a few years ago.

Cryptocurrencies have become one of the most trending topics in recent economic and financial issues. Cryptocurrency has become a global term; still not fully understood by most of the people, banks, governments and many companies. The value of one cryptocurrency was just a few cents, just a few years back; for this reason, it was ignored by the masses. In present scenario, Crypto currencies have become a common word but a very limited knowledge about it is available across the world.

There are over 2000 cryptocurrencies available on internet. Bitcoin often is regarded as father of cryptocurrencies and all other cryptocurrencies are referred as altcoins, which was launched in 2009 by an individual or group known under the pseudonym Satoshi Nakamoto. Since its inception in 2009as an open-source digital currency, Bitcoin has brought the attention of economists, policy-makers, and traders. Especially, Bitcoin has dominated the financial press, led by the phenomenal surge in its number of transactions and market value. The latter surpassed $216 billion at end of 2017 after ending the years 2015 and 2016 below $7 billion and $16 billion, respectively. Importantly, Bitcoin has inspired and provoked the release of a large number of cryptocurrencies based on its technology – block- chain (Bouri et al., 2018a). Bitcoin is unique because it does not rely on government/bank created money. In addition, transactions occur directly between pseudonymous people (their real names are not known), meaning there are no banks or intermediaries.

As of Nov 2018, there are over 17 million Bitcoins in circulation with a total market value of $96 billion. Bitcoin's success has spawned a number of competing cryptocurrencies such as Ethereum, Litecoin, and Ripple. Any cryptocurrency can be divided into several forks. A fork is the term used in a single blockchain that deviates into two paths. This is usually due to a significant change in the protocol of the network, which effectively divides the blockchain into an old way of doing things and a new way to do things.

There is increasing interest in Cryptocurrency all over the world and in the MENA region. For example, in Egypt, there is EGYPT CryptoCoin “A Gold-backed open-source payment network which allows peer-to-peer transfer of tokens among community or EGY holders.” Recent fluctuations in cryptocurrency prices have resulted in periods of high volatility. In fact, as cryptocurrency is mainly used as an asset rather than a currency, the cryptocurrency

market is currently highly speculative, and more volatile and susceptible to speculative bubbles than other currencies. Cryptocurrency has therefore a place in the financial markets and in portfolio management and examining its volatility is crucial.

Since cryptocurrency became one of the most crucial topics nowadays in the financial markets, the IMF (The International Monetary Fund) believes that international regulatory action on cryptocurrencies is inevitable. The IMF's concerns over cryptocurrencies stem largely from their potential use in illicit financial activities. Christina Lagarde, who is the managing director of the international organization that aims to foster global financial stability explained that the regulatory direction should be activity-based, focusing on "who is doing what, and whether they're properly licensed and supervised. This indicates the IMF may be moving to be more actively involved in preventing the illicit use of cryptocurrency. On multiple occasions, Lagarde has previously cautioned that cryptocurrencies should be taken seriously and called for global cooperation among worldwide regulators. And she is not alone in voicing concerns over use of cryptocurrency in cross-border financial crimes. According to an earlier report by CoinDesk, during the Davos World Economic Forum in late January, several worldwide leaders shared the same sentiment, including the U.K. Prime Minister Theresa May, French President Emmanuel Macron and the secretary of the U.S. Treasury Department Steven Mnuchin.

According to the IMF, they believe that Financial technologies such as digital currencies are "shaking" the banking system and must be monitored to maintain stability. She said: "I think the role of the disruptors and anything that is using distributed ledger technology, whether you call it crypto, assets, currencies, or whatever ... that is clearly shaking the system." Also, Lagarde pointed to the changing business models of commercial banks as evidence that innovations like

cryptocurrencies are having a clear impact on financial sector incumbents; she warned that such financial industry changes must be accompanied by regulation.

However, after that IMF has had many positive thing to say about the potential of digital currencies and that global financial institutions are taking risks by not watching and understanding emerging financial tech products. Moreover, IMF cited several factors that may drive the adoption of virtual currencies. Among them is the possible shift in consumer preference for new currencies which are "easier and safer" than traditional ones. These will be further improved if the digital currencies become more stable. IMF calls for a balanced outlook on cryptocurrency comes at a time of increasing regulatory involvement in the industry, while traditional financiers continue to call Bitcoin a 'bubble' and pundits spy the start of a market surge. During January's World Economic Forum 2018, while continuing her narrative about the need to reign in illicit activity involving crypto; Lagarde nonetheless reiterates the need for an "even-handed approach" going forward. IMF believes that a clear-eyed approach can help harness the gains and avoid the pitfalls of the new crypto-assets landscape. Meanwhile, the IMF continued to promote a balanced approach to digital currency regulation. In its early 2018 staff paper, IMF considers distributed ledgers to have the capability to revolutionize the financial sector through cost reduction and deeper financial inclusion in the long term.

Bitcoin, the first decentralized cryptocurrency, has gained a large following from the media, academics and the finance industry since its inception in 2009. Built upon blockchain technology, it has established itself as the leader of cryptocurrencies and shows no signs of slowing down. Our first contribution and the aim of this thesis is to understand the relation in the movement in Bitcoin prices and movement in its respective volatilities. Thus we study the relation between Bitcoin and its forks and its forks controlling for Bitcoin volume, S&P500,

euro-dollar exchange rate, interest rate and the gold and their respective volatilities. Our second contribution is to add to the limited literature in Fintech in general and bitcoins in specific, the literature examining the financial implication of bitcoins is limited, as of our knowledge none is written on the relation between Bitcoins and its forks. Thus, the contribution of this thesis will be two-folds: First will survey recent modification in Fintech industry and document it and categorized. Secondly it will carry empirical investigation to study the relation between Bitcoins and their forks.

The rest of the thesis is organized as follows. Section 2 will critically analyze the literature review, section 2.1 includes theoretical background, section 2.2 presents empirical literature, section 2.2.1 examine Bitcoin literature, section 2.2.2 Independent variable: the fork of Bitcoin, section 2.2.3 presents volatility literature, section 3 includes data, section 4 examines model and research methodology, section 5 presents results, section 6 conclude.

1.1 Research Question:

What is the relation between Bitcoin and their forks in terms of price performance and volatility?

2. Literature Review

2.1 Theoretical Background:

FinTech is a term used to refer to "financial technology.” The fintech sector is evolving fast, but a great variety of definitions of the concept exists in academic practice and business journals. Meanwhile, even if stakeholders agree about the core elements of the term, its scope has not been clearly defined. Financial technology describes tech-enabled products and services

that improve traditional financial services. They are faster, cheaper, more convenient or more accessible. FinTech has been a reemerging, fast-developing sector within the financial services industry for several years and has been pioneered by those who are developing or innovating new technologies to modify the way financial markets traditionally operate. It is innovating within applications, processes, products or business models and the potential for doing things in a new way are endless.

Fintec has developed over several years starting from the 1900 by the invention of Fedwire then the first iteration of credit cards. Also During this period the physical foundations of modern telecommunication infrastructure were laid down across the globe. Then in the 1960, Quatron was the first product to offer stockbrokers and money manager's stock market quotes on an electronic screen instead of printed ticker tape. Banks became increasingly digitized and built significant IT infrastructure to support their operations. After that, Barclays Bank installed the first automated teller machine (ATM). Also Central clearing houses, stock exchanges and international correspondent banking became widespread, and regulatory standards were drawn up. The early 1980s saw two large steps taken in the Fintech revolution: E-Trade and online banking. Later on, Fintech is ongoing and involves both newly emerging technology-enabled financial service companies and traditional banking institutions. Fintech innovations in the new millennium in 2009 by the release of Bitcoin, the first cryptocurrency. Until we reach to one of the latest fintech innovation "smile to pay" an innovation that enables users to pay simply by smiling at a 3D camera. Fintech has disrupted the financial services industry, while also changing financial technology forever.

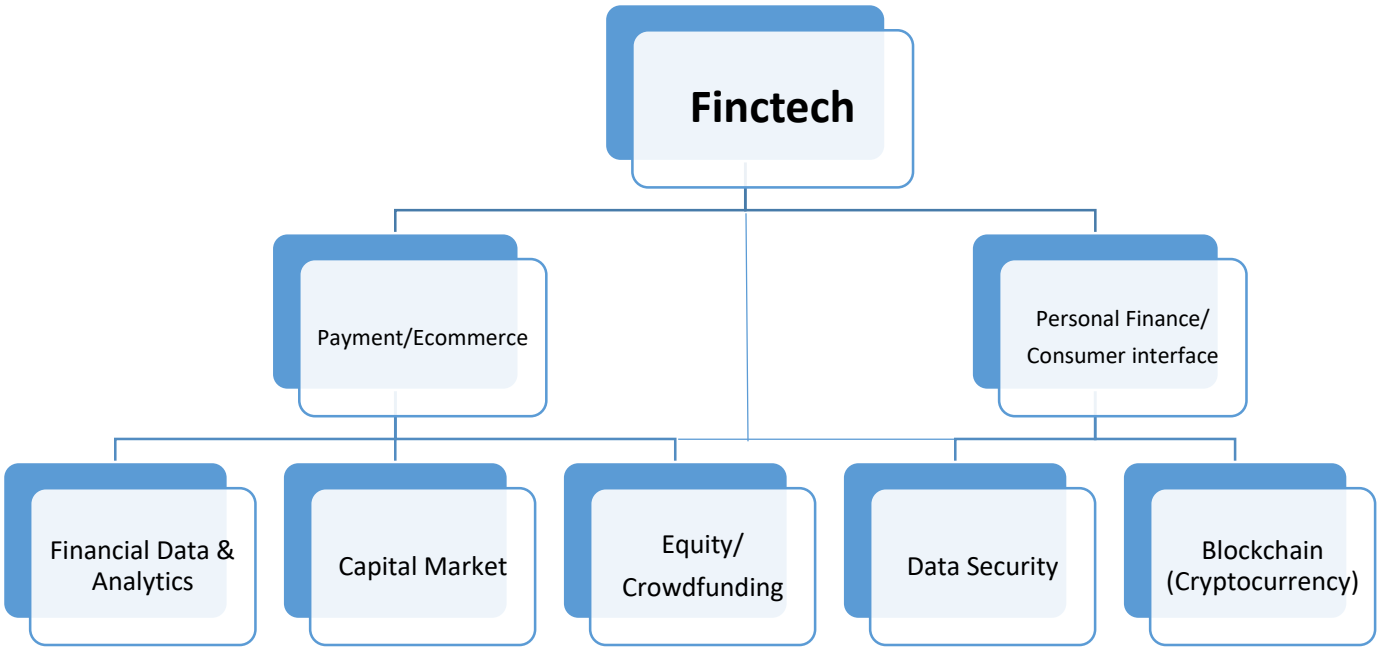
Based on research from Ernst and Young showed that on average one in three digitally active consumers now use two or more FinTech services, making FinTech usage significant

enough to suggest that FinTech has reached early mass adoption. The research also indicates that there is a hunger amongst consumers for new financial service benefits that utilize technology such as mobile devices and cloud based. Some numbers and statistics related to FinTech showed that 33% is the average FinTech adoption globally compared with 16% in previous year, 46% is the average FinTech adoption across emerging markets, 50% of consumers use FinTech money transfer and payment services, 64% of Fintech users prefer using digital channels to manage all aspects of their life and finally 13% of consumers are regular users of five or more FinTech services. Regarding the percentage in group age using FinTech, 37% is between 18-24, 48% is between 25-34 and this is the highest percentage, 41% is between 35-44, 30% is between 45-54, 22% is between 55-64, 15% is between 65-75 and 9% is over 75 and this is the lowest percentage in terms of adoption of Fintech across different group age.

With new startups in the Fintech field sprouting up at a rapid rate, more innovation are constantly underway, which makes it harder for more traditional institutions in the financial services to keep up. The Fintech revolution has not only changed the financial services industry as a whole, but it has also changed specific sectors, including: retail, banking, lending and financing, payments and transfers, wealth and asset management, markets and exchanges, insurance and blockchain transactions. It will continue to be vital for those who work in such sectors to learn how the Fintech revolution affects them immediately, as well as their future careers and business dealing. Moreover, the advances made by FinTech firms and business visionaries make increasingly decision and choices, eventually bringing about additional available money related markets for normal shoppers - not simply top pay workers. The innovation and information that FinTech utilizes make it simpler to circulate data, prompt, and offer progressively fundamental parts of budgetary administrations including banking,

contributing, getting and sparing to bigger populaces. What's more, advocates demand, in light of the fact that FinTech firms are utilizing distinctive informational collections and thinking about other factors amid the endorsing forms that customary banks don't consider, buyers have extraordinary access to capital that develops the economy and makes occupations.

The below graph shows the development stage of Fintech:



Fintech was initially associated with three services – lending, capital raising, and payment solutions. Crowdfunding platforms, peer-to-peer lending networks, and payment solutions such as PayPal build on the megatrends of the emerging internet economy: the sharing economy, social networks, and ecommerce. However, FinTech today comprises five major areas:

- Finance and Investment: Fintech reaches out past option financing components like P2P loaning to incorporate the financing of innovation itself (for example by means of

crowdfunding) and the utilization of innovation in financial exchanges, for example, algorithmic exchanging.

- Internal financial operation and risk management: These have been center drivers of IT spending by financial establishments, as they have fabricated better consistence frameworks.
- Payments and infrastructure: Installments have been a region of incredible administrative consideration since the 1970s, bringing about the improvement of both household and cross-fringe electronic installment frameworks. In like manner, foundation for securities exchanging and settlement and OTC subordinates exchanging is focal, and IT and media communications organizations are looking for chances to disintermediate customary establishments here
- Data security and monetization: The digitization of the financial business implies it is especially defenseless against cybercrime and secret activities.
- Consumer interface: The consumer interface offers the best degree for rivalry with the conventional financial part, as tech organizations can use of their previous client bases to take off new financial items. Curiously, it might be in creating nations where this marvel is generally obvious.

The “FinTech revolution” built around three main pillars: (1) capital availability both for start-ups in the form of venture capital and for incumbents; (2) new technologies; and (3) new business models (Gomber et al. 2018). Some forms of financial technology offer greater benefits than others offer and receive backing and support from governments and businesses. As an enabling and disruptive technology, blockchain is arguably one of those forms of financial technology, at the core of the FinTech revolution and has the potential to radically change a large

number of activities and processes within the industry. Blockchain is a digital database containing information that can be simultaneously used and shared within a large decentralized, publicly accessible network. This form of Fintech has allowed the creation of cryptocurrencies and digital currencies.

Blockchain currencies and payment technologies are experiencing a boom and we now have a plethora of different digital payment methods that make online transactions that much easier. Blockchain, still in its early days, is potentially transforming technology that goes well beyond finance. Consider the blockchain startup Ripple which settles an international money transfer between two banks in 20 seconds. Traditionally, this process takes two to six working days. This transformative technology won't find instant global adoption due to many unsolved challenges. However, it is expected that around 10 percent of global GDP might be stored in blockchain before 2030. Bitcoin as an example of the Blockchin technology, become more widely adopted. The incredible growth of Fintech indicates that it is here to stay and has transformed the way in which we do business, make transactions and manage our money. The growing interest in Fintech will soon be visible in the academic literature, but there is currently a large knowledge deficit about this field. Fintech is an evolving concept which has so far created little historical evidence or statistically significant time-series data for analysis, leaving researchers only secondary data with which to work, or sponsored research carried out by large advisory companies. As signs are already emerging that such financial technologies have the ability to significantly impact the use of cash and current banking and financial practices, and may empower individuals living at the bottom of the pyramid, the validity of research into the various areas of fintech and the financial sector is apparent.

2.2 Empirical Literature:

The cryptocurrency market has seen an extraordinary dimension of enthusiasm from investors. Cryptocurrencies have received much attention by the media and investors alike, which can be attributed to their innovative features, transparency, simplicity and increasing popularity. Investors are looking for new assets in order to diversify their portfolios. Cryptocurrency is a shared framework where exchanges happen without a focal player. Since cryptocurrency is such an ongoing creation, there has been a moderate yet consistent increment in the measure of research work done in connection to this digital money. Yet the literature examining the financial implication of bitcoin is limited, as of our knowledge none is written on the relation between Bitcoins and its forks. Lately, there has been more research on the value formation of cryptocurrency, the fundamental drivers of cryptocurrency price and on the volatility of cryptocurrency‘s price. Concerning the price and volatility, it was difficult to find papers and research totally focusing on this part only especially the one that we are trying to test, and based on our info, we did not find papers that show the relation between the cryptocurrency and its forks. The effect on the price performance and the volatility of the cryptocurrency from its forks and the effect of cryptocurrency on the price performance and the volatility of its forks. Therefore, this was a major challenge in this thesis to find related literature review and study concerning this type of relation.

The cryptocurrency market is like any financial market that has some characteristics, which are important to know and analyze it. Coin Dance regularly announces up-to-date and historical report statistics of cryptocurrency markets. According their most recent report 55.2% of total market share belongs to Bitcoin, while 11.94%, 9.34% and 2.58% shares are attributable to Ripple, Ethereum and Litecoin. Moreover, their report shows that 91.22% of cryptocurrency market involvers are males, while only 8.78% are females. The age distribution refers to ability of the

cryptocurrency market to attract wide range of people from very young to very old. The report gives statistics for only 18+ ages where 13.84% of the market involvers are aged 18- 24, while 48.43% and 24.96% are attributable to people aged 25-34 and 35-44 respectively. Interestingly, the share of elderly people (45+) is about 12.77%, which provides evidence for that cryptocurrency market attract from youngest to elderly people into financial activities.

2.2.1 Bitcoin

The dependent variable in this thesis is Bitcoin; the world's biggest computerized money, has risen 1500 percent since the beginning of 2017. As Katsiampa (2017) notes, Bitcoin is the most popular cryptocurrency with 41% of the estimated cryptocurrency capitalization in Bitcoin. However little is known about the behavior Bitcoin prices. There have been many studies looking at the eventual fate of Bitcoin and its unpredictability however, there have been not many that investigate the more extensive digital currency market and how it is advancing. Bitcoin is currently trading at around $5,586.28 at the beginning of the year, Bitcoin price was at $13,444.8 resulted that some analysts and experts believe that it is a bubble. The currency is extraordinarily volatile despite its peaking performance, rising by thousands of dollars in value on one day only to fall by even more the next. The price of cryptocurrency is highly volatile and some experts believe that this is due to the aggregate demand. If a constant supply of money meets a fluctuating aggregate demand, the result is fluctuating prices. The central banks always aim to change the money supply in response to change in demand of the money to maintain the price level constant. However, this concept does not exist in the cryptocurrency world; consequently, high volatility is expected to happen in the prices of cryptocurrency.

Moreover, Ciaian et al. (2014) studied the relationship between Bitcoin price and digital currency demand and supply fundamentals, some global economic factors (oil price and the Dow

Jones index) and the desirability of Bitcoin to investors. The author studied the impact of each of the variables on Bitcoin's price individually, as well as the interaction of these factors on the price of the cryptocurrency. The first independent variable is the supply-demand interactions where the demand of Bictoin is primarily driven by its value as a medium of exchange and the supply is given by the stock of Bitcoin in circulation. The second independent variable is the attractiveness of Bitcoin to investors. They found that there are several factors which affect the behavior of Bitcoin such as the risk and uncertainty of the Bitcoin system. Given that Bitcoin is a fiat cash and therefore inherently useless, it doesn't have a fundamental esteem got from utilization or its utilization underway procedure, (for example, gold). The estimation of fiat cash depends on trust that it will be important and acknowledged as a mechanism of trade likewise later on (Greco 2001). The assumptions regarding trust and acknowledgment are especially significant for Bitcoin, which being a moderately new cash is in the period of setting up its piece of the pie by structure validity among potential clients. Moreover, since Bitcoin is a digital currency, it is more vulnerable to cyber-attack, which can easily destabilize the whole Bitcoin system and thus cause more volatile price responses. The last independent variable is macroeconomic and financial developments such as stock exchange indices, exchange rates, and oil prices measures in determining Bitcoin price. They found that favorable macroeconomic and financial developments may stimulate the use of Bitcoin in trade and exchange and thus strengthen its demand, which may have positive impact on Bitcoin price.

According to Dimitrov (2005), there could be likewise negative connection between Bitcoin cost and investors decision to buy Bitcoin . A decrease in stock costs initiates outside financial specialists to sell the money related resources they hold. This prompts a deterioration of the particular money, however may animate Bitcoin cost if financial specialists substitute interest

in stock for interest in Bitcoin. Invetors' return on stock trade may catch opportunity expenses of putting resources into Bitcoin. Subsequently, stock trade records are relied upon to be emphatically related with Bitcoin cost. He concluded that Bitcoin's price is largely determined by the interaction between supply and demand, which is one of the key drivers. The demand side variables appear to exert strong impact on Bitcoin price. Also an increase in the stock of Bitcoin leads to a decrease in Bitcoin prices. However, he is not able to reject the hypothesis that speculation and Bitcoin's attractiveness for investors affect Bitcoin price. Finally, the author does not find evidence that the financial variables have an effect on Bitcoin's price. They do not affect Bitcoin prices in the long run.

Ciaian et al. (2016) also found that supply and demand of Bitcoin have strong impacts on price and that standard economic currency models can partly explain price fluctuation. The value of Bitcoin and its relationship to different financial data (e.g. the Dow Jones, FTSE 100, Nikkei 225 and the WTI oil) was examined by van Wijk (2013). The authors were able to conclude that the Dow Jones, the WTI oil price and the euro-dollar exchange rate have a significant impact on the price of Bitcoin in the short run but only the Dow Jones has a significant impact on the value of Bitcoin in the long run. Also, the researchers concluded that other variables, like the dollar-yen exchange rate and the Nikkei 225, have no statistically significant effect on the formation of Bitcoin price.

Bouoiyour and Selmi (2016) examine daily Bitcoin prices utilizing GARCH model and show that the pre-and post-2015 prices have a decreasing pattern of unpredictability. Despite everything they watch noteworthy asymmetries in the Bitcoin showcase where the prices are driven more by negative than positive stuns. With regard to the statistical properties of the Bitcoin market, Bariviera et al. (2017) found that Hurst exponents changed significantly during

the first years of existence of Bitcoin, tending to stabilize in recent times, while Alvarez-Ramirez, Rodriguez, and Ibarra-Valdez (2018) found that the market of Bitcoin presents asymmetric correlations with respect to increasing and decreasing price trending,with the former trend linked to anti-persistence of returns dynamics.

Urquhart (2017) found that Bitcoin's price and volume have a significant positive relationship. Bitcoin volume can predict returns except in bear and bull market regimes and that volume cannot predict the volatility of Bitcoin returns. Li and VVang (2017) indicated that Bitcoin prices adjust to economic fundamentals and market conditions. Polasik et al. (2015) states that an increase in the transaction volume will lead to higher prices and that global economic factors do not seem to be an important driver; the association between Bitcoin returns and fluctuations of major currencies, as well as global macroeconomic aggregates, is weak and statistically insignificant. Vassilladis, Papadopoulos, Ranquoussi, and Konieczny (2017) found that there is a correlation between Bitcoin prices and stock prices; As the cross correlation function, its peaks at zero and remain above of 0.6 (normalized value) for lags up to 150weeks. This behaviour reveals strong cross-correlations between bitcoin price with contemporary stock market indices like NASDAQ, DAX and S&P500. Hong (2017) showed that Bitcoin returns are similar to those of the other asset returns over a shorter time span. This may be due to much quicker nature and shorter term memory of Bitcoin investors.

Moreover, with regard to product diversification, Dyhrberg (2016) showed that Cryptocurrency can be used as a hedge against stocks in the Financial Times Stock Exchange Index and against the US dollar in the short-term, therefore, Cryptocurrency was found to possess some of the same hedging abilities as gold and can be included in the variety of tools available to market analysts to hedge market-specific risk.

Some studies have been dedicated to determining the factors that drive the price of cryptocurrency. Bouoiyour and Selmi (2015) argue that long-term fundamentals are likely to be major contributors to cryptocurrency price variations. They regressed Bitcoin price on investor's attractiveness, exchange trade volume, monetary velocity, estimated output volume, hash rate, gold price and Shanghai market index. By doing so, they showed the unpleasant speculative behavior of Bitcoin and also provided insightful evidence that Bitcoin may be served partially for trade transactions.

Several researchers found technical factors like Hashrate to be a positive driver of cryptocurrency prices (Bouoiyour and Selmi 2015; Ciaian et al. 2016; Garcia et al. 2014; Georgoula et al. 2015; Hayes 2015; Kristoufek 2015). Specifically, Georgoula et al. (2015) and Hayes (2015) found the technical factor Hashrate (measuring the mining difficulty) to be a significant positive price driver. An increase in the hash rate has a positive effect on Bitcoin prices. This is scarcely astounding, since the hash rate demonstrates the mining trouble or peripheral creation cost of Bitcoins and subsequently typically applies an upward weight on their cost. On the contrary, the price of Bitcoin is negatively affected by the exchange rate between USD and Euro. To the extent that this exchange rate represents the general level of prices, its inverse relationship with the value of Bitcoins contrasts the prediction of Fisher's equation associated with the quantity theory of money.

Utilizing the literature we use five control variables; one of the main control variables is volume of Bitcoin, first control variable. The trading volume of Bitcoin has increased immensely since its conception. Urquhart (2017) found that Bitcoin's price and volume have a significant positive relationship. Bitcoin volume can predict returns except in bear and bull market regimes and that volume cannot predict the volatility of Bitcoin returns. Polasik et al. (2015) states that an

increase in the transaction volume will lead to higher prices and that global economic factors do not seem to be an important driver; the association between Bitcoin returns and fluctuations of major currencies, as well as global macroeconomic aggregates, is weak and statistically insignificant. Second control variable is the interest rate, which might have an impact on the returns and volatility of the Bitcoin prices. In addition, the exchange rate is the third control variable that should be taken into consideration while testing the effect of the forks on Bitcoin's returns and volatility. Georgoula et al. (2015) and Hayes (2015) found that the price of Bitcoin is negatively affected by the exchange rate between USD and Euro. To the extent that this exchange rate represents the general level of prices, its inverse relationship with the value of Bitcoins contrasts the prediction of Fisher's equation associated with the quantity theory of money.

The fourth control variable in this thesis is the index (S&P500). The empirical findings indicate that the price of Bitcoin is affected by returns on the S&P 500. Frode, Aras, Erlend, Frans and Are Oust (2018) found that the S&P 500, Google searches and last week's return on Bitcoin to be significant explanatory variables, while gold, oil, CBOE (Chicago Board Option Exchange) volatility index (VIX), and Bitcoin transaction volume are found to be insignificant in the estimation period. The fifth control variable is gold that we are going to use in this thesis. Zwick and Sarfaraz (2019) found that gold is a significant indicator of Bitcoin prices. They indicate however that this impact in not linear over the time. Before October 2017, a significant negative and weak impact of gold on Bitcoin prices is found. This shows that investors see Bitcoin as a speculative asset than a hedge or safe haven one. After October 2017, an increase in gold prices predicts a significant positive and strong impact on Bitcoin prices. They found that a rise in the demand for gold, traditionally motivated by economic or financial uncertainty, increases the demand for Bitcoin.

2.2.2 Independent Variables: The forks of Bitcoin

Blockchain forks, which occur when two miners independently find and publish a new block referencing the same previous block, occur regularly in permission less blockchains such as Bitcoin. While the existence of delay between miners inevitably leads to blockchain forks, deviating. A blockchain fork occurs if two new blocks that reference the same previous block are independently found at the same time by different miners. Forks can also be the result of selfish mining, a mining strategy in which a miner withholds new blocks instead of immediately publishing them in order to gain an advantage in finding the next block. Another strategy that can create blockchain forks is the fork after withholding attack-mining strategies such as selfish mining can also lead to forks. The forks of Bitcoin are the in dependent variables in this thesis. Although it often speaks of the Bitcoin log as a "chain" of blocks, in general the log could fork, perhaps at several points, leading to a structure that is more like a branching tree than a single linear sequence of blocks. Forks are thought to be dangerous to Bitcoin because they create multiple, competing versions of the transaction history and thus sow doubt about who owns which coins. As of our knowledge, we cannot find any literature related to Forks in general nor its relation with Bitcoin in specific, the literature examining this topic is very limited almost not available.

2.2.3 Volatility Literature:

The trading volume of Bitcoin has increased immensely since its conception. Although its popularity has grown worldwide, fluctuation of the prices are sometimes erratic. Hence, such

large and sudden movements would dampen the sound development of Bitcoin. The price stability of Bitcoin is at least as important as the price of Bitcoin. In this section, we are concerned with the volatility of Bitcoin and what are the factors that affect the volatility of Bitcoin?

Phillip, Chan, and Peiris (2018) employed the stochastic volatility model to examine the price volatility of several cryptocurrencies; they found that Cryptocurrencies exhibit long memory, leverage, stochastic volatility and heavy tailedness. Also, their model showed that currencies with lower market capitalizations exhibit larger variability. Gronwald (2014) showed that Bitcoin prices are characterized by large price fluctuations such as those found in newly emerging markets. This implies that returns of Bitcoin prices are characterized by both extreme movements and conditional heteroscedasticity. Bitcoin prices are strongly characterized by extreme price movement. As this market is still in early stages, these results are generally to be expected. In addition, Brière et al. (2013) claims that the volatility of Bitcoin prices is many times greater than that of stocks, bonds, hard currencies and goods. Further, its lack of fundamental value and lack of regulation suggest different characteristics than many traditional assets.

In the paper "The curious case of Bitcoin: Is Bitcoin volatility driven by online research?" Davies (2014) found that there is a relationship between the volatility of Bitcoin and two different measure of online search. The VAR and Granger causality results shown in this paper indicate that changes in Google Trends have an effect on the realized volatility of Bitcoin. Changes in the volatility of Bitcoin also have an effect on Google searches for Bitcoin. He implied that Google Trends could be a useful tool for forecasting future periods of volatility in the market for Bitcoin. Also Ciaian et al. (2016) also found a positive relationship between

Wikipedia searches and Bitcoin. The author was able to conclude that changes in Google Trends of Bitcoin do have an effect on the volatility of Bitcoin and that changes in Bitcoin volatility also have an effect on Google searches for Bitcoin.

The price returns and volatility changes in Bitcoin market were studied by Bourie et al (2016).Their analysis showed that there exists an inverse relation between the US stock market uncertainty and the Bitcoin Volatility. This means that in an environmentof high certainty in the stock market, market participants moved into Bitcoin to hedge any possible stock market losses. Their analysis showed a negative relation between the US implied volatility index (VIX) and Bitcoin realized volatility.Moreover, Bourie found that the volatility of Bitcoin decreases less as the price of Bitcoin increases, leading to an inverted asymmetry phenomenon.

In addition, while studying the general behavioural aspects of cryptocurrencies, Corbet, Larkin, Lucey, Meegan,and Yarovaya (2018) examined the reaction of a broad set of digital assets to US Federal Fund interest rates and quantitative easing announcements to find a broad range of differing volatility responses and feedback dependent on the type of crytocurrency investigated and as to whether the cryptocurrency was mineable or not. Sapuric and Kokkinaki (2014) investigate the volatility of Bitcoin, using data from July 2010 to April 2014, by comparing it to the volatility of the exchange rates of major global currencies. Their analysis indicates that the exchange rate of Bitcoin has high annualised volatility, however, it can be considered more stable when transaction volume is taken into consideration. Yermack (2013) finds Bitcoin prices to be considerable more volatile than e.g. gold prices. The gold is a natural resource with limited supply both reserves and resources are uncertain same thing apply to Bitcoin that’s why it is volatile.

3. Data:

In this section, we describe the dataset we use to study the relation between forks and Bitcoin. Overall, we collected a comprehensive historical and market price dataset Bitcoin and its forks. Our sample is composed of daily data from 2010- 2017. We will utilize the daily prices and volume of 17 forks of Bitcoin as well as the ones for Bitcoin cryptocurrency. We use data from coin checkup. Our sample includes 17 types of Bitcoin forks, which are Litecoin, Bitcoin Cash, Dash, Bitcoin Gold, Zcash, Qtum, Decred, Digibyte, Syscoin, Navcoin, Peercoin, Bitcoin Diamond, Reddcoin, Elastos, Viacoin, Emercoin, and Grostlcoin. Each of the previous fork has specific starting date; therefore, our sample is constrained by the short length of the available time-series and we choose to consider only the period in which data of all forks and Bitcoin are available. We use the forks to create a portfolio of all the Bitcoin forks against Bitcoin. We define Rb as the return on Bitcoin calculated as Rb $=\log\frac{Pt}{P_{t-1}}$. Pt is the price at time t and P_{t-1} is the the price and time t-1. Rp as the return of portfolio calculated as Rp= W_1 Rf1+ W_2 Rf2+……+Wi Rfi where Rfi is the return for fork (i) calculated the same as the return of Bitcoin. Wi is the weight of each fork calculated as value weighted PiQi/∑PQ

Table 1: Descriptive Statistics

This table shows descriptive statistics (mean, variance, standard deviation, coefficient of variation, skewness and kurtosis) of daily returns in USD of the 17 forks of Bitcoin over the time period 2010-2018. By looking at the table, we will found that Dash has the highest mean, which means it has the highest returns, on the other side; it has the highest standard deviation, the highest risk followed by Qtum.

Table (1)

Descriptive Statistics (2010-2017)

Forks		Mean	Variance	StD	CV	Skewness	Kurtosis
Litecoin	X1R	0.0043	0.0071	0.0846	19.5272	4.7472	64.8648
Bitcoin Cash	X2R	0.0025	0.0089	0.0943	37.5468	1.4142	7.2888
Dash	X3R	0.0575	2.0336	1.4260	24.8204	38.7571	1,571.4448
Bitcoin Gold	X4R	-0.0001	0.0099	0.0996	-677.1199	3.2914	32.8698
Zcash	X5R	-0.0004	0.0104	0.1021	-272.5606	3.6532	64.2702
Qtum	X6R	0.0273	0.3167	0.5628	20.5833	23.0872	558.1663
Decred	X7R	0.0185	0.1086	0.3295	17.7828	25.1299	730.4990
Digibyte	X8R	0.0092	0.0149	0.1222	13.2987	6.1133	86.0125
Syscoin	X9R	0.0079	0.0107	0.1033	13.0169	1.5981	7.8986
Navcoin	X10R	0.0108	0.0187	0.1366	12.6466	3.9014	40.8421
Peercoin	X11R	0.0016	0.0051	0.0717	45.3409	0.9191	8.3328
Bitcoin Diamond	X12R	0.0063	0.0565	0.2378	37.8209	7.5471	94.0706
Reddcoin	X13R	0.0169	0.1605	0.4006	23.6569	7.6533	109.6447
Elastos	X14R	-0.0052	0.0075	0.0869	-16.6783	0.8520	6.6946
Viacoin	X15R	0.0066	0.0139	0.1181	17.8099	3.1629	28.7042
Emercoin	X16R	0.0137	0.0423	0.2057	15.0104	9.8494	178.3472
Grostlcoin	X17R	0.0159	0.0367	0.1914	12.0377	4.7946	49.6500

Source: Author's estimates

Table 2: Correlation Matrix.

This table shows the correlation coefficient of the returns of the 17 Forks and Bitcoin

	Table (2)																	
	Correlation Matrix																	
Corr.	*X1R*	*X2R*	*X3R*	*X4R*	*X5R*	*X6R*	*X7R*	*X8R*	*X9R*	*X10R*	*X11R*	*X12R*	*X13R*	*X14R*	*X15R*	*X16R*	*X17R*	*Bitcoin*
X1R	1.000																	
X2R	0.411	1.000																
X3R	0.009	0.516	1.000															
X4R	0.429	0.620	0.433	1.000														
X5R	0.293	0.493	0.399	0.488	1.000													
X6R	0.193	0.254	0.127	0.349	0.154	1.000												
X7R	0.094	0.385	0.051	0.392	0.239	0.104	1.000											
X8R	0.198	0.392	0.049	0.367	0.193	0.091	0.076	1.000										
X9R	0.283	0.347	0.116	0.333	0.279	0.071	0.057	0.259	1.000									
X10R	0.200	0.282	0.063	0.292	0.249	0.088	0.075	0.198	0.184	1.000								
X11R	0.437	0.296	-0.013	0.314	0.262	0.114	0.076	0.200	0.263	0.172	1.000							
X12R	0.259	0.224	0.242	0.303	0.150	0.136	0.205	0.161	0.212	0.123	0.168	1.000						
X13R	0.003	0.123	0.013	0.076	0.010	-0.048	-0.013	0.064	0.039	0.017	0.023	0.061	1.000					
X14R	0.580	0.562	0.556	0.622	0.551	0.582	0.540	0.541	0.461	0.480	0.343	0.155	0.040	1.000				
X15R	0.239	0.357	0.021	0.327	0.267	0.100	0.083	0.218	0.238	0.190	0.213	0.208	0.031	0.449	1.000			
X16R	0.049	0.087	0.021	0.164	0.107	0.073	0.028	0.031	0.054	0.006	0.016	0.098	0.013	0.230	0.026	1.000		
X17R	0.128	0.213	-0.004	0.186	0.086	0.043	0.035	0.103	0.100	0.125	0.136	0.110	0.003	0.250	0.092	0.026	1.000	
Bitcoin	-0.002	-0.011	0.003	-0.022	0.024	-0.025	-0.013	-0.045	0.042	0.020	0.035	-0.016	0.047	-0.027	-0.004	-0.023	0.059	1.000

Source: Author's estimates

4. Model & Research Methodology:

In this thesis, we use the quantitative method regression, Vector Auto regression model, in order to study the impact of Bitcoin forks portfolio independent variable on the return of Bitcoin dependent variable since simple regression analysis is based on the functional relationship between independent variable and the dependent variable.

We use the following equation to model the conditional mean

$R_{bt} = \alpha_i + \sum_{j=1}^{n} \beta_{j_b} R_{b_{t-j}} + \sum_{j=1}^{n} \beta_{jp} R_{p_{t-j}} + \varepsilon_{bt}$

Where R_{bt} is Bitcoin return at time t. ε_{bt} is the innovation to Bitcoin return equation. αi stands for the intercept of the Bitcoin equation and the Bitcoin forks equation. β_{jb_b} and β_{jp_p} measure respectively the responses of Bitcoin returns and Bitcoin forks changes to their own lags (where lags j=1 to n). The lag length is selected using the Akaike Information Criterion (AIC). β_{jb_b} and β_{jp_p} measure the cross effect of Bitcoins returns on Forks portfolio returns and vice versa. These two coefficients measure any causality between Bitcoin and Bitcoin forks returns, or the mean spillover between Bitcoin and Bitcoin forks returns.

We are going to test for our hypothesis; test hypothesis is partial test (t-test). The partial test is used to test independent variable whether the Bitcoin forks portfolio return has positive and significant effect on the dependent variable Bitcoin return. Our hypothesis is an increase in the return of Bitcoin Forks portfolio, Bitcoin returns will increase. With the significance level at 5%, if the significance value greater than 0.05, the H_0 is accepted and H_1 is rejected or independent variable has no effect on the dependent variable. If the significance value less than 0.05, then H_0 is rejected and H_1 is accepted or independent variable has effect on the dependent variable.

After modeling the conditional mean, we use GARCH to capture the joint volatility dynamics between Bitcoin returns and its forks returns.

Let (σ_t^2) be variance

$$[\sigma_t^2\ ] = [\sigma] + \left[a + bI_{t-1}\right] * [\varepsilon_{t-1}^2] + [d\sigma_{t-1}^2]$$

$$bI = \begin{cases} 1, & bI < 0 \\ 0, & bI > 0 \end{cases}$$

Where σ is a constant. A & BI captures the news effect on dynamic covariance. BI is the leverage effect, bad news. D captures memory effect; the effect of past volatility on current volatility. We restrict the off-diagonal parameters to be zero. This specification has the advantage of dynamically estimating the variance without being subject to the curse of dimensionality.

5. Results:

5.1 Results of Model 1: VAR

The regression output of the model is presented in table 3 below. This model presents the relation between Bitcoin and a portfolio of 17 forks. We first test for the stationarity of each variable; we found some of them are not stationary like euro-dollar exchange rate, interest rate, gold prices and S&P 500, so we took the first difference. After we run the regression between Bitcoin and its forks with five control variables, which are Bitcoin volume, S&P 500, euro-dollar exchange rate, US interest rate and gold prices. We found out that by looking at the adjusted R-squared 81% of the change in Bitcoin returns is explained by its forks and the control variables. When we repeated the regression to see only the effect of the Forks, we found that the adjusted R-squared is also 81%, which shows that 81% of the changes in Bitcoin is explained by its forks, and the coefficient is 0.678 and this indicates a strong positive relation between Bitcoin and its Forks.

By analyzing more the result of the VAR between Bitcoin returns and its forks returns with the five control variables, at 5% we found out that forks has a strong positive relation with Bitcoin with 0.7 coefficient. This indicates that when Bitcoin increases by 1, forks increases by 0.7, therefore; we accept our null hypothesis that the return of forks of Bitcoin is related to the returns of Bitcoin. Based on our knowledge, there is no literature review regarding the relation between the returns of Bitcoin and the returns of its forks, which we found in the regression. One believe that investors should consider it.

Moreover, we examine the impact of each of the control variables on the returns of Bitcoin. The results show that there is a negative relation between Bitcoin and the euro-dollar exchange rate and between Bitcoin and S&P500 at 5% significance. This means that any increase in the

exchange rate or S&P500, will lead to a decrease in the returns of Bitcoin. This finding is matching with the finding of Van Wijk (2013). He was able to conclude that the Dow Jones, the WTI oil price and the euro-dollar exchange rate have a significant impact on the price of Bitcoin in the short run but only the Dow Jones has a significant impact on the value of Bitcoin in the long run. Adding to Van Wijk, the result from our regression is in line with Vassilladis, Papadopoulos, Ranquoussi, and Konieczny (2017). They found that there is a correlation between Bitcoin prices and stock prices; as the cross correlation function, its peaks at zero and remain above of 0.6 (normalized value) for lags up to 150weeks. This behavior reveals strong cross-correlations between Bitcoin price with contemporary stock market indices like NASDAQ, DAX and S&P500. Moreover, this result is in line with Georgoula et al. (2015) and Hayes (2015). They found that the price of Bitcoin is negatively affected by the exchange rate between USD and Euro. To the extent that this exchange rate represents the general level of prices, its inverse relationship with the value of Bitcoin contrasts the prediction of Fisher's equation associated with the quantity theory of money.

In addition, we found that volume of Bitcoin has a significant positive relation with the returns of Bitcoin. This result is in line with that of Urquhart (2017). He found that Bitcoin's price and volume have a significant positive relationship. Bitcoin volume can predict returns except in bear and bull market regimes and that volume cannot predict the volatility of Bitcoin returns. Moreover, this finding is matching with Polasik et al. (2015). He states that an increase in the transaction volume will lead to higher prices of Bitcoin, which means higher returns.

Regarding the interest rate and the gold prices, there is no relation between Bitcoin returns and those control variables. Any increase or decrease in those variables have no effect on the returns of Bitcoin. This finding is in line with Frode, Aras, Erlend, Frans and Are Oust (2018).

They noticed that gold, oil and CBOE (Chicago Board Option Exchange) volatility index (VIX) are found to be insignificant in the estimation period.

5.2 Results of Model 2: GARCH

In this subsection, we present the results of the estimated volatility between Bitcoin return and the forks of Bitcoin returns. The estimates of the variance equation in the GARCH are presented in table 4. Regarding the GARCH model used to capture the volatility between Bitcoin and its forks, the results show that forks have no effect on the volatility of Bitcoin. The significant effect in our model comes from two main things, the news effect and past volatility effect. The news effect is significant on Bitcoin returns. In addition, the leverage effect, refers to the generally negative correlation between an asset return and its changes of volatility, is significant on Bitcoin return. This finding is in line with Phillip, Chan, and Peiris (2018).They found that cryptocurrencies exhibit long memory, leverage, stochastic volatility and heavy tailedness. The past volatility effect in Bitcoin returns is significant; it represents around 50%.

Moreover, the results show that the interest rate has a significant effect on the volatility of Bitcoin. Regarding the euro-dollar exchange rate, the S&P500, the volume of Bitcoin and the price of gold, all of them have no significant effect on the volatility of Bitcoin. This finding is in line with Yermack (2013). He found Bitcoin prices to be considerable more volatile than e.g. gold prices. The gold is a natural resource with limited supply both reserves and resources are uncertain same thing apply to Bitcoin that's why it is volatile.

Table 3: VAR Results

Dependent Variable:	Bitcoin
Variable	Coefficient
Constant	-0.706040 (0.015053)
FORKS	0.705277* (0.015399)
DFX	-0.403453** (0.201604)
DR	-0.061412 (0.054558)
DGOLD	-0.001597 (0.163470)
RSP500	-0.309172 (0.114211)
Observations	204
R-squared	0.815641
Adjusted R-squared	0.810985

(1) Parenthesis imply St. Error.
(2) *, ** indicate statistical significance at the 1 ,5% levels respectively

The above regression was conducted using the following equation

$$R_{bt} = \alpha_i + \sum_{j=1}^{n} \beta_{j_b} R_{b_{t-j}} + \sum_{j=1}^{n} \beta_{jp} R_{p_{t-j}} + \varepsilon_{bt}$$

Table 4: GARCH Results

Variance	
Variable	Coefficient
Constant	-0.000337 (0.000195)
RESID(-1)^2	0.151226 (0.087003)
RESID(-1)^2*(RESID(-1)<0)	0.484586** (0.225977)
GARCH(-1)	0.484951* (0.118066)
FORKS	0.000394** (0.000203)
DFX	-0.002538 (0.003217)
DR	0.002451** (0.001197)
DGOLD	-0.002357 (0.002634)
RSP500	-0.002196 (0.002191)
Observations	204
R-squared	0.815641
Adjusted R-squared	0.810985

(1) Parenthesis imply St. Error.
(2) *, ** indicate statistical significance at the 1% ,5% levels respectively

The above regression was conducted using the following equation

$$[\sigma_t^2)\ ] = [\sigma] + \left[a + bI_{t-1}\right] * [\varepsilon_{t-1}^2] + [d\sigma_{t-1}^2]$$

6. Conclusion:

Cryptocurrencies have been a controversial academic topic. Whether cryptocurrencies are money or financial assets, there is no clear definition for them. They have become one of the most trending topics in recent economic and financial issues. Cryptocurrency has become a global term; still not fully understood by most of the people, banks, governments and many companies. They are not widely used since they are rarely accepted as money and are very volatile. Opposite to the financial assets, they do not have intrinsic value. There are over 2000 cryptocurrencies available on internet. Bitcoin often is regarded as father of cryptocurrencies. Bitcoin, the first decentralized cryptocurrency, has gained a large following from the media, academics and the finance industry since its inception in 2009 with the increase interest in the Blockchain technology. One of the subtopic of Blockchain is Forks, which is part of our interest in this thesis. Forks is simply when a blockchain diverges into two potential paths forward. This is what happens several times to Bitcoin.

This thesis examines the relation between Bitcoin and its forks in terms of returns and volatility. The results of our study confirmed that there is a strong positive relation in returns between Bitcoin and its forks, however, forks have no impact on volatility of Bitcoin. The results also show the negative relation between Bitcoin and S&P500 and the negative relation between Bitcoin and US exchange rate. According to these results, understanding the movement in forks of Bitcoin helps understanding the movement in Bitcoins and hence could be used in predicting the returns of Bitcoin.

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