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in
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Final Thesis

ISSUES IN ASSESMENT OF BITCOIN'S VOLATILITY

AND ITS PRICE FORECAST

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Abstract

Created in 2009, the digital money of bitcoin is a relatively new phenomenon. During this short period of time, it has nonetheless showed a robust development of both price and trade volume. This has led to greater media attention, but also regulators and researchers have taken an interest. At this point, the quantity of accessible research is however restricted. With a focus on the price volatility of bitcoin and an objective of forecasting this volatility, our study is adopting a distinct perspective.

The research is based on the positivist and objectivist philosophical positions.

This has influenced the research topic and the study's design. Research is described and explained using deductive research, quantitative research, and an archival research technique. As a result, we've done a lot of research and found a lot of material. Volatility, economic cycles, legal, ethical and security challenges, and informational architectures are some of the topics that will be discussed.

For the lack of prior bitcoin volatility studies, the study relied heavily on research on more conventional assets, such as the correlation between bitcoin volatility and that of other financial assets. As a foundation/reference and inspiration, bitcoin research has been utilized whenever possible. Market volatility is frequently regarded the best indication of risk in research, and volatility forecasting is used in a number of contexts. Market making, portfolio optimization, and option trading are just a few of the many applications for Realized Volatility Forecasting models. Academic research on volatility forecasting and modelling has been extensive, yet academics are still unable to accurately anticipate the volatility of financial markets. Aside from the fact that this Bitcoin volatility forecasting is still relatively new, there hasn't been much research done on the subject. Consider the distinctive characteristics of cryptocurrencies, which differ from regulated stock and commodity markets in many ways. The historical Bitcoin Open, Close, High, and Low prices were gathered using the Yahoo Finance API yfinance. An easy-to-use platform that provides access to a wide range of data and offers. GARCH, TARCH, and LSTM are the three models. These models' forecasts of bitcoin volatility are interesting. We analyzed the outcomes of different models in order to determine which forecast was more reliable.

We've come to the conclusion that traders might have a positive outlook on the markets if they provide forecasts that are both correct and more accurate than the general consensus. Although the GARCH model is currently the most extensively employed to predict volatility, LSTM multivariate models have the potential to increase forecasting accuracy.

1. Chapter 1

1.1. The Background

In Europe, the concept of money was first introduced in the area known as Lydia mean modern western Turkey. Considering into the primary characteristics of the money such as avalue storing, a fundamental unit of account, and exchange medium, the decision was madethat for representation, currency is better. Among various kinds of available currencies, digital and virtual currencies were on the top position. If we bring fiat currencies under spotlight, they were a) Coin and paper formatted b) Standard or Real currencies c) Identified as a legal tender d) Central bank regulatory authority (FATF 2014).

1.2. Evolution of Fiat Currencies

The standard definitions defined it as a kind of money with no intrinsic value, not for its production or consumption, but for its long- or short-time usage. According to some other definitions it is a currency that is declared legal by the government, despite of the fact that itis not for reserves and having no intrinsic value1 and coin or money made from paper havingno intrinsic value themselves and can't convert into silver or gold, but it is legal by fiat of thegovernment2 (Financial Times Lexicon). Fiat money is present from the day when money wasfirst introduced in the world. Currently, all the money is in use all around the world is in the form of fiat money.

As a commodity, it has no worth and there is no use in production. It has only future exchangevalue. Fiat money is founded based on faith with the expectation of high value in future. Several hypotheses proposed by researchers about the use of fiat money.

1.2.1. Theoretical Perspective About Fiat Money

Fiat money can be more explained under the light of some famous theories. A good theory for the explanation of money is the commodity theory that suggests the money is an object that is spend by its owner on his desirable goods. The theory described that money has high value due to its exchange usage and its only acceptation is as money and because of its high liquidity, people accept it (Menger, 1892). But the fiat money occurrence could not be properly described by the theory of commodity. There are no proper reasons to accept the presence of fiat money in future.

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[1]https://www.investopedia.com/terms/f/fiatmoney.asp

[2]https://www.ft.com/

A State money theory which described the government restriction of money with legal documents and payment of taxes can be able to explain the fiat currency in more proper and better way. It was first described by the Adam Smith that paper money has potential to gain a good value when people use it in the payment of taxes and this use will give it a relevant importance and value. Another best reason comes from the side of the government to maintain and grow the economy, which can be obtained through the same currency use by everyone. The government promised people that the fiat money will get great value in exchange. A government done this to maintain stable economy and enhance its growth rate and due to this reason fiat money will gain high exchange rate value in near future. All these actions of the government build the faith of people in Fiat currency. Moreover, its uses are better explained by the government.

1.2.2. Infinite Market and Fiat Currency

Several researchers in different theories made assumption about the acceptance of fiat currency by agents because of its infinitely huge market. No doubt those assumptions provide surety for its success and high value in the market. Furthermore, uncertainty factor in future exchange of Fiat currency was also removed through these assumptions and its use was better explained by them. Though, the world market never found that phenomenon, making explanation and assumption about Fiat currency implausible.

1.2.3. Finite Market and Fiat Economy

Kovenock & De Vries, 2002 developed helicopter money theory based on previous assumption that Fiat can gain a valuable place in an infinite market. A helicopter money theory explained the presence and worth of Fiat currency in finite economy. The theory was constructed as follows: three people make an economy, agent A, B, and C. The possibility of coming together of all these three agents in pairs in the following way, first A and B will meet, and the B met C, and, in the end, C will meet A. They desired goods of each other. No doubt their basic endowment based on goods that are worthy for them already. When we draw out the trade option, then we can see an enhancement in their overall utility. There is no scene of wants which make commodity trade not possible and in this way the remaining source of trade is with fiat exchange. Due to this reason, fiat currency enhances the economy by providing it to one agent and he is the first link and now he can select to stay autarkic or do some trade. On the other hand, if he decides to stay autarkic then it is the end of economy at this point. But trading is a better option for him because he will gain something from this trade. At this point uncertainty can cause a problem because in case of first agent the situation is clear that he is a first link, but in case of second and third agents they are not sure that they are second link or third agent in overall economy. The first one will deny the acceptance of fiat currency at last point of trading meet-up because he doesn't want to stick in the end with fiat currency and in this way the last or third agent that will get fiat currency will lose. It was

concluded that fiat currency should not be accepted by first person to extract the solution of this problem.

The problem was solved by increasing the number of agents to that extent that when it comes to the last person then the amount of the Fiat currency must be that much small that the reward of selecting trade must be huge enough that person don't focus on smaller loss of fiat currency acceptance. So, they concluded that because of this uncertainty the fiat currency must be used in finite market till the reward is higher than the possible loss for the last person in the economy which will hold it at end point.

1.3. Evolution of Crypto

According to the ECB (2012), the virtual currency is digital and virtual money that is controlled and issued by the main developers and the virtual community. It is also stated by EBA (2014) that virtual currencies are only representation of a value digitally and have no connection with any government and are not issued by any central bank authority but stored and used by real and legal people. The whole exchange process is taken place electronically.

A Satoshi Nakamoto, a Japanese Programmer founded the most famous digital currency Bitcoin in 2009 (Nakamoto 2009). In 2008, he wrote his famous article and list about crypto currency. In his article he described a type of a cryptocurrency which after some time became famous as Bitcoin. A global internet is used for the Bitcoin creation, exchange, use, and transaction by using an open-source software algorithm.

1.3.1. Bitcoin as a Crypto currency

i. The Peer-to-peer mechanism was the foundation of the Bitcoin invention.

ii. Cryptographic principles generate, trade, and regulate the Bitcoins. Due to this, they are referred frequently as cryptocurrencies.

iii. Bitcoins are saved in local wallets through open-source software like computer, smartphones, etc. or in digital wallet of internet (Brito and Castillo 2013; Coin desk, 2015b)

iv. Bitcoin users and Computer Network members contribute to its mining process and record and validate payments in public ledger which is known as Block chain.

1.3.2. Bitcoin is different from other Currencies

A major difference between Bitcoin and other currencies like euro, dollar, etc. is that the circulation of the units is regulated by the algorithm of software rather than a company, group, government or central authority.

Another distinguishing factor involves its direct transactions between people. Moreover, third-party entities are not required by the Bitcoin which increase its charm among individuals because of the decentralization of the whole system (Brito and Castillo 2013). It is assumed by the network that the nodes that are users of Bitcoin are reliable and trustworthy and transactions are overall interrelated. A Bitcoin's system lacks any mediating institution and process of transaction is done by various current nodes. Infect these nodes are responsible for all the transactions done in the block chain. The nodes are usually known as miners and the mining is the main process of creation of the Bitcoin. There are three ways in which we can obtained Bitcoins i) Buying them from Bitcoin denominated services or goods ii) Bitcoin trading through standard money on block chain orthrough Bitcoin dealer iii) Mining (Plassaras 2013; Coindesk 2015c).

The benefits of adopting block chain network includes user anonymity, international payments, free from third-parties' issues, no transaction taxes, irreversible payments, low risk of theft, and minimum transaction fees.

1.4. Inclusion of Bitcoin

The market capitalization of the Bitcoin is around 16 billion US dollar because all around the world it is traded in more than forty exchanges. Moreover, it becomes the most attractive option for the investors for investments because it is widely in use and there is no correlation with any other assets. Due to this reason the assessment and prediction of the prices is quite easier for the investors. Bitcoin price prediction was investigated by various researchers because of the significance of this topic. (Almeida et al. 2015) studied the Bitcoin price of previous day and the turnover volume through artificial neural network for its price prediction. A basic flaw of this method is that it requires a huge amount of data for any kind of prediction. On the other hand, the McNally's 2016 research utilized the machine learning to anticipate the prices of Bitcoin. Various ARIMA, RNN, and LSTM patterns were used for itsaccomplishment. Furthermore, Greaves and Au, 2015 used ANN and studied the Block chainnetwork characteristics based on future prices of Bitcoin. According to their findings the accuracy was 55%. Shah and Zhang (2014) claimed that best Bitcoin strategy can be based onBayesian regression because the accuracy is about 89% upon using nonparametric classification technique. Madan et al. 2015 studied the features of the Block chain network for the prediction of Bitcoin price. But they became able to forecast its price with 55% accuracy level utilizing binomial logistic regression classifiers, SVM algorithms as well as random forecasts.

1.5. Characteristics of Bitcoin

Bitcoins have their own specific characteristics that effect their price and responsible for theissues and volatility of their prices.

Decentralization:

The fundamental characteristic of Bitcoin is known as decentralization. Bitcoin is not controlled by the central power like other traditional money which are managed and issues by specific authority belonging from any organization or government sector. In contrast to the traditional money, the decentralization of the Bitcoin provides various benefits like tax, seizure vulnerability, etc.

Transparency

The system of Bitcoin is totally transparent. It is completely visible on the ledger board that how much Bitcoins hold by which person and how many transactions made by this person. Who is receiver and who is user everything is visible to everyone? So, in the Bitcoin ecosystemeverything is crystal clear for all users.

Opaqueness

The best thing of the Bitcoin system is that the reality of the identity of user. Are users being anonymous and there is no way to know their original Id. Moreover, there is no legal documentation involved in the whole process of Bitcoin trading that's why no one can track anyone. Even government can't be able to identify the actual person behind any account.

Fast

If we compare the transaction system of Bitcoin with any other system, then this system is quite better and fast. Even a person can send a huge amount of money in Bitcoin form from one corner of the world to another within minutes. On the other hand, bank take at least one week for such big transactions.

Digital Money

Bitcoins are not in the form of coins or paper money. So, it quite convenient to have them just in your mobile account and they are safe from the danger of any theft from home or fromany bank.

Non-Repudiable

Another incredible characteristic of Bitcoin is that they are non-repudiable. Once one person transferred the bitcoin to another one, there is no way to get them back or receiver can't be able to decline the receiving of Bitcoins.

Transaction Fee

It entirely depends on you that you are going to pay the transaction fee or not. The payment of transaction fee will give you extra benefits. But users that are not paying anything are also safe and doing trading with profit without any issue.

Simple Set Up

Usually, the documentation procedure of all banks is time taking to open any account and to manage it because it involves credit check, dealer records, and legal documents for the user identification. But in case of Bitcoin, you can create your account without fulfilling any formalities and legal process. There is only needed to have a hard to guess password and remembering the password all the time because once you forget the password there is no chance to get it back or reset it.

Demand will Determined the Value

The price and value of the Bitcoin is not fixed. The price is always fluctuating within the blockchain market, and it totally depends on the demand factor. In the block chain market, the value and cost of the Bitcoin is determined by the members present in the Bitcoin ecosystem.

1.6. Block Chain Technology

Georgoula 2015 for exploring the factors of Bitcoin price used SVM for the sake of emotional analysis. Based on findings, it is concluded that hash and hit rate of Wikipedia in the network had a positive relation with the price of a Bitcoin in the block chain market. Matta et.al, 2015 also studied the phenomenon of the Bitcoin trade. They wished to find out that is it possible to forecast the ups and downs of the price of the Bitcoin within market through the study of the Twitter messages series about Bitcoin price. Later, their findings of the study showed a positive correlation between the expected Bitcoin's price and a amount of Tweeter message within one day. Several researchers used wavelets for attaining these results. After studying the effects of microwaves on the Bitcoin's price, Kristoufek described the presence of direct relationship between complexity of Bitcoin mining and hash rates or views of search engine. The creation of the Bitcoin price utilized both specific digital money

characteristics as well astraditional ones. According to the various researchers the attraction of Bitcoins and dynamicsof the block chain market are the two essential factors that affect the price of these Bitcoinsin the block chain market.

On the other hand, Bouri et.al 2017, also investigated the relation between commodities andBitcoins, known as energy market and according to the findings, it is possible that the Bitcoincan perform diversified work in the currency market. It is confirmed through several researches that the price of the Bitcoin varied under the influence of various factors and all these things make the process of its price prediction complex.

1.6.1. Block Chain Technology's Characteristics

Block chain market has a great influence over the changing price of Bitcoin. Even within one day its price fluctuates several times. All these things have a direct link with the block chain market. In contrast to the other trading markets, the block chain market has its own unique characteristics.

Day Trading

Day trading can be defined in such a way that you should open and close the position within the same day of trading. In other words, there is no chance to expose the market of Bitcoin overnight. This is the implementation of the rules on you that you can't be able to make a payment for overnight fund of your position. On the other hand, this method is quite beneficial for you, if you wish to gain profit from this short-term price fluctuation of Bitcoin. You can gain a great profit from this daily volatility of Bitcoin price.

Trend Trading

If your positing is reflecting the current trend, then researchers called it trend trading. If the block chain market is short and in bullish trend there is a clear chance to go long. Another significant thing is the closing and opening of your trade at right time. It's time to open new one and close the current trade when you are seeing that trend is going to reverse or stall.

Hedging Strategy Bitcoin

Hedging strategy is gaining an opposing position from your current one which you recently open to lower down the risk factor. This step can be taken at the time when you feel that themovement of the block chain market is not in favor of you. It can be explained through the example that you are holding some bitcoins and now you are worried that there is a chance of drop in their price then at this stage use CFDs for short position opening on Bitcoin. If the market shows you a decline in the bitcoin price, there you are not going in complete loss theprofit of short position will compensate the loss of the

long position.

HODL Strategy

When you buy and hold the Bitcoins then this strategy is called HODL strategy. Basically, the names belong from the "Hold" on main site of cryptocurrency and nowadays its interpretation is "hang on for dear life.". But you should not take this too seriously. You should not buy andhold the Bitcoins for longer time until you know that there is a chance of increase in its long-term price. You can also gain profit and lessen the loss by selling your position on correct time in the block chain market. Based on your plan of trading you can close your positions automatically to stop gaining any type of loss.

2. Chapter 2

Literature Review

2.1. Description of the topic under investigation

There has been few research on the dynamics of Bitcoin's volatility; rather, the emphasis has been on price determination as well as the key drivers of the Price of bitcoin. Determinants connected to buyer's sentiment and concentration, factors relating to BTC's demand and supply, and vectors related to macroeconomics and financial sector have often been employed as explanatory variables. Variables from different groups have been mixed in a single study only a few times. Furthermore, empirical study demonstrates that the price formulation is influenced by factors that are very different from those that effect traditional reserves. Internet search and social media activity, as well as Bitcoin's trade balance and supplies, are among these elements, with the latter being one of the most researched. Whenever it pertains to explaining and predicting Bitcoin's instability, the descriptive strength of these elements has varied, with arguably internet search and social network engagement being the most reliable. Furthermore, the asset nature of Bitcoin has become difficult to explain — is it a unit of money or a product? It has been equated to US dollars and gold because of its several characteristics in common with both. Both BTC and gold are expensive to acquire, none of which is owned by administration or a state, however both are mined by individual entrepreneurs through the procedure of "mining." Because of its negative association with the US dollars, Gold has traditionally been seen as a haven asset and a trading tool. Bitcoin, on the other hand, hasn't always been thought of as a hedge. The similarities between Bitcoins and the US dollars can be justified in the same way. Both have little or no fundamental worth, but unlike the US dollar, Bitcoin is not supported by government. As a result, some, such as Yermack, contend that Bitcoin does not fit the threshold for being a fiat currency, he examines the Price of bitcoin formulation by considering both conventional drivers of currency pricing as well as Bitcoin-specific elements. The demand and supply market dynamics had been discovered, such as Bitcoin transaction volume, outstanding Bitcoins, and market price, have a significant influence on price formation. Furthermore, Yermack discovered that no indication for stock market indicators, asset values, inflation, and macro-financial trends, could influence the worth of bitcoin in the brief or medium run. Kristoufek uses Google and Wikipedia search queries as proxy to explore the correlation of Bitcoin price with shareholder enthusiasm and attentiveness. On both internet sites, he discovers a substantial link between price and search requests. When pricing is above trend, more attraction in Bitcoin contributes to a resumption of the value rise, and when prices are below trend, the opposite is true. For capital assets with no economic

fundamentals, like as Bitcoin, this bi-directional, asymmetric correlation is said to be prevalent. Kristoufek expands on the investigation in a later work by looking at probable fundamental, or economical, determinants, as well as transactional (the use of crypto coin inreal-world transactions) and technological causes i-e, the extraction process. In the long term, he discovers, Bitcoin follows traditional economic theory, but in the short term at least, it is prone to booms and busts. Users are inspired to start mining when the Bitcoin price rises, from a technological aspect. He also sees no evidence that Bitcoin is a secured asset, a theory that might have been tested by any. At least according to the research result, the range of available drivers for Bitcoin unpredictability is like the list of potential drivers for Bitcoin price. Bouri used the asymmetrical GARCH model to assess the influence of favorable and unfavorable shocks on Bitcoin fluctuation. They do detect a link among shocks to yield and instability, but only in the days leading up to the crisis, from June 20, 2011, when Mt. Gox was hacked, causing Bitcoin's value to plummet to 0.01 USD $ in a matter of minutes. Bouri also discovers that the VIX index and Bitcoin realized volatility have an inverse relation. Dyhrbergexamines the nature of Bitcoin fluctuations in contrast to USD-EUR and gold trade rate usingthe GARCH methodology. Bitcoin's price instability, like gold's, is characterized by volatility cluster and highly liquid tenacity. Dyhrberg also discovers that the forecasting capacity of shock (news) impacts for Bitcoin is surpassed by historical volatility as an indicator of future volatility. Urquhart's research focuses on "what elements attract Bitcoin's consideration?"and is like ours. Urquhart, like us, uses Google Trends dataset as a surrogate for buyer's attention before examining whether realized volatility (rather than returns) is a primary driver of Bitcoin interest. As a result, he discovers that buyer attention has little predictive potential when it comes to projecting recognized volatility. However, the volatility and density of the preceding day's result, are discovered to be key drivers of Bitcoin's attention. He speculates that this is due to increased volatility and trade volume, which has drawn investors to Bitcoin. He looks at a timeframe that concludes one month after, only looking at daily returns and Google searches conducted in the United States. Overall, there is significant evidence that social factors linked to online search activity drive Bitcoin price and volatility trends. Other financial assets and resources, like as gold & oil, appear to play a vital role as well, maybe because of the discovery that Bitcoin is a cross between a money and a commodity. To studythe driving mechanisms behind Bitcoin volatility, our study adds to the currently available content by merging social characteristics, volatilities in various traditional financialmarketplaces, as well as macro-economic risk metrics. When researching Bitcoin's volatility, we feel that a combination of the three groups of plausible driving variables may be useful.

2.1.1. Related work on the Block chain technology

Bitcoin's technological advancement is based on two important components: mining and block chain. Another clever combination of technology is known as block chain like peer-to- peer, timestamps, and cryptography that creates a data structure organized into blocks, whose contents can only be modified with the system's users' consent and can never be erased. It produces an immutable and verifiable record of all transactions in practice. Moreover, as Crosby points out, the blockchain has applications outside of Bitcoin. The minng of Bitcoin is possible. Generally, an advanced computers' network is compensated with Bitcoins units when it solves an algorithm; fresh coins are added to circulation every 10 minutes. Satoshi Nakamoto set a limit of 21 million coins, ensuring that the issuance of Bitcoin will be concluded around the year 2140. The Bitcoin creators create a issuance of money method that is controlled and its inspiration comes from the restricted gold supply through the crypto mining process. Is Bitcoin, on the other hand, a commodity, or a currency? It is still a matter of contention, as stated in preceding lines. During times like the 2010–2013 the crisis debt and a collapse of Cyproit' banking in 2012–2013, cryptos were marketed as a cure that hid the financial system's vulnerabilities, as Bouri points out. Although, in a formal sense, Bitcoin has not fulfilled its duty as a money. Yermack examines the Bitcoin anomalies in terms of the three responsibilities that a currency must play: trade's medium, unit of payment, or a wealth store. A researcher identifies several form issues in Bitcoin's functioning, such as the unusual decimal pricing, lags in transaction verification, and the process of purchase, which limit the use of bitcoin for payment. He described that in every event the Bitcoin's price must be steadier for it to operate as a measure's unit and a wealth's store, because the Bitcoin volatility is very reflective of the speculative investment behavior. Baur characterizes Bitcoin as a risky and unrelated commodity, not a viable means of exchange, in the same way. Other studies define Bitcoin as a hybrid innovative instrument or claim that its currency-fiat asset function and the crypto commodity utilized for financial and commercial reasons. In case of regulation, the International Financial Reporting Interpretation Committee (IFRIC) informed the International Accounting Standards Board (IASB) that digital currencies are neither economic asset nor officially permitted money. Moreover, these are assets that are intangible and these are also not financial assest [56]. Bitcoin is an asset for the US Commodity FuturesTrading Commission under the Commodity Exchange Act. The Chicago Board Options Exchange and the Chicago Mercantile Exchange have both traded future contracts utilizing Bitcoin as the underlying stock. Selgin points out that Bitcoin possesses commodity-like properties and might be called synthetic commodities money in this aspect. Bitcoin, like gold, represents few characteristics of classic commodity; it is a fixed source with a finite quantity. However, according to Gronwald, large price swings caused by Bitcoin's price is influenced significantly by demand shocks. The analysis backs up this distinction in Bitcoin's immaturity, particularly in its predictable and planned supply vs gold and oil's uncertain short-term supply. In this sense, even though Bitcoin's design is motivated by gold, it has less volatility, more

complicated transactions, and is, most all, considerably more volatile. Various attempts made by several researchers to compare the similar attributes of the Bitcoin, concentrating on gold, variation, hedging, and safe refuge attributes, the outcomes varied because of the intensity of the scenario of stress and the capital composition. Furthermore, Urquhart and Zhang described Bitcoin as a credible place of safety in opposition to supreme currency; Wang got similar findings related to the Chinese financial sector capital; and Dyhrberg claims that it can hedge stances on Financial Times Stock Exchange Index and the USD. In a form of secure harbor and the oil price, Selmi compares Bitcoins to gold. Although Bitcoin's low association with formal economic assets, some studies agree that at a time of severe stress it provide inadequate coverage in the form of safe-haven value. The flaw was proved by Conlon in the economic collapse of Covid-19; the excessive Bitcoin volatility makes it ineffective in the form of haven, and also encourages the stable coin requirement like Tether for security. In all situations, the researches like Brieri represented that the Bitcoin's minor proportion can provide the optimization of the market that are risk-return for the portfolios that are well- diversified, while other like Ghabri's find that Bitcoin can reduce the portfolio's liquidity risk, using the Mean-Variance-Liquidity framework. As a result, while its utility as a currency or haven is limited for the time being, its diversification element and the high potential of return pique the portfolio managers investment interest. Volatility modelling has gotten a lot of attention for this reason. Volatility is an essential indicator of market instability and, as a result, an important factor in investors' portfolio management decisions. The Andersen and Bollerslev research and findings served as a reference point in academic study, with major contributions to forecasting volatility and modeling utilizing data of high-frequency. As a result, the study of volatility is a well-developed academic field, even if the modelling of bitcoin volatility is a term with many unsolved gaps. In recent years, a field of inquiry has evolved focusing on the models of GARCH-type construction that forecast and describe the Bitcoin volatility and other cryptocurrencies in generally, using the long memory assumption. As a result, the model of Bollerslev's GARCH (q, m) become a benchmark. Glaser used the typical GARCH (1,1) to successfully described through the model of Bitcoin's price and volume which is a main purpose of the investors when switching their to digital currency from the national one is not only to get another transaction mechanism, but also to get another vehicle for their investment. It is showed by the Ardiatt that for Bitcoin Value-at-Risk (VaR) forecasting, the Markov switching the models of GARCH (MS-GARCH) improved the efficacy of the models of the single-regime. To model the excessive price swings of Bitcoin, Gronwald compared various nonlinear and linear approaches with the GARCH (1,1). Hung, uses the RGARCH (1,1) model to add jump-robust-realized metrics in the GARCH simple model, resulting in improved Bitcoin volatility's forecast efficiency. Furthermore, with the start of GARCH (1,1), Trucos performed a thorough comparison of Bitcoin volatility forecasts using various extensions of numerous standard GARCH-type models. Other research, such as those by Katsiampa and Conrad, have used GARCH simple models for the sake of forecasting

fluctuations of Bitcoins. Even though the model of GARCH (1,1) is offered a starting point for the creation of the models of MGARCH that can provide high capacity, which allow the incorporation of the linkages between the processes of volatility of different bitcoin's time series. Chan et al. examine Bitcoin's ability to hedge and diversify next to stock indices like the Shanghai A-Share, Euro STOXX, Nikkei, TSX index and S&P 500. The authors use the TARCH(1,2), LSTM among others, to conduct their research. The regular GARCH model, TARCH and Bidirectional LSTM provides a good fit and consistent results. These research findings also contributed to this present topic in numerous kinds, on the basis of the evaluation material and the time-series of bitcoin continuing to increase and established. First, the findings of the constructed models provides a novel view of the degree of the Bitcoin's association with traditional financial market benchmarks, calibrating its diversity component. Similarly, the relation between the swings of Bitcoin yields and formerly untested parameters is incorporated into the structure of the models, but with a probable cohesive link. Second, as a starting point using the GARCH (1,1), the modification and the appropriateness of the models of the GARCH CCC, DCC, and VCC to investigate the Bitcoin fluctuation.

2.1.2. Its importance/relevance to the field of cryptocurrencies

Bitcoin is a famous cryptocurrency and widely in use. Recent price variations of the Bitcoin have piqued the interest of academics. Previous research on Bitcoin and other cryptocurrencies, such as Ethereum, Litecoin, and Ripple, has focused primarily on the ideas,theories, and economies of cryptocurrencies, which is understandable given the nascency of this research stream. Dwyer spoke on the fundamentals of Bitcoin and other crypto currencies. He discusses the market dynamics of digital currencies, Bitcoin's equilibria, and Bitcoin's usage in exchange for goods, as well as its competition with other currency pairs. Brière also investigated the relationship between Bitcoin and other cryptocurrencies. Bitcoin's overall market capitalization is around USD 840 billion (as of September08, 2021), accounting for nearly 44.82 percent of all cryptocurrency market caps3. As a result, several research take Bitcoin price swings into account. Brandvold investigated how Bitcoin exchangeprices are determined and discovered that two of them, Mt. Gox& BTC-e, are at the top end of the market with the most data. Ciaian also investigated the operational role of Bitcoin's pricing using traditional currency price parameters. Furthermore, considering the economic environment's concerns, Bitcoin in the perspective of alternate economic structures.

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[3]https://coinmarketcap.com/

Bitcoin, on the other hand, is seen as a risky investment or a speculative asset. Yermack, on the otherhand, sees Bitcoin as a liquid investment rather than a money. Money as a means of exchange,a measure of wealth, or a monetary unit does not meet the requirements. Molnár comparedand examined the risks of exchange of the Bitcoin with different variables such as Euro and the Gold and discovered that bitcoins are more unpredictable and dangerous than Euro as well as the gold, restricting its utility as a means of exchange. The bureau also investigated the Bitcoin price fluctuation and discovered that the price and variability remained consistent.Because Bitcoin's market volatility is so high, speculators are curious if future Bitcoin prices can be predicted. Because of its boom-bust nature, price of bitcoin or yield forecasting is gaining greater traction. To position their stock portfolios in a profitability ratio, Venture investors look for methods and strategies that are more accurate than a naive prediction to anticipate Bitcoin price. The focus of Bitcoin study is on price returns and volatility, whether it is a speculative asset or a boom. Some research focused on the diversification, safe and riskaspects of the Ethereum and the Bitcoin. Furthermore, to the best knowledge of the authors'understanding, there is tiny research utilizing test-sample data to estimate Bitcoin price. Thisstudy compares LSTM and GARCH models to provide a novel way to provide a forecast aboutthe daily price of the Bitcoin utilizing model re-estimation or sometime without it.

3. Chapter 3

Bitcoin's Volatility And Its Drivers With Respect To Its Generations

3.1. Bitcoin market:

The financial world is a buzz with the arrival of Bitcoin, a brand-new digital currency. When compared to other financial assets, this digital currency shows unique characteristics that need a variety of difficulties and trade-offs for its investors to consider. In November 2008, Satoshi Nakamoto proposed the concept of Bitcoin in a white paper, and it became a reality in 2009 when the first bitcoin was mined. Even though it isn't the first virtual money, Bitcoin has addressed many of the major issues that hampered past attempts. By using encryption and a public/private key combination, Bitcoin's usage is practically completely anonymous. This eliminates the need for any central authority to monitor every transaction. Using this method, a currency may be produced in a predictable quantity without the need for intervention from a central regulating body, which would be tempted to devalue it by generating new money at will. There are around 21 million bitcoins in circulation, of which approximately 12 million have been mined(Brito & Castillo, 2013); Tucker, 2013). Though Bitcoin's total supply is limited, a fraction of one bitcoin can be used to execute a transaction according to the digital currency's nature as a fractional currency (Fowler, 2014). The "satoshi," or 0.00000001 of a bitcoin, is the lowest unit of currency in the Bitcoin system. According to current projections, the final satoshi will be mined in the year 2140. (Brito & Castillo, 2013; Tucker, 2013).

To put it another way, Bitcoin is a decentralized peer-to-peer electronic cash system that eliminates the need for a centralized authority to settle and validate currency transactions. Since Bitcoins are decentralized and unbacked by any government, they don't pay interest or dividends like traditional currencies. It's a decentralized currency that doesn't have a government or central bank supporting it. Instead, Bitcoins are created through a process known as mining, in which miners provide the Bitcoin network with the required processing power in return for Bitcoins. Satoshi Nakamoto, a pseudonym for the person who created Bitcoin, announced it in October of that year under the pseudonym "Bitcoin" and Digital currencies have an issue known as "double-spend" that can be solved by the decentralized Bitcoin network. A network of nodes (the miners) verifies the correctness of each transaction using prior transactions logged in a ledger known as the blockchain to validate Bitcoin transactions. A notion known as proof-of-work is used by the whole decentralized network to verify each new transaction (Antonopoulos, 2017); (Baur & Dimpfl, 2017)that is

added to the blockchain. The quantity of Bitcoins in circulation is continually expanding as a result of the mining process. Traditional currencies, on the other hand, have a fixed supply of money, which is why they tend to rise and fall in value over time. Bitcoin's total market value is over $230 billion as of January 2018 and there are close to 17 million of them in circulation (i.e. 80 percent of its hard-limit total money supply, which will be achieved in the year 2140). (Blockchain.com, 2018, Coinmarketcap.com, 2018).

Libertarians, speculators, and criminals alike are drawn to Bitcoin for a variety of reasons, including the chance of making money through quicker and better mining than their competitors, as well as the extreme volatility of the cryptocurrency's price. It's also worth asking how and by whom the Bitcoin price is set. Internal or external causes, such as macro-variables and pricing in other financial markets are driving the price of Bitcoin. When it comes to Bitcoin pricing, (Baek & Elbeck, 2015)argue that there is no substantial relationship between the latter (external basic economic variables) as well as variations in Bitcoin prices. They see this as proof that the Bitcoin market is still in its infancy and characterized by high levels of speculation.

3.1.1. Bitcoin as financial innovation:
Other cryptocurrencies have a larger reach and may be used in both directions in addition to only within virtual communities (ECB, 2012). Systems based on the Austrian School of Economics and Nobel Laureate Friedrich August von Hayek have a theoretical basis (Rogojanu & Badea, 2014). In Hayek's view, unfettered competition between private parties was the best way to develop a healthy and efficient currency.

The subset of digital currencies falls under the umbrella of virtual currencies (Chowdhury & Mendelson, 2013). They are more commonly employed in the broader economic system since they often operate independently of a specific counterparty (Bradbury, Appleby, & Key, 2014).

The peer-to-peer networking and cryptography used by bitcoin, the first of its type, ensure its integrity (Grinberg, 2011); (Kaplanov, 2012); (Lin, Harmsen, Baker, & Luco, 2013). Its creators developed the bitcoin in order to break away from the trust-based notion of current currencies and build a secure system based on cryptographic proof (Nakamoto & Bitcoin, 2008).

Bitcoin is now accepted not only for online services but also for a wide range of tangible things, whether they are acquired from a real store or online (Bradbury, 2014).

Virgin Galactic, an American space tourism company, used Bitcoin as payment for a space journey last year (Holpuch, 2013; Tong et al., 2013). (Yermack, 2014) argues that Despite the abundance of evidence to the

contrary, bitcoin's characteristics are more like those of a speculative investment. Uncertainty and volatility exist in the market's pricing. Whether or if bitcoin becomes a useful currency is immaterial; it has the potential to be a launching pad for new financial innovations (Economist, 2014).

3.1.2. Bitcoin: A developing market:

No macroeconomic variables, like as interest rates, GDP, or inflation, impact the value of bitcoin (ECB, 2012; (Kristoufek, 2013). It isn't tied to any other currency either. Exchange rates are determined solely by the forces of supply and demand. The price evolution of bitcoin can only be understood if we have a firm grasp of the market microstructure (Garman, 1976). With the advent of over 40 different exchanges, it is now feasible to swap conventional currencies for bitcoins (Bitcoin charts, 2014). The number of investors has risen substantially in the last few years, and there are now around 68,000 transactions every day (Bitcoin charts, 2014a). According to others, the market is controlled by technophiles, liberals searching for an alternative to national currencies, and criminals who take advantage of the transaction secrecy given by the blockchain technology (Grinberg, 2011); Yermack, 2014).

Bitcoin's low correlation to other assets has made it an appealing market for investors in these uncertain financial times (Brière & Proulx, 2013; Chowdhury & Mendelson, 2014). Since institutional investors are beginning to take an interest in bitcoin, the market is growing and the cryptocurrency is on its way to maturity (W. K. Chan, Chin, & Goh, 2020). Since it is still a developing market, Bitcoin has generated a great deal of discussion (Arthur, 2013; Rushe, 2013a) and (The Economist, 2013). Consequently, the media (e.g. Bradbury, 2014; Finextra, 2013) (Rizza & Ciattoni, 2013) and governments and institutions (e.g. Bloomberg News, 2013; ECB, 2012; Strauss, 2013) have covered bitcoin extensively and researchers (e.g. Brière et al., 2013; Chowdhury, 2014; Garca et al., 2014) are just getting started investigation of this market.

3.2. Analysis of bitcoin volatility with other financial assets

3.2.1. Correlation with S&P 500, Gold and Wheat:

For example, gold (the precious metal), wheat, and the S&P500 Composite Price Index (CPI) may be used to hedge the value of Bitcoin. S&P500 composite price index represents the market capitalization of 500 of the most notable publicly listed firms in the United States (Bouri et al., 2017) In addition to bitcoin and gold, we also highlight gold since both are highly valued due to their scarcity and because they are transnational in nature, as they are not controlled by any sovereign country (Dyhrberg, 2016). Because wheat is a non-energy commodity, it has been included. Wheat prices, on the other hand, have been quite volatile since

2008. (Pal & Mitra, 2018). In this paper, we demonstrate that hedging using bitcoin and gold is the most effective strategy.

Pearson correlations (of daily returns).

	BTC	S&P500	Gold	Wheat
BTC	1.000			
S&P500	0.012	1.000		
GOLD	0.064	−0.009	1.000	
WHEAT	0.015	0.030	0.024	1.000

Table: Correlation of bitcoin with other assets

a. Optimal hedge ratio between bitcoin and S & P 500 composite price index
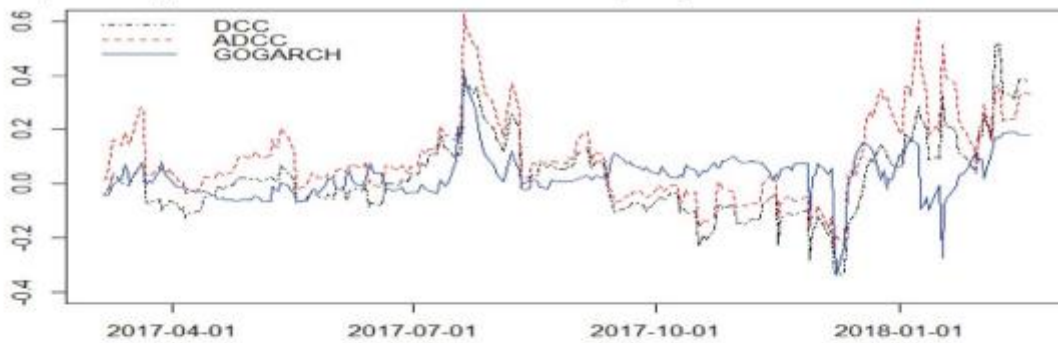
b. Optimal hedge ratio between bitcoin and gold
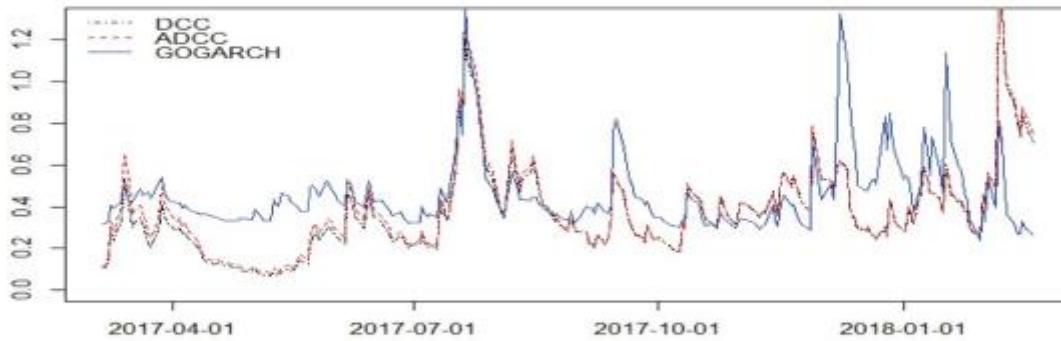
c. Optimal hedge ratio between bitcoin and wheat
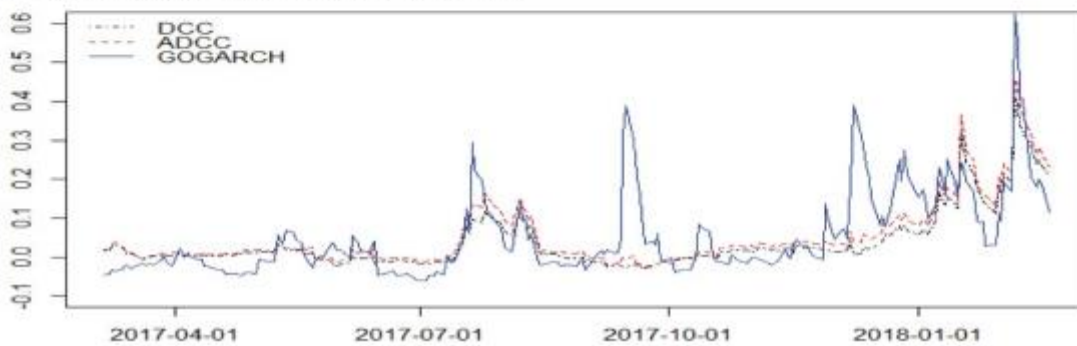
Fig:optimal hedge ratio of bitcoin with S&P 500, Gold and Wheat

Above the course of numerous projection periods, Bitcoin/gold has proven to be the most effective hedge according to GARCH requirements, i.e. gold is the preferred hedge to bitcoin over stock and commodities. As a consequence of these findings, it appears that the S&P 500 Composite Price Index, Gold, and Wheat can be used to hedge Bitcoin. In terms of hedging, GO-GARCH is more effective, and gold is determined to be a superior alternative to bitcoin. It is possible to hedge one dollar of bitcoin with 70 cents of gold in accordance with the GO-GARCH standard. Hedging other cryptocurrencies with equities, precious metals, and commodities may be the subject of future study.

3.2.2. Bitcoin volatility interaction with financial assets of different countries:

In order to assess bitcoin's worth as a financial asset, we will compare it to other financial assets. Many derivatives for risk hedging have emerged in the modern capital market, and research has been done on the connections between bonds, equities, and foreign currency rates (Hamrita & Trifi, 2011). Many studies have shown that studying the flow of information across assets may be beneficial for risk hedging. Oil and stock market volatility is influenced by gold and exchange rate volatility, according to an examination of information flow across assets; this knowledge is valuable for risk managers and investors looking to hedge their portfolio assets' risks effectively (Dimpfl & Peter, 2018). There's been a substantial correlation between stock market volatility and the behavior of the foreign currency market since the financial crisis of 2008 and this correlation has been greater since then. Traditional financial assets like equities, bonds, and mutual funds are strongly correlated with bitcoin. Bitcoin and other financial assets were ranked based on their ability to influence information flow.
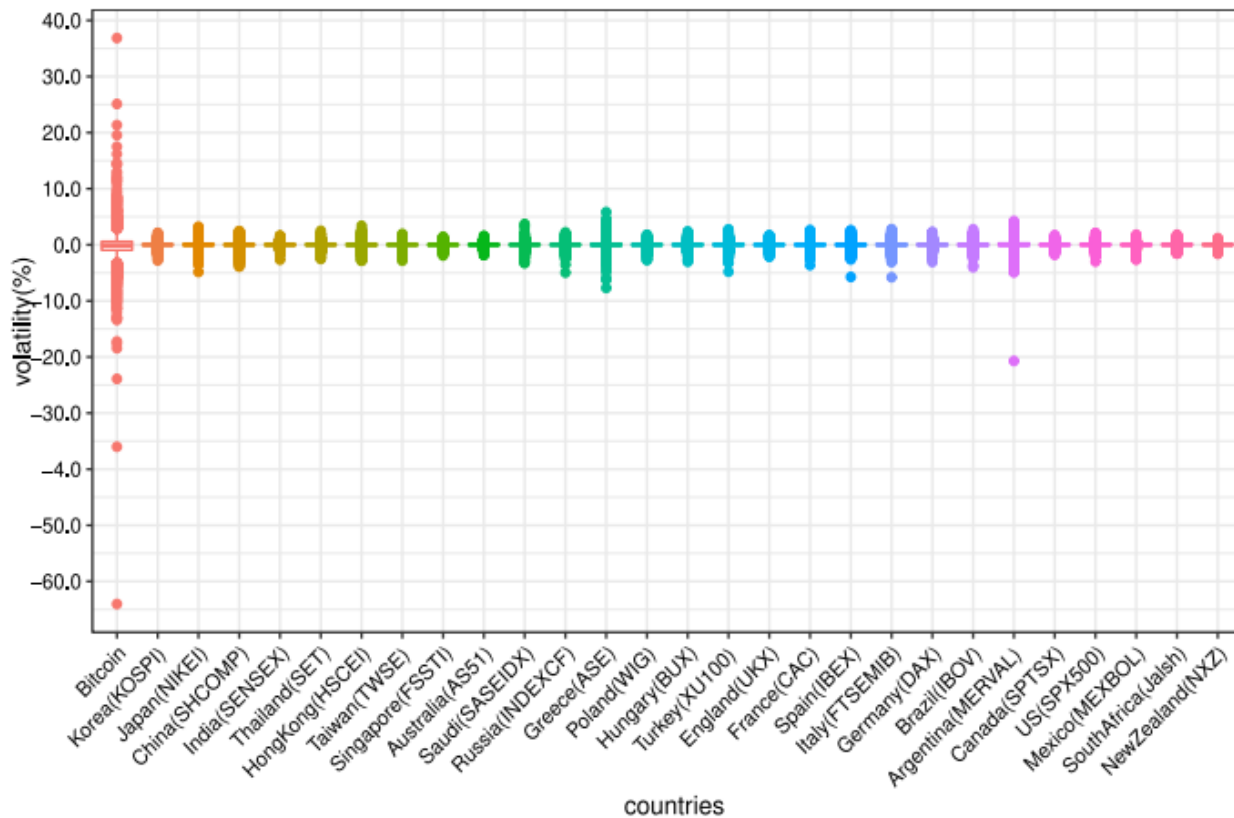
Fig: Daily volatility for bitcoin prices and financial assets

Coin prices in developed economies are linked to dollar values, according to recent research. The value of bitcoin is more likely to remain steady. Investors may use this knowledge to hedge against known risk in the Bitcoin market, which is impacted by recent severe exchange rate movements in industrialized nations.

Bitcoin and other financial asset prices are linked in 27 different countries throughout the world. The flow of currency rate information was more significant than that of other financial instruments such as shares and bonds issued by the federal government. Stock prices and the price of bitcoin showed a strong association in developed countries, and this correlation was stronger than in developing markets, where these financial assets had a smaller effect. As a result of our research, we think that bitcoin's value and stability as a financial asset may be increased, as well as the creation of more effective investment methods.

3.3.   Bitcoin volatility:

The degree to which the value of a financial asset fluctuates over time is referred to as its volatility. When an asset's value fluctuates widely during the day, it is considered volatile and hence unwise to keep onto it.

As an asset's volatility increases, so does the desire of investors to reduce their exposure to it. Hedging costs, which are a key factor in the cost of merchant services, are also impacted by volatility. Volatility in Bitcoin will diminish as a result of this, lowering the cost of exchanging Bitcoin for other currencies.

3.3.1. Why is Volatility important?

Risk management, market making, portfolio selection, derivative pricing and hedging, and a host of other activities all rely heavily on the volatility of the market. Getting a handle on Bitcoin's volatility is an important first step in determining its risk profile. Various models of volatility may be found on the market. Models using daily returns data, such as GARCH and HART, as well as high-frequency data-based heterogeneous autoregressive models with realised variance, may be used for this purpose.

Since its inception in 2009, the value of Bitcoin has fluctuated considerably. However, the comparison to other cryptocurrencies will have a significant impact. The degree to which the price of Bitcoin varies from its average over a certain period of time is a measure of its volatility.

Standard deviation = ((Bitcoin's opening price – Price at N)/N). Use the following formula to calculate the volatility of a stock over a certain time period: Timeframe x Bitcoin's price volatility.

Bitcoin and other virtual currency markets thrive on speculation. Bitcoin investors place bets on whether or not the price of the cryptocurrency will rise or fall in order to make money. As a result, Bitcoin's value might rise or fall at any time, resulting in volatility.

3.3.2. Bitcoin volatility index:

In the 30-day and 60-day periods, the standard deviation of daily returns These are historical metrics of Bitcoin price volatility. Bitcoin's implied volatility, a more accurate metric, will be available once the options market for the digital currency develops.

Bitcoin's historical volatility

Year	Average 30-Day BTC/USD Volatility
2010	6.21%
2011	8.26%
2012	4.50%
2013	5.50%
2014	5.06%

2015	4.26%
2016	2.49%
2017	4.13%
2018	4.58%
2019	4.06%
2020	5.17%
2021	4.56%

3.4. Bitcoin dramatic price volatility:

Bitcoin's price volatility is far greater than the volatility of equities, bonds, hard currencies, and commodities, according to Brière et al. (2013) and Chowdhury (2014) in their working papers on the subject. Furthermore, its lack of intrinsic worth and absence of regulation imply that it has distinct features from many other assets. Market structure and informational efficiency, according to (Madhavan, 2000), provide clues as to how prices are set. In finance, this is a hotly discussed topic. FAMA, 1970, proposes that information is absorbed into pricing as soon as it becomes available, while behavioral finance holds that investors' emotions and attention spans play an important role in the market's ability to respond quickly to new information.

Figure 1 shows the huge price swings that bitcoin saw in 2013 and the beginning of 2014. While perusing news headlines at times of extreme volatility, one finds numerous intriguing effects. During a single day in April of that year, the BTC value dropped by 160 dollars (Rushe, 2013b). However, the value of Bitcoin has increased from 20 USD/BTC to an incredible 266 USD/BTC in the two months leading up to today. Some believe that the capital limits in Cyprus sparked an interest in denationalised currencies, leading to this price surge (The Economist, 2013).
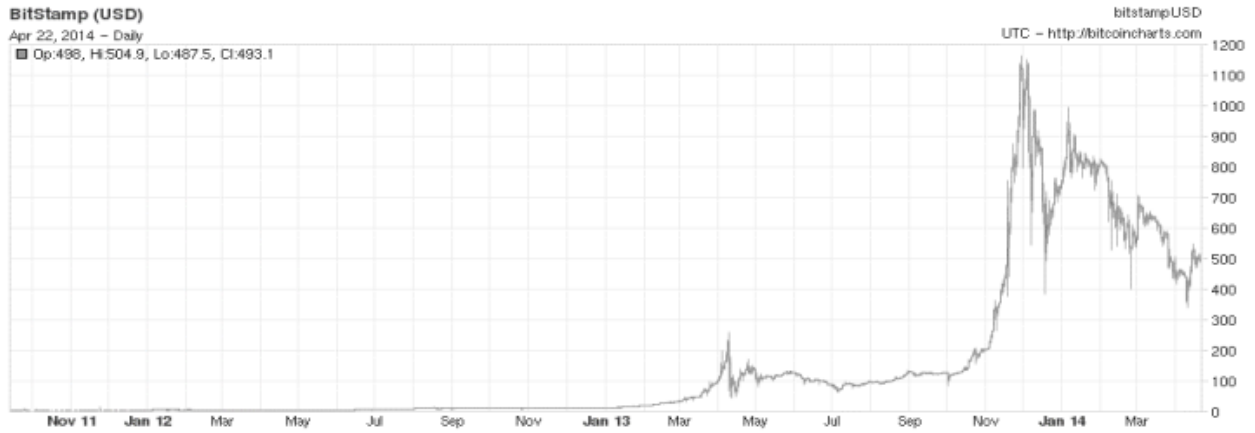
Fig 1: BTC price chart of Bitstamp (USD) (Bitcoincharts 2014b)

As with Baidu's decision to accept bitcoin payments in October 2013, the Chinese market's BTC demand soared, fueling the worldwide boom (Bloomberg News, 2013). One day after US Federal Reserve Chairman Ben Bernake made an official statement that bitcoin may have a bright future, the price of BTC surged by about $200 in a matter of hours (Strauss, 2013). 1.242 USD/BTC was the all-time high for bitcoin on November 29. (Kitco News, 2013). The former head of the US Federal Reserve, Alan Greenspan, believes that bitcoin is a bubble since it has any intrinsic worth (Bloomberg News, 2013).
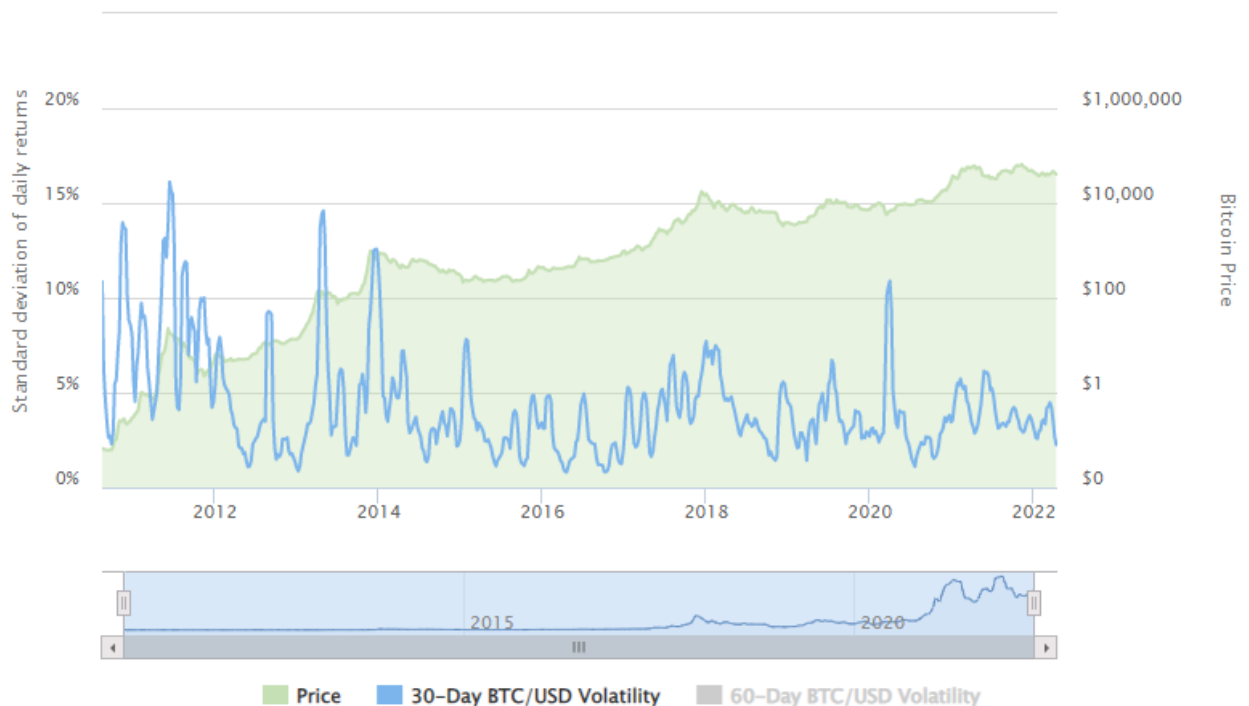
Fig 2: Bitcoin Price and Volatility chart

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3.4.1. Price analysis due to bitcoin volatility:

What's known as "Bitcoin Velocity" monitors how often one Bitcoin is utilised to buy goods and services. According to quantitative theory, the price of Bitcoin grows as Bitcoin's stock and velocity increase. As the economy of Bitcoin grows, so does the value of Bitcoin. To put it another way, if the dollar's value rises against the euro, the dollar's value will almost surely climb against bitcoin. If the value of the Euro/Dollar currency pair rises, the value of a currency declines.
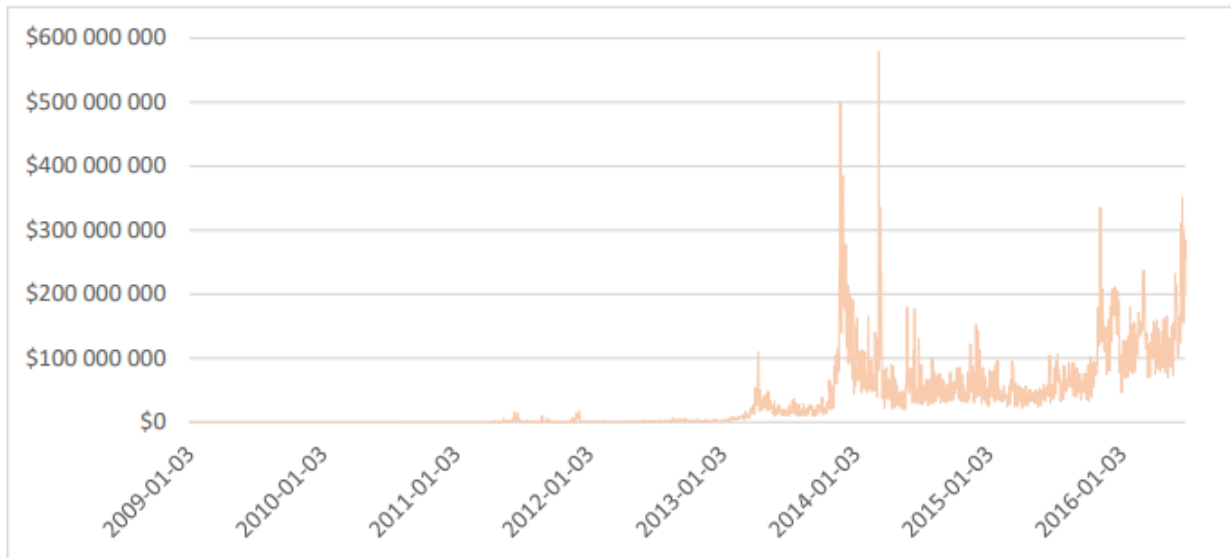
Fig 3: estimated transaction volume USD

After a period of significant volatility and market bubble behaviour, the price of bitcoin has gradually increased since January, reaching a value of about $770 USD on July 16th, 2016. Figure 4 depicts this data, as seen below.
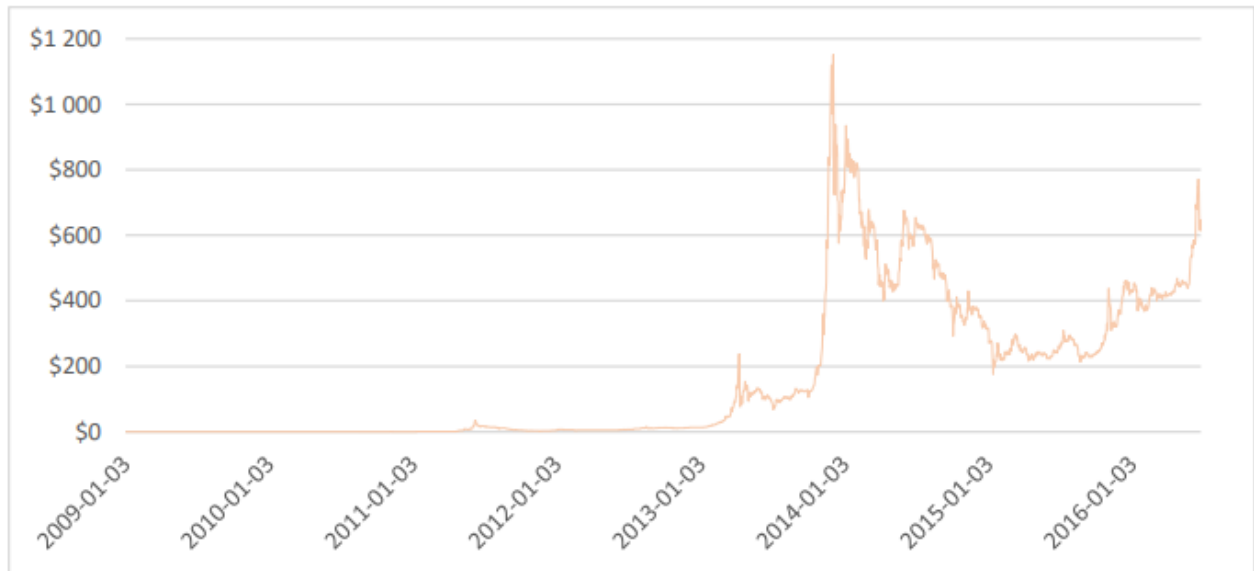
Fig 4: Market price USD

3.4.2. What drives bitcoin volatility?

After Bitcoin was made public in 2009, the price of a single token soared from fractions of a dollar to $0.09 around that time. For the last few years, its price has risen and fallen by thousands of dollars in a matter of days. Bitcoin's price swings can be attributed to a number of different factors. Investing, trading, or simply keeping tabs on its progress may all be aided by knowing the market elements that impact its price.

- Bitcoin's value is significantly influenced by supply and demand, much like other commodities, assets, investments, or other items.
- A large percentage of Bitcoin's current value is determined by market speculation regarding price changes, since it was swiftly accepted by investors and traders alike.
- Investors' fears are stoked by media outlets, influencers, outspoken industry moguls, and well-known cryptocurrency supporters.

For the most part, the origins of Bitcoin's volatility remain a mystery. The volatility nature of Bitcoin may be explained by studying the components of the currency's price development. In determining the cost of a product, demand-related variables are essential. As long as investors may be swayed by market circumstances and current events, the perceived worth of Bitcoins will vary based on public perception. Predicted future events have an enormous impact on how much Bitcoin is worth now (Brandvold, Molnár, Vagstad, & Valstad, 2015). According to this line of reasoning, Bitcoin's volatility may be explained by fluctuations in the currency's perceived value. The quantity of purchasers entering the market is directly

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connected to the variations in these prices (Ciaian, Rajcaniova, & Kancs, 2016). Sellers are able to exchange Bitcoin at a greater price due of a rise in demand. Due to the fact that sellers are primarily selling Bitcoin in order to realize capital gains, they have an incentive to act in this manner. To put it another way, anything that encourages more individuals to enter the market is likely to raise prices. Alternatively, sellers who seek to convert their Bitcoins into fiat cash must drop their prices when purchasers leave the market.

3.5. Drivers that create bitcoin volatility:

The price of Bitcoin and other cryptocurrencies fluctuates based on supply and demand and the perception of value. You can't get people to pay you for Bitcoin unless they feel the currency is worth what you're charging. A maximum of 21 million Bitcoins will ever be issued as part of the Bitcoin protocol. The closer Bitcoin approaches to its limit, the higher its price will be, as long as demand remains stable or grows.

At a predetermined pace, mining software and hardware generate bitcoins. Every four years, this pace is cut in half, resulting in a decrease in the amount of coins being produced. As long as Bitcoin's popularity grows, its supply may not be able to keep up with demand, resulting in an increase in its price. There will be more supply than demand if Bitcoin becomes less popular and less sought after, hence its price should decline unless it retains its worth for some other reason.

There are a variety of approaches to measure bitcoin's price swings and volatility. For the purposes of this chapter, we will discuss several factors and variables, as well as the effects they have on it.

Exogenous drivers

Supply and demand	Investors sentiments	Media hype	Government regulation
• Reward system	People's views	Google trends	Government interest
• Transaction cost	Market price	Snow ball effect	Tax
• Mining difficulty	Investor portfolio	Financial market	Unstable currency
• Coins circulation			

Endogenous drivers

Crypto market	Macro financial	political
Stock market	Adaptation	Popularity
Market trend	Gold price	Restriction
Speculations	Exchange rate	Others

a) Exogenous drivers include: supply and demand, investor and user sentiments, media hype and government regulation.
b) endogenous drivers include: cryptomaket, macro financial and political.

3.5.1. Exogenous drivers:

Supply and demand:

Supply and demand have a major role in determining the price of most goods. There is a direct correlation between the number of Bitcoins in circulation and the price individuals are willing to pay for them. It is designed so only 21 million coins are in circulation, and prices are projected to grow as the supply approaches this limit. No one can predict what will happen to Bitcoin prices after the cap is hit, and mining Bitcoin won't be lucrative anymore. As big financial institutions compete for ownership of Bitcoin in a falling supply environment, the price is anticipated to vary in response to any steps implemented.

BTC's price is mostly determined by the market's demand and supply for Bitcoin, as outlined by Buchholz. The entire amount of bitcoin in circulation, according to quantitative theory, specifies BTC's supply. Bitcoin's demand is determined by the volume of cryptocurrency transactions and the rate at which it emerges. What's known as "Bitcoin Velocity" monitors how often one Bitcoin is utilized to buy goods and services. According to quantitative theory, the price of Bitcoin grows as Bitcoin's stock and velocity increase. As the economy of Bitcoin grows, so does the value of Bitcoin. To put it another way, if the dollar's value rises against the euro, the dollar's value will almost surely climb against bitcoin. If the value of the Euro/Dollar currency pair rises, the value of a currency declines. BTC's value as a means of exchange is what fuels demand for the currency. The basic value of Bitcoin is not the same as that of gold or another commodity money. BTC demand is driven exclusively by its long-term value (e.g., the EUR / USD exchange rate), whereas commodities' inherent and future value drives demand for commodities, as well as their intrinsic value. Supply was governed by the number of Bitcoins in circulation, which could be a publicly known and set figure. While the external variables that affect Bitcoin's supply, changing production methods affect the supply of gold, which is self-sustaining. (As an example, gold mining methods and earnings). Expect price swings to be driven by demand-side shocks due to the wide range of Bitcoin's supply. Such demand shocks can have a significant impact on the price of bitcoin and the market's expectations for the future.

Investor and user's sentiments:

A rise in demand for Bitcoin is occurring because of a decrease in supply. According to the National Bureau of Economic Research, the top 10,000 Bitcoin investors would hold one-third of all Bitcoins by 2020, barring

individuals with less money from participating. For present, the SEC has not yet authorised any Bitcoin-backed securities, but as more securities are established, the number of institutions and significant investors that possess them is projected to grow. These investors have an impact on the volatility of Bitcoin. It's difficult for investors with Bitcoin holdings of more than a few million dollars to figure out how to get their money out of the cryptocurrency without affecting the market price. If the world's biggest investors suddenly decided to dump their Bitcoins, the price of Bitcoin would fall. Liquidity restrictions on most exchanges are $50,000 or less per day or less. Investors with large Bitcoin holdings may not be able to get rid of them soon enough to prevent huge losses. An investor with a larger portfolio could only sell one Bitcoin each day if the price of the cryptocurrency stays around $50,000. Investors possessing more than $50,000 in coins would be unable to sell them all at once, resulting in enormous and swift losses. Bitcoin's market staying power may be revealed by emerging technologies like decentralized banking and the metaverse, although it is yet uncertain if Bitcoin will have any value or utility in these systems.

The volatility of Bitcoin is also influenced by people's differing views on how useful it is as a store of value and a means of transferring wealth. With some degree of certainty, a store of value is an asset's function. Bitcoin is seen by many as a safe haven against inflation and a viable alternative to more traditional safe havens like gold or other precious metals.

Media hype:

To satisfy its readers and viewers, news and media sources often give information and forecasts from "experts" that are based only on their own personal beliefs rather than actual data. Bitcoin is frequently predicted to be worth hundreds of thousands of dollars in the near future by someone who has a lot of money invested in the currency. To counteract Bitcoin's market dominance, other cryptocurrencies are being promoted. Bitcoin's price is being influenced by all of this media coverage, mostly for the advantage of individuals who have amassed large sums of the cryptocurrency. As soon as Pro share announced it will be launching its Bitcoin Strategy ETF (exchange-traded fund) by the end of October 2021, the price of Bitcoin surged. As a result, the price of each coin surged by more than $69,000 after being made accessible on an official exchange for the first time. When the initial burst of excitement wore off and investors found that the ETF was related to Bitcoin via futures contracts offered on the commodities market, prices plummeted to about $50,000.

We looked at a variety of studies to see if the media's influence on public opinion, stock prices, and other markets may effect Bitcoin's price. A natural field experiment is used by (Pal & Mitra, 2018)to examine

whether the media influences voting decisions. People's choice of who to vote for is heavily influenced by their media exposure, according to this study. In this experiment, they use newspapers as their primary news source and self-report surveys to get data from their respondents. A number of researchers have looked at the link between news announcements, such as those from (Andersson, Eriksson, & Torstensson, 2006) and (Nikkinen, Omran, Sahlström, & Äijö, 2006) as well as Fang and Peress (2009).

Media impact on financial market:

It's clear from these pieces that the media can have an impact on financial markets in some way. Many studies have looked at various aspects of news and markets, but one thing they all agree on is that traders rely on public opinion and news releases to make predictions about the direction the markets will go. Insights from these researches are valuable because they shed light on what traders consider when attempting to forecast changes in the price of Bitcoin, assuming that investors in each market depend on information that is comparable.

According to Stenquist and Lonno (2017), social media can help anticipate the price of crypto currencies. Predicting the price of Bitcoin is easier than previously thought thanks to their ability to produce accurate forecasts. For example, Kaminski and (Lemola, Perkinson-Gloor, Brand, Dewald-Kaufmann, & Grob, 2015) uses tweets' emotional cues to anticipate the Bitcoin market's price movement. Positive Bitcoin tweets, for example, are associated with price increases, whereas negative Bitcoin tweets are associated with decreases in price.

Many studies, like those by (Nuti, Mirghaemi, Treleaven, & Yingsaeree, 2011), (Mai & Hoffmann, 2015) (Lamon & Habib, 2016), Bukovina and Marticek (2016), and (Matta et al., 2016), indicate that different types of social media have the same effect on adolescents. What these publications don't do is include broader media into their approach by connecting important news announcements to social media like twitter. It's not out of the question that social media activity is sparked by major media outlets. However, for the sake of our study, we are primarily interested in how important media releases affect Bitcoin's price fluctuations, rather than the transmission of significant media to social media sites. We need to distinguish between major and small media releases in order to show the connection between the two.

Google trends:

It is important to use Google Trends as a control variable and to measure public knowledge of a media release to determine wide public awareness. This year, Choi and Varian (2012) showed how Google trends might help predict economic indicators. Unemployment rates can be predicted, for example, based on

changes in the number of people seeking for work. Google trends may also be utilised as a predictor of customer confidence in this article, which is why it is included. Searches for hybrid automobiles and renewable energy have been linked to a decrease in trust in the oil and automobile markets. Similar reasoning will be used to analyse the link between Google searches and news events.

Most Bitcoin users will be able to tell from Google trends if an article has made an impact on them. Several studies have previously found a correlation between Google searches and the price of Bitcoin (Puri, Iung, Cohen, & Rodés-Cabau, 2016). Using the prior research as a foundation, we want to see how the price volatility of Bitcoin exchanges is affected by large media releases and Google searches.

Snow ball effect:

Public opinion may be swayed through the use of news to influence people's decision to buy or sell Bitcoin. Bitcoin's perceived worth and demand are influenced by the public's view (Stenquist and Lonno, 2017). As Bitcoin's price fluctuates, the public's perception of its value is further influenced by the news, resulting in a snowball effect.
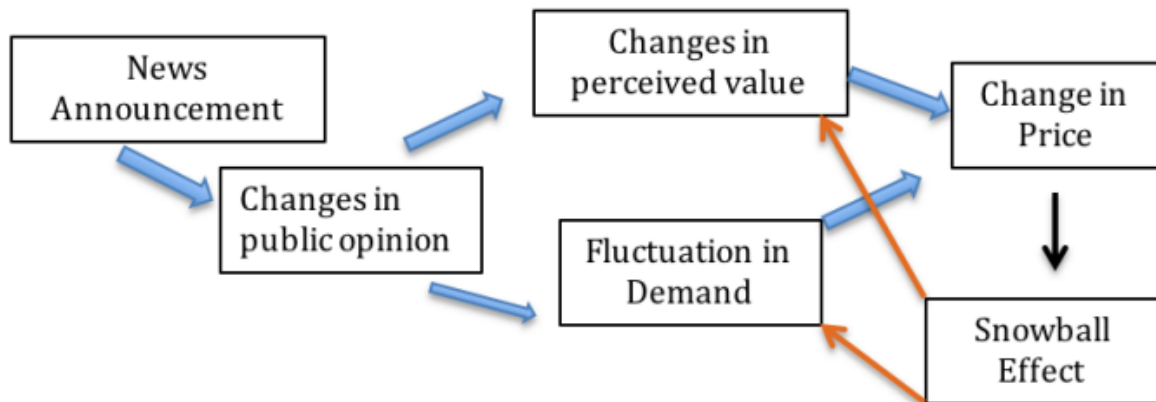
The idea of the "snow ball effect" holds that the first shift in public perception caused by breaking news may have only a modest influence on the market. However, even a tiny influence may have a significant effect on the market since it influences more people's opinions. This is because purchasers in the market base their investment decisions both on expected changes and on currently observed fluctuations in the price of Bitcoin.

Bitcoin market volatility is depicted in a flowchart. It is not certain how long or how much the snowball effect will affect or increase Bitcoin's price, despite its immediate impact. If the effect persists, the public's

perception may be altered again by a subsequent piece of news. In February and March of this year, a succession of bad news releases linked with a prolonged period of decreasing prices, which is evidence of this (Bitcoinity, 2018). There was a significant drop in transactions during this timeframe, according to BlockChain 2018. It is possible that investors exited the market as a result of declining prices and a lack of confidence that prices would rise again soon.

Government regulations:

You must pay taxes if you use Bitcoin because of the IRS's position. However, taxes do play a role in Bitcoin's market price—but only if the tax laws change often and generate investor anxiety. In 2021, China's government and central bank stated that all transactions or facilitation of transactions involving cryptocurrencies would be outlawed. In May, the State Council Financial Stability and Development Committee held a meeting that led throughout a significant shutdown of cryptocurrency mining farms in the nation. Bitcoin's price decreased to $29,700 by August 2021 as miners rushed to migrate after news of a push to halt mining in the country, which was disclosed in May. Gold has been used as a currency for a long time. When it comes to price, demand and supply stability, it is a fairly steady commodity. Furthermore, fiat money has been present for a long time; while exchange rates between nations vary and are a bit turbulent, their values are to some extent predictable depending on the issuing country and its economic situation. For the time being, Bitcoin is still in the price discovery stage. A steady point may not be achieved until the early growing pains and worries are worked out by investors, end-users, and governments.

The way Bitcoin is taxed and regulated by the government may potentially increase its volatility (Barker, 2018). Investors might use tax and regulatory incentives to decide whether or not to participate in a market. Bitcoin's regulation and taxation by governments indicates that the money is being accepted by the country's leaders. Investors gain confidence in the long-term viability of Bitcoin in this perspective. Taxation and regulation, on the other hand, reduce the fundamental value of Bitcoin over fiat currency.

As a result of regulations and taxes, some of the market's original purposes have been lost. Anonymity, cheap money transfers, and the acquisition of unlawful goods are only a few examples (Barker, 2018). In the words of (Barker, 2018) Governments would want to abolish the anonymity of crypto currency transactions in order to prohibit the acquisition of illegal goods. Governments, on the other hand, want to benefit from cryptos' capital gains by imposing new tax rules. Governments throughout the globe might benefit from a new source of revenue if they impose taxes on Bitcoin.

It is in the interest of governments to raise the cost of Bitcoin transactions in order to boost the competitiveness of their own currencies as a means of payment. to keep their monetary systems in place, governments want to keep Bitcoins from displacing their own currencies (Barker, 2018). Government action in Bitcoin is probable if it continues to grow in popularity, but it is not yet apparent what governments across the world would do to regulate it. Those who worry that rules and taxation may outweigh the benefits of Bitcoin may be less inclined to utilise the currency in the first place. In this respect, regulation and taxes will diminish the demand of Bitcoin, which in turn should push sellers to lower the market price. The public's reaction to new regulations and taxes will determine whether regulation decreases or increases demand. Predicting how the public would react is impossible because of a lack of evidence.

Will the benefits of international regulation of the Bitcoin market offset the risks of legitimization in governments' eyes? The public's perception of future policy can be swayed by the news and media. If Bitcoin's volatility can be stabilised, as suggested by Cermak (2017) and Yermack (2013), it will be safer and easier to handle for governments. In this study, we're looking to see if news updates affect Bitcoin's price volatility by changing people's perceptions of the digital currency.

3.5.2. Endogenous drivers:
Crypto market:

First and foremost, Bitcoin pricing is determined by the risk and unpredictability of the Bitcoin system as a whole. Due to the fact that Bitcoin is a fiat currency, it is basically useless, since it lacks any intrinsic value that is generated by its usage or the process of its creation. The value of fiat currencies was built on the assumption that they would be useful in the future as a medium of exchange and would thus be preserved. For BTC, which is currently expanding its market share by establishing the trustworthiness of market participants as a relatively new currency, the expectations of trust and acceptance are particularly critical.

Second, because BTC is a virtual currency, it is more vulnerable to hacking than traditional currencies. This might lead to the collapse of the whole Bitcoin system and the eventual annihilation of the cryptocurrency. Attacks of this type have been seen often in the Bitcoin system in the past. During their 2013 investigation, Moore and Christin found that 18 separate Bitcoin markets had been shut down because of hacker attacks on their security, with the world's largest Bitcoin trade platform falling in 2014 as well.

Third, the interest of prospective investors in Bitcoin as an investment option might have an impact on its price. Investors' judgments may be influenced by changes in the media's coverage of a company. Bitcoin price fluctuations may be attributed to either positive or bad news, according to a 2018 study by Kristoufek.

Furthermore, there are a number of different investment possibilities that are less expensive, and here is where the knowledge plays a crucial role.

The cost of acquiring information about prospective marketplace investment possibilities has an impact on investment demand, as can be seen in the stock market and how potential investors may choose investment ideas from media in order to cut search costs. A rise in investor interest might drive up the price of bitcoin. It was indeed the case that Lee produced evidence for BTC in 2014, which suggested that considerable price cycles were generated by the volatility of positive and unfavorable news cycles. The type of news that is most prevalent in the media at a given moment might have an impact on the price of Bitcoin. To put it another way, it is possible that the press's coverage of Bitcoin can have a good or negative impact on the currency's value.

Macrofinancial:

There are several ways in which financial and global macroeconomic variables might affect the price of BTC. There might be a rise in demand for Bitcoin as a marketing and sales tool if the macroeconomic situation improves.

Because of the decline in stock prices, international investors are forced to sell their stock market investments. Coinciding with this, Bitcoin's value might rise as a result of currency devaluation. Short-term and long-term fluctuations in the DJI (Dow Jones index) have an influence on cryptocurrency prices. BTC's value is negatively affected by the Nikkei 225 index, indicating that it is more tightly tied to the US economy than the Japanese one. For investors, Bitcoin's opportunity costs may be recouped by stock market profits. There is a strong link between the Bitcoin price and stock market indices. An empirical study may help policymakers who are worried about market efficiency in this early stage of the Cryptocurrency market improve their long-term volatility estimates. The work of Urquhart, 2016, Nadarajah & Chu, 2017, Bariviera et al., 2017, Kristoufek, 2018, and Alaoui et al., 2018 on the efficiency of the Cryptocurrency market is pertinent here, as is Malkiel's (1989) theory of financial markets' efficiency. It is likely that cryptocurrency markets will be less efficient since they are so young in comparison to the stock market, which might lead to more predictability. Despite the conflicting results of recent empirical studies on Bitcoin and other Cryptocurrencies' efficiency, there is evidence that market efficiency develops over time. According to Baek & Elbeck (2015), there was no evidence of predictability, however more recent research have provided contrary data (Urquhart, 2016, Nadarajah & Chu, 2017, Bariviera, 2017, Kristoufek, 2018, Sensoy, 2019) that demonstrates the capacity to foresee Bitcoin volatility.

Global economic and financial reasons are more important than country-specific ones in driving volatility in the cryptocurrency market. Fang and colleagues (2018), and Conrad et al (2019).

Cryptocurrencies' volatility is influenced by the global business cycle, rather than country-specific economic or financial causes. Cryptocurrency market volatility is not affected by increased trading activity and market share in emerging economies. Policy alterations, by contrast, have a short-term effect but may be substantial. Although the largest predictor is global real economic activity, other external indicators like the global financial stress index and the Chinese policy uncertainty index provide crucial information and assist to diversify the effect. As a result, we may infer that the cryptocurrency market is not driven by a single factor but rather by a network of interrelated forces.

Political:

The news events that worry bitcoin customers are the result of geopolitical crises and official statements that the cryptocurrency sector will be regulated. A slew of heinous celebrities were among the first users of these cryptocurrencies, making headlines and scaring away would-be investors. Since bitcoin's birth, the collapse of Mt. Gox and the insolvency of Yapian Youbit, a South Korean stock exchange, have both garnered headlines in the last decade or so. Bitcoin's usage to buy narcotics through the Silk Route, which was shut down by the FBI in October 2013, was another breaking news event that shook investors. As a result of these events and the public outrage that ensued, the value of bitcoins dropped in comparison to fiat currency. Investors saw this as proof that the Bitcoin market has matured to the dollar in the short period after the subsequent news events.

For one thing, cryptocurrencies' unique ability to hold value may be one reason why they're not as stable as conventional currencies. The characteristics of Bitcoin are similar to those of gold. As a result of this restriction, only 21 million BTC may be mined at a given time. Governments actively manage it to keep inflation low since it differs greatly from fiat currencies. investors' decisions to allocate more or less of their assets to cryptocurrencies when economies based on fiat currencies demonstrate importance of resilience or fragility are an important consideration.

3.6. Some other factors influence on bitcoin price:
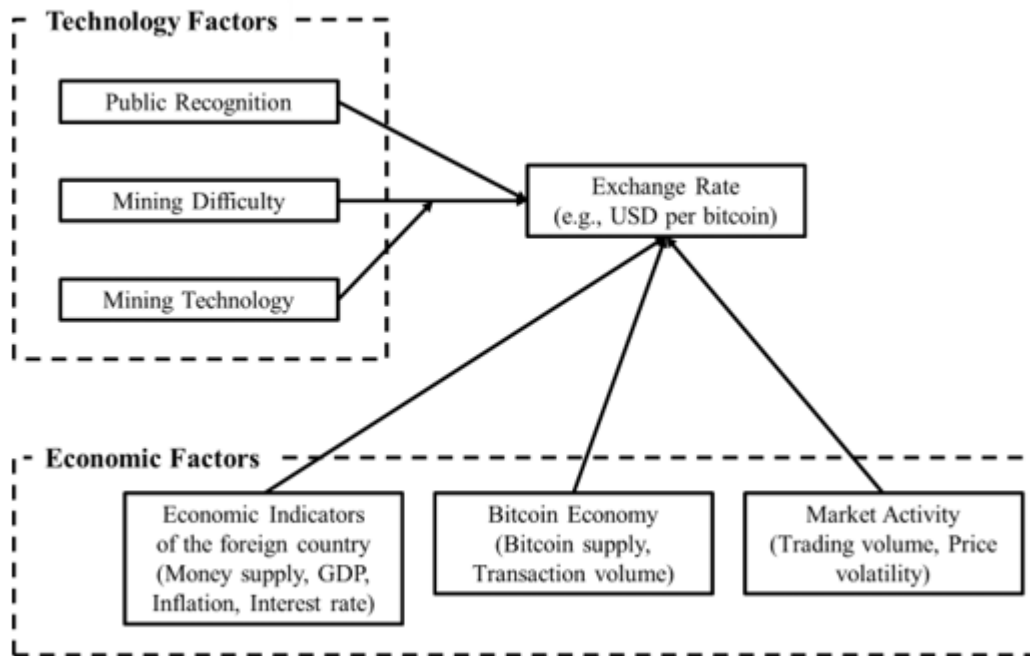
3.6.1. Technology factors:

Mining and ledger protection:

The Bitcoin system revolves around mining. Bitcoin miners use their processing power to secure transaction records by hashing, and they are rewarded with fresh bitcoins. The Bitcoin mining method is unique. The rise in Bitcoin's price First, Bitcoin's mining process is similar to that of commodity money. gold. Mining cost impacts commodities money price (Shafiee & Topal, 2010). In IS Existing study shows that virtual currency value is based on users' time and effort. monetarily (Peng & Xu, 2009). Because bitcoin mining requires a lot of expensive hardware, these expenses should be reflected in the exchange value. The mining difficulty in the Bitcoin system is based on the average amount of effort a valid hash requires. Mining difficulty is an excellent predictor of miners' average cost, even if it is impossible to track down the costs of individual miners.

Second, the Bitcoin system's sturdiness is captured by the difficulty of mining. As a result, the pace at which Bitcoin is mined is controlled using a target hash rate. When more processing power is committed to validation, the target rate rises. problems. The act of mining is a way for Bitcoin's infrastructure to verify and secure recent transactions. A lower chance of retrieving a valid hash is indicated by a greater target

hash rate. By hashing and altering transaction records, this improves system security. Prior Security appears to be important in system value (Chai, Kim, & Rao, 2011). Thus, the trade Bitcoin's payment value should rise with mining difficulty.

Public recognition:

Bitcoin is a blockchain-based peer-to-peer payment system. The value of a network product or peer-to-peer technology is impacted by the network's effects, as is true for all such products and technologies. Meaning that a system's value rises according to the number of users (Tucker, 2008) who make use of it. It is reasonable to assume that the value of Bitcoin will rise or fall in direct proportion to the level of public acceptance and use. Perception of the technology influences a person's intention to use it, which in turn is impacted by variables such as the availability of information and social norms (Davis, 1989; Venkatesh, Morris, Davis, & Davis, 2003). This will have an effect on both the overall value of the Bitcoin system and the Bitcoin exchange rate.

Economic factors:

As was seen during the COVID-19 outbreak, the price of Bitcoin may be affected by external economic factors as well. Aside from supply and demand, Bitcoin's price is also influenced by investors and financial organisations that utilise it to hold value and create profits. Brokers, investors, and traders build and trade derivatives in order to further impact Bitcoin's price. Because demand rises and falls with investor moods (speculation), investment product hype, irrational exuberance, or investor panic and fear, Bitcoin's price may also be anticipated to be affected.

The price of Bitcoin may be affected by the performance of other cryptocurrencies as well. It's becoming increasingly common for regulators, institutions, and merchants to accept cryptocurrency as a form of payment and money, and the number of cryptocurrencies is only going up. Finally, if consumers and investors feel that alternative coins will prove to be more valuable than Bitcoin, demand will decline, bringing prices with it. Or, if emotions flip in the opposite way, demand will climb, taking prices with it.

Economic fundamentals:

As a means of trade, Bitcoin should have a value that is consistent with predictions made by economic theory. Much study has been done on traditional currency exchange rates (Castillo-Maldonado & Pérez-Macal, 2013; Cheung, Chinn & Pascual, 2005), for example.

8 Because of PPP, even if the nominal currencies of two nations vary, their long-term buying power should be similar (Dornbusch, 1976). The exchange rate between two countries should be determined by the Consumer Price Index ratio in order to preserve purchasing power parity (CPI). There is an assumption in the sticky-price monetary model that economic conditions and monetary policy have an impact on the economy (Ho, 1993; McCallum, 1994).

Coincidences between monetary policy and economic conditions in the Bitcoin economy and those in other countries are thought to impact exchange rates for Bitcoin. The basics of the economy may be easily assessed and are not subject to additional discussion.

In the Bitcoin economy, however, economic fundamentals have a distinct character. It is not necessary to rely on national or institutional credit or commodities in order to use Bitcoin's credit system. Due to difficulties in quantifying commercial activity in the Bitcoin economy, the Bitcoin economy's inflation rate cannot be defined and measured.

Speculation and exchange market activities:

The early trading of bitcoins has been attributed in part to speculative activity (Bouoiyour & Selmi, 2015; Cheah & Fry, 2015). Speculative trading practices, such as making investment decisions based on incomplete or irrelevant data or on the principles of Chartism, are common in the commodities, securities, and foreign currency markets (Vitale, 2000). During times of high market volatility, speculative trading is a must-have component of the financial markets. It is possible to increase market efficiency by encouraging market participants to trade and raising liquidity via speculation. According to theory, the short-term impact of market speculation is projected to outweigh the long-term effect. When trading is scarce and the worth of an item is uncertain, speculation may have a long-lasting influence on the asset's price. Because of the novelty of a new money system like Bitcoin, the media has paid close attention to it.

The Bitcoin exchange market has been vulnerable to speculative investments since the market lacks basic grasp of the technology and there is no agreement on the future. Early in Bitcoin's life, this was especially true: Using market activity indicators like trade volume and volatility in the exchange pricing model is a typical way to capture the influence of speculative trading.

Research framework:

Bitcoin mining expenses seem to have a time-varying effect on the exchange rate, according to our analysis. In addition, as in prior studies, we take into account public-recognized factors. From an economic

perspective, both the Bitcoin economy and the economy of a foreign nation are examined. Volatility and transaction volume are two indicators of speculative activity in the market. While the framework creates an organized vision, it also incorporates other aspects that synthesize and expand prior research.

3.7. The three economic generations and their price history comparison:

When Satoshi Nakamoto, the mysterious creator of the first cryptocurrency, released Bitcoin (BTC), he projected that cryptocurrencies will eventually overtake the financial system. When he predicted that this would happen between 2020 and 2021, no one believed him. It is only when all of the world's assets decline due to the pandemic that "safe havens" like gold and oil appreciate.

Bitcoin's fluctuating price reflects investors' excitement and disillusionment with its promise. After the financial crisis of 2008, Bitcoin's secretive creators, known only as "Satoshi Nakamoto," envisioned it as a method to bypass conventional banking institutions and be used as a medium for everyday transactions. Traders who are betting against the currency's shifting value have taken notice of its rising prominence as a means of exchange. On the other hand, Bitcoin may also be used to hold money and act as a hedge against inflation. Although this new tale has greater credibility, price fluctuations of the past were mostly driven by individual investors and traders gambling against a growing price without much foundation in reason or facts. Since then, however, the price of Bitcoin has seen a dramatic change in narrative. Regulations for institutional investors are being developed specifically for the cryptocurrency markets as they mature. However, despite the volatility of its value, Bitcoin is becoming more widely used than only as a speculative tool by the general public.

3.7.1. 1st Generation (2009-2013):
When bitcoin was first introduced, it was unknown and undervalued. You could transmit any amount you wanted because the demand was so low. Gambling service software and business concepts were not able to deal with the lack of congestion. The infinite-capacity blockchain was used as a signalling layer by Satoshidice to send a 1-satoshi payout to losing bets. All of it was free.

As a brand-new and little-known technology, Bitcoin was a mystery. In order to grasp how its components interacted, it was difficult to imagine what this might entail in the future. This was made even worse by a number of circumstances, including:

It was a huge draw for fraudsters because of the anonymity and absence of central authority, which made it impossible for actual information to permeate and also sparked widespread suspicion.

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Because of the system's success, others have attempted to duplicate it (often with the sole purpose of making money), almost invariably with little comprehension of the system as it was originally designed.

In addition to the typical tribalism of a newly formed group, the early adopters had a clear financial stake in adoption. It was incredibly difficult for any inconvenient truths to reach the larger ecology as a result of the resultant euphoria.

In the end, there was shockingly limited knowledge that this era of "free money" was not the natural condition of bitcoin. Because they were aware of the problem, the reference client's developers incorporated certain customizability options to limit the worst-case scenarios. Adding a minimal fee, stopping relaying small payments, and enhancing the scripting language to limit the space taken up by unspent outputs did not modify bitcoin's default behavior.

Comparison of bitcoin price fluctuation in 1st generation:
There was no money exchanged between August 18, 2008 and January 1, 2009. Nobody was aware of Bitcoin at the time. Bitcoin.org was registered and the blockchain was being constructed, but no other domains were registered or used. 2009 (January 1st to 30th) Is of little or no worth at all. The only people who sent bitcoins were crypto enthusiasts doing so as a pastime rather than on an exchange. Little or no value could be found in the coins. When "SmokeTooMuch" put 10,000 BTC on the auction block in March of that year, no one bid. On October 5, 2009, one dollar equaled 1,309.03 BTC. There has been a release of the first Bitcoin-to-dollar rate: 1 dollar equals 1,309.03 BTC. The New Liberty Standard Stock Exchange is now open to the general public. $ 0.003 in March of 2010 The now-defunct BitcoinMarket.com exchange discontinued operations on March 17, 2010. Less than a penny in May 2010.

On May 22, 2010, Laszlo Hanets purchased two pizzas in Jacksonville, Florida, for 10,000 BTC, his first real-world transaction. In July of this year, $ 0.008. Within a span of five days, the price went from 0.008 to 0.08 dollars for each coin. $1.00 from February 2011 to April 2011. Bitcoin and the dollar are now equal in value. 8th of July, 2011 $31.00 When the first price bubble reaches its apex, the first decline occurs. $ 2.00 in December of 2011 That was the lowest point in Bitcoin's history. $13.00 in December of last year Slowly increases during the course of the year. 11th of April, 2013, $266 It was at this point that the price surged 5 to 10 percent every day. 130 $ in May of 2013 Basically, the price has stabilised and BTC has begun to rise again. $ 100 in June of 2013 In June, it falls to $70, but in July, it jumps to $ 110. $ 350 - $ 1242 in November 2013 From October to November, the price rises from $ 150 to $ 200 to $ 1242. (November 29, 2013.) $600

to $1,000 in December 2013 When the price plummeted to $ 600, it rallied and then sank back. The price eventually settles around the $650–800 area.
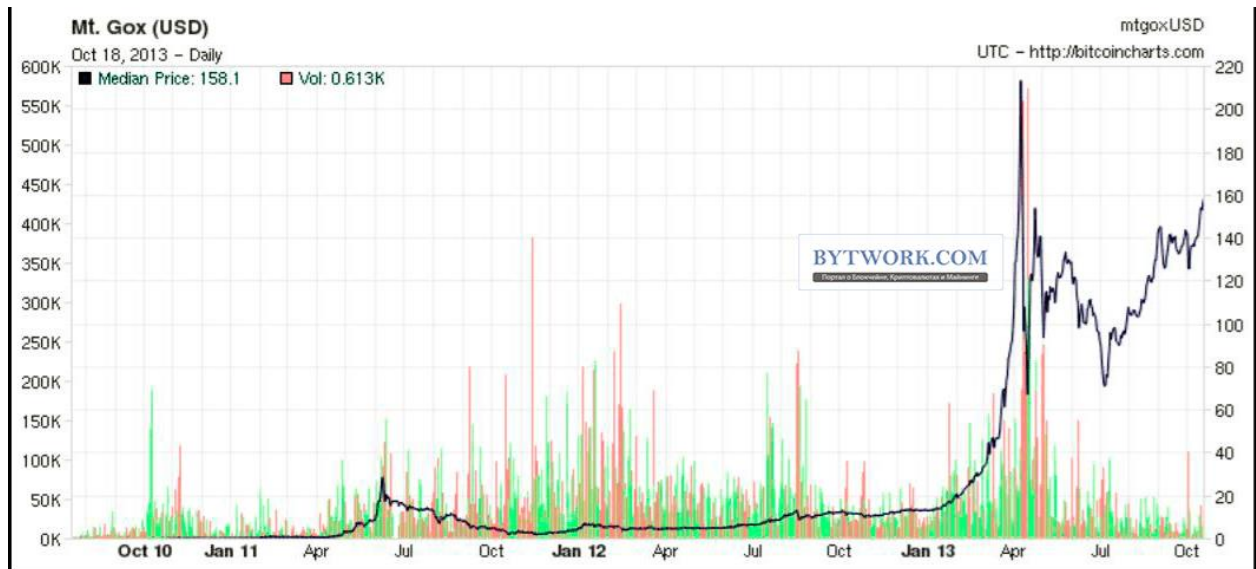
BTC's history value is shown on the chart, as well as the Bitcoin market capitalization's logarithm and key dates.

The conclusion of this comparison is that the value of Bitcoin was zero when it was initially created in 2009. On July 17th, 2010, it was trading at $.091. Bitcoin's price rose 2,960 percent in three months, from $1 on April 13 to a high of $29.60 on June 7 of this year. Midway through the month of November, Bitcoin's price had dropped to a low of $2.05, and the cryptocurrency market had gone into a severe recessionary phase. On May 9 of the next year, the price rose to $4.85; on August 15, the price rose to $13.50.

Compared to 2012, 2013 was an eventful year for the Bitcoin market. Priced at $13.28 at the start of the year, it surged to $230 on April 8 before plummeting to $68.50 a few weeks later on July 4 in an equally quick decline.

3.7.2. 2nd Generation (2013-2017):

Bitcoin's fluctuating market and the bursty statistical nature of block manufacturing led to capacity challenges. There was a growing sense that the First Era was in danger because of these issues, which had previously been addressed by code optimizations and modifying settings by miners. It was inevitable that many sought to extend the free ride. As a result of software and services being unprepared for dynamic fee conditions, and the inherent difficulty of dynamic fee conditions itself, this strain was exacerbated. It proved to be impossible to accurately predict what amount would enable a transaction to go onto the next block.

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Many reasons contributed to the developers' unwillingness to approve an ill-advised increase.

- There had previously been a period where over half of the network was under the authority of a single pool due to previous growth on the network.
- This would be the first time since Bitcoin's inception that a modification would be backwards-incompatible.
- It's risky to give a "one-time" boost since expanding is seen to be cheaper and easier than developing improvements.

Despite the fact that the shift was foreseen, neither software nor services were prepared. Possibly because they didn't trust the shift would actually happen. Developers prefer to follow rather than lead the community. Changes that have a large financial impact or are politically charged bolster the impression that developers are too reliant. Transitions in a big, complex system should be as gradual as feasible in order to prevent unforeseen consequences. As the Third Era approaches, the Second Era offers a gradual transition, giving software and services time to develop expertise with bitcoin in its final form.

What year is it? 2013 or 2017?

The answer to this question may be more difficult to give today than you might anticipate for bitcoin investors, traders, and fans. In the midst of increased volatility and concerning – though not clear – news out of China, Bitcoin prices climbed past the $1,100 mark this week (near all-time highs). When taken as a whole, the recent happenings bring back memories of the bitcoin price spike of 2013, which brought the digital currency to the attention of the rest of the world.

There was a strong sense of optimism among traders in both rallies, and both rallies would meet headwinds from China's developments. Even while digital currency exchanges (where most trades take place) have fundamentally changed since 2013-2014, the public interest in digital currency as a whole hasn't (and its underlying blockchain technology). Do the two bull runs compare favourably? Data from the CoinDesk Bitcoin Price Index and Bitcoinity, as well as comments from industry insiders, are used to compare and contrast the two.

Even though price data is useful, it only provides a partial view. With this information, one may acquire a better understanding of the ecosystem variations between now and then by comparing rally volume data from before and after each rally. We'll turn to Bitcoinity, a data company that releases information on

bitcoin trading exchanges throughout the world. Using a five-year period prior to the 2013 run, let's take a look at the volume picture.

Comparison of Bitcoin price fluctuation in 2nd generation:

$ 550 - $ 750 in February 2014 Mt. Gox's suspension led to a drop in the price before it rebounded to between $600 and $700. 450-700 dollars in March 2014 Uncertainty over whether the Chinese government would seek to prohibit banks from dealing in digital currency exchanges caused the price of Bitcoin to continue to plummet. 200,000 to 300,000 yen Until early 2015, the price had fallen. Three hundred ninety-five and four (395) Value increased dramatically from $ 225-250 in early October to $ 504 in 2015, which was a new record high. May-June 2016: $450-$750 per week. Value skyrocketed from $ 450 to $ 750 in a short period of time. Prices have maintained at $ 600 and $ 630 in July and September of this year. A fall in the Chinese yuan's value versus the dollar helped Bitcoin soar to a high of $ 700 in October and November of 2016. The price fell by 30 percent throughout the week, reaching a multi-month low of $ 750, on January 5-12, 2017. A BTC was first valued at over $ 3,000 on August 5, 2017. On August 12, 2017, for the first time, the price of one Bitcoin (BTC) crossed the $4,000 mark. A week after that, the price of a single BTC reached a new all-time high of $4,400 and $ 5000 in September of 2017. September 1, 2017, marked the first time that Bitcoin traded at or over $ 5,000. 12, 2017 $ 5,519 to $ 6,295. As Bitcoin Cash's price rose beyond $ 2,477.65, or 2.2-2.5 times the cost of one bitcoin, this resulted in a surge in demand. 29th of November, 2017; $11,000. It's the first time that Bitcoin has surpassed $11,000. $ 14277. Despite falling below $ 14,000, the price of Bitcoin rebounded to $ 16,250 on the same day. $15,790, on December 15th, 2017. It's now $17,900 for one bitcoin. 22.12.2017 13800 $ In a single day, the price of bitcoin drops by $ 14,000, a 33% decline.
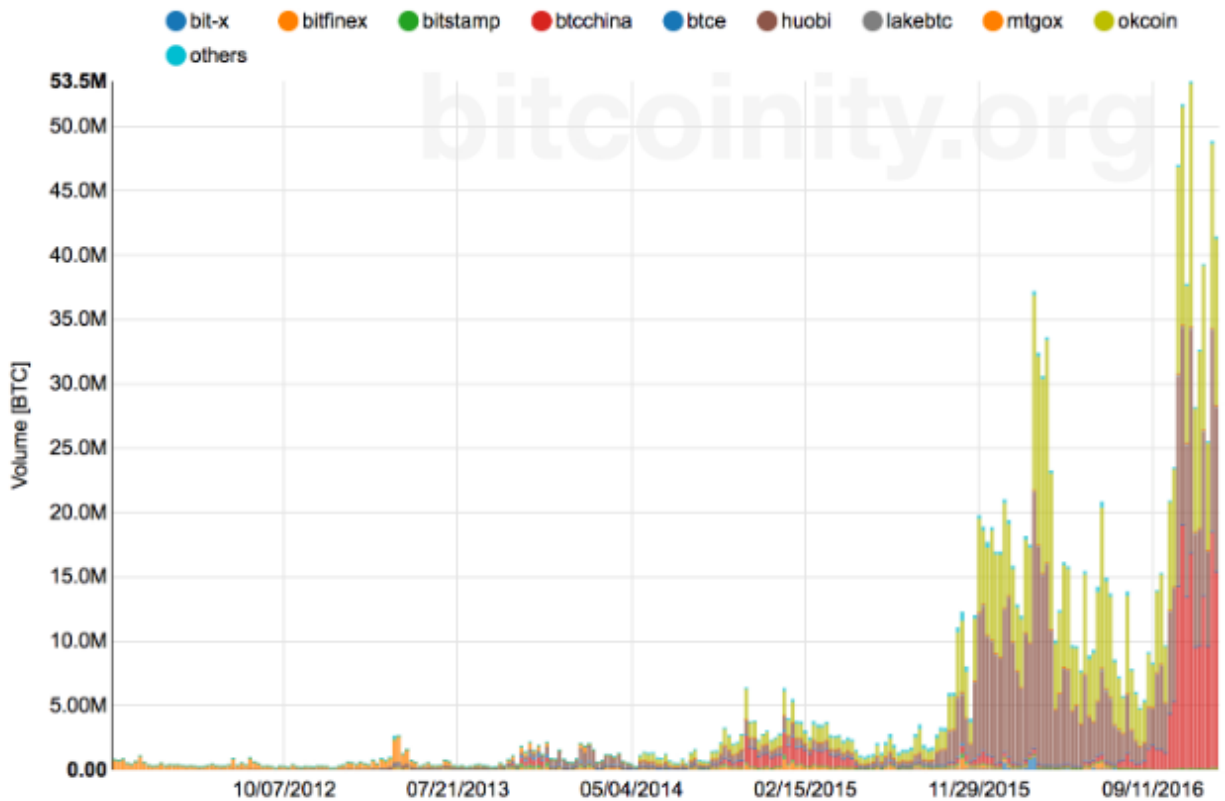
Volume is higher in 2ⁿᵈ generation:

Starting in 2013, most non-OTC bitcoin trading traffic was routed through the now-defunct bitcoin exchange Mt Gox, which accounted for as much as 90% of global trading volume.

Compared to today's landscape, which features numerous Chinese-based exchanges hosting the majority of trade, as well as Bitstamp, Bitfinex, and Coinbase servicing significant chunks of the market, this is a stark contrast.

According to the data, trade volumes in Bitcoin (BTC) were substantially smaller back then.

The data shows a significant difference: traders are just exchanging more bitcoins, which might be due to an increase in algorithmic trading, an increase in the number of traders, or other variables that aren't immediately evident. Some of this notion can be confirmed by Bitcoinity's data on the number of transactions each minute.

The distinctions between the two rallies become more apparent when looking at the volume picture.

In a more sophisticated exchange ecosystem, trading has taken place over a greater range of exchanges. Furthermore, trade was restricted to a phoney exchange that was bankrupt at the time of the initial rise.

In an interview with CoinDesk, Bram Ceelen, co-founder of cryptocurrency brokerage Anycoin Direct, said that the market has matured since 2013, when it was bolstered by manipulation.

Markets are more leveraged:

Leveraged trading is another significant development. Back in 2013, the majority of big exchange platforms merely provided the ability to buy and sell, but even this basic service was not always stable or trustworthy (as was the case with Mt Gox). There are now several prominent bitcoin exchanges that enable traders to take out leverage of up to 5x, 10x, or even 20x. Traders may now consolidate huge holdings around key price points because of these massive positions. Sell orders in the $900 level were executed earlier this week, causing the price to tumble drastically in only one hour. Petar Zivkovski, COO of Whaleclub, said despite the enormous losses that the most recent surge – and drop – had deeper fundamental roots. Speculation fueled the surge in 2013, but early adopters cashed out around the psychological $1,000 mark, as Zivkovski described. "It was both a dangerous increase and a dangerous selloff.

Ecosystem is more mature:

Genesis Mining CEO Marco Streng believes that the subsequent price surge was put in motion by the 2013 rally itself, and that expansion in the larger bitcoin and blockchain business was a key component of that development. Many bitcoin firms have been founded since that time, and they've been delivering services that make the bitcoin blockchain more usable as a payment network, remittance route or vehicle for speculation. He said to CoinDesk: Many things have changed since the all-time peak in 2013. Innovation and tenacity have propelled the sector forward and made it stronger.

One bitcoin cost $123.00 in early October; by December, it had soared to $1,237.55 before falling three days later to $687.02. 7 Through 2014, the value of a Bitcoin plunged to $315.21, its lowest point since 2009.

By the end of 2016, prices had risen to above $900. 9 After hovering around $1,000 for much of the year, the price of Bitcoin jumped to $19,345.49 on December 15 after breaking the $2,000 barrier. It wasn't long before governments, economists, and scientists began building cryptocurrencies of their own in an effort to take on Bitcoin.

3.7.3. 3rd Generation (2017-2021):

The economics of Bitcoin are changing, and fees may rise as a result. Congestion was reduced by a number of changes made by the programmers. In order to handle the network's current capacity, a number of major and wide-ranging improvements were implemented. A worldwide network of node relays and innovative propagation strategies have enhanced block propagation. Transactions can be replaced (by raising the charge) and recipients can enhance their own transactions. Fee estimate algorithms grew more complex.

Opt-in block expansion was implemented, which would gradually quadruple the network performance when software is upgraded to support it. Despite centralization worries of bigger blocks. More transactions are being crammed into a single block in order to boost throughput without increasing the risk of centralized control.

That such efforts were deemed insufficient to preserve the First Era is understandable. Due to block time variation, using Bitcoin as a payment network had always been uncomfortable. Now it was significantly more difficult: transfers under $20 were no longer feasible as a whole. They looked wistfully at alternate coinage still from their own first era, and they also pushed for relief from this situation. These efforts were joined by a large mining monopoly at this point.

Many of those who wished to keep the First Era going regarded the Third Era preventable, while many others merely felt that it shouldn't happen just now. As a key element in both usefulness and regulatory opposition, the most persuasive argument was that it would hamper adoption. Sadly, this argument never loses its potency, and it comes with all of the dangers listed above.

Comparison of Bitcoin price fluctuation in 3rd generation:

with $6200 on the 5th of February 2018 In just 16 days, the price of bitcoin has fallen by half, to below $7,000 per coin. 4th of January, 2019, with $ 3820 Since the beginning of the year, Bitcoin's value has continued to decline. 15 february 2020, $ 10320.000 $ 300 million was supposedly laundered with Bitcoin after the price hit $ 10,000. With a budget of $ 8000-4600 for March 12, 2020 In the bitcoin market, "Black Thursday." the first time since May 8th that bitcoin has fallen below $ 5000. Prior to this transaction, substantial amounts of BTC had been moved to exchanges, and this caused several whales to dump their holdings. 13,000 BTC was moved from PlusToken's wallets to exchanges via the $ 2.9 billion pyramid scam. 13 March 2020, 4600 to 3800 dollars On Friday the 13th, Bitcoin witnessed its largest plunge in recent memory. In the entire globe, three major events occurred on this date: There was a pandemic declaration for COVID-19; stock prices fell in all three major US indices as a result; and President Trump proposed a

shutdown of the US border because of the epidemic. The first wave of the global economic crisis begins on March 26, 2020, with a starting balance of $6,700. The value of Bitcoin has fallen to zero. It appears that BTC is still undecided on whether or not it is a solution to the situation. 40,000 $ on January 7, 2021 First time over $40,000 was paid. BTC hit a new all-time high of $67,549.14 on November 7th, 2021.

With intermittent bursts of activity, Bitcoin's value began to settle after two years. The price of bitcoin crossed the $10,000 mark for the first time in history in June 2019. However, it had dropped to $6,635.84 by the middle of December.

The Rise and Fall and Rise and Fall of Bitcoin

Daily price of Bitcoin (in U.S. dollars)
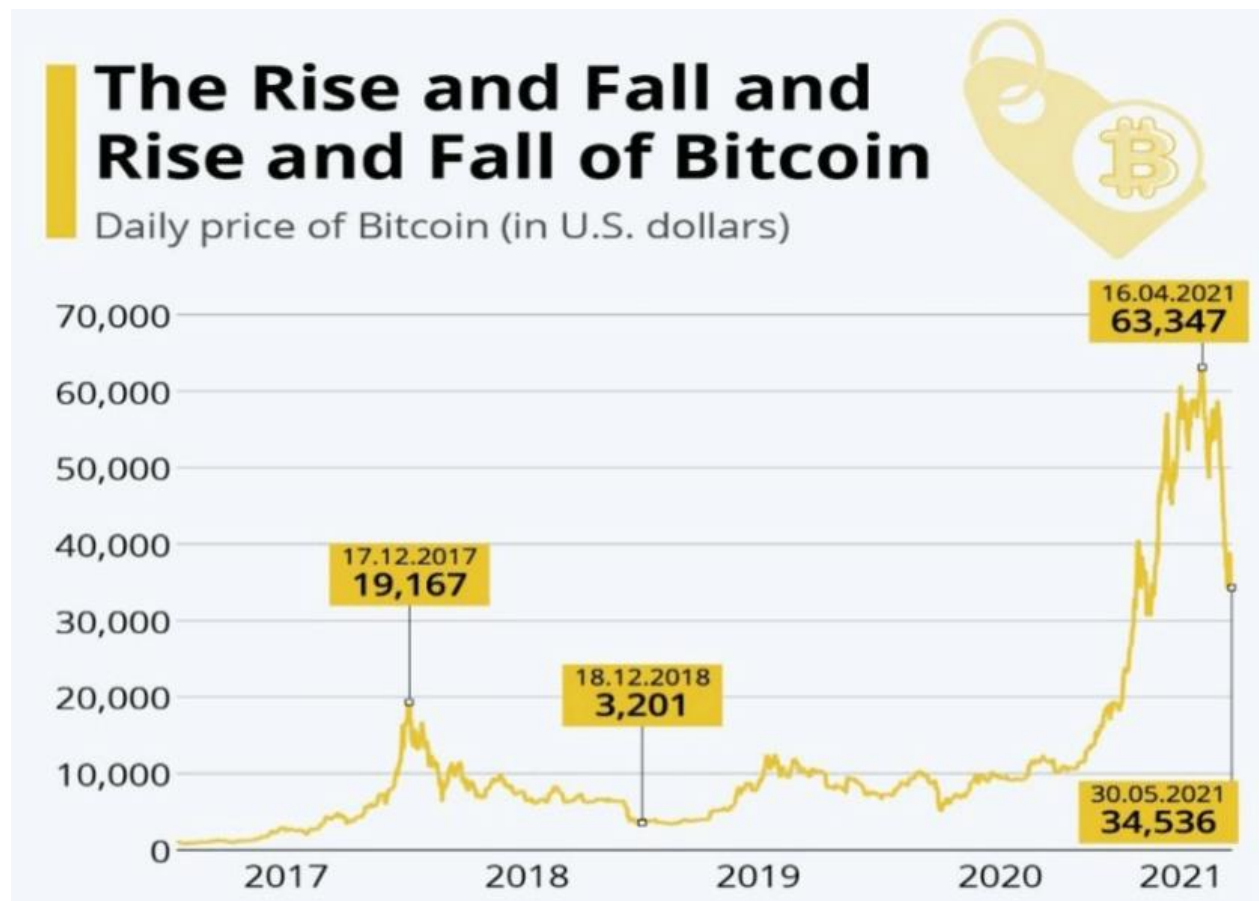
Prices of Bitcoin skyrocketed in 2020 after the COIVD-19 pandemic occurred. At the beginning of the year, the cryptocurrency was trading at $6,965.72. Bitcoin's ascent was fueled by investors' anxieties about the global economy, which was exacerbated by the pandemic shutdown and following government policies. On November 23, the price of a Bitcoin was $19,157.16. In December 2020, Bitcoin's price hit slightly under $29,000, an increase of 416 percent from the beginning of the year.

Growth plans established in this era were motivated by the fact that increasing transaction capacity decreases costs in the long run. Just over a month after its 2020 price record was set, bitcoin surpassed $40,000 on Jan. 7, 2021. As Coinbase, a cryptocurrency exchange, went public in mid-April, Bitcoin values rose to fresh all-time highs of over $60,000 per coin. On April 12, 2021, Bitcoin's price hit a high of more over $63,000, fueled by institutional interest.

On July 19, 2021, the lowest price was $29,795.55 at $29,795.55 per square foot. In September, prices rose to $52,693.32 during another autumn bull run, but a huge decline brought them down to $40,709.59 two weeks later.

Bitcoin hit a new all-time high of $68,990.90.16 on Nov. 10, 2021, making it the most expensive currency in history. A new COVID-19 variation known as Omicron emerged in early December 2021, and Bitcoin plunged to $49,243.39. It then fluctuated further as investors were more concerned about inflation.

3.8.   Analysis of driver's effect on bitcoin volatility in different generations:

examine the impact of unsystematic price fluctuations on Bitcoin's market value, as well as the most recent and essential studies in this area. As early as 2008, a scholarly article by Satoshi Nakamoto described bitcoin as the world's first digital currency. In 2009, the first Bitcoins were created. Understanding the elements that influence the value of bitcoin in 2009 to2013 (1st generation) has been the topic of several research. and indirectly, the current stage of decentralized development financial sites where customers are prepared to lock (term) bitcoins worth more than a certain amount. The solution is complex, but there is no doubt Yield Farming and recognized management techniques were used in the high-yield area. Investor's sentiments, bitcoin economy, market trends are mainly the drivers that affect on bitcoin price volatility in this era. Dealing with the possibility of a change in the value of bitcoin. The more we know about the world, the more we can appreciate it. better problem solvers we are, the more we can adapt to the changing circumstances in which we find ourselves (Adizes 2006).

Satoshi Nakamoto, the pseudonymous creator of Bitcoin, was the first to outline the blockchain as we know it in the white paper for BTC. Blockchain technology was born out of the Bitcoin network in this fashion. In some ways, blockchain was built specifically for this digital currency and for the advancement of the purposes of digital currencies in general, even if it has subsequently been used in a wide range of other fields. Initially, blockchain was designed to facilitate a decentralized cryptocurrency network by creating a shared public ledger. Satoshi's notion of the blockchain uses blocks of 1 megabyte (MB) of information on

bitcoin transactions to record transactions. An immutable chain is formed through cryptographic verification of links between blocks. Blockchain technology was already in place when these systems were first developed, and many of the core elements of these systems are still present today. Indeed, the blockchain of bitcoin has remained virtually untouched from these first attempts at creating a digital currency.

There is a relationship between Bitcoin market volatility and other traditional markets, such as gold, currency and the stock market. We also try to answer if the volatility in the Bitcoin market can be explained by internet search volumes caused by ordinary investors or, possibly, by the Two market-wide risk indicators provide an overview of the financial system's overall degree of risk. To put it another way, we daily, weekly, and monthly statistics from 2013 to 2017 (2nd generation). Regressions and correlations the relationship between changes in the volatility of Bitcoin and changes in the trade-weighted USD currency index volatility. Bitcoin and its value have a more beneficial relationship than previously thought.

Volatility and media connected to Bitcoin, notably "bitcoin." At which moment the term "bitcoin" is searched for on Google and the USD currency index is somewhat Bitcoin's current volatility is the single factor that will determine its future volatility. Make decisions based on what we've learned Based on Google search behaviour, more accurate projections of Bitcoin volatility Rather a few of the key factors are, in fact, quite little. Google search volume and market volatility appear to have a direct correlation. Bitcoin volatility is driven more by the actions of small businesses and individuals than by huge institutions. Crypto market and some technical factors are also an important reason of bitcoin volatility in this generation.

Supply and demand, investor attitudes, government laws, and media frenzy all impact Bitcoin's price in 2017 to 2021 (3rd generation). The combination of these elements results in price volatility.

If people desire something, they will pay for it. The price rises if demand outstrips supply faster than supply. Grain and other agricultural products, for example, may see an increase in price due to an increase in supply in the event of a drought. Other currencies, products, and services in a country or economy are subject to supply and demand, just like Bitcoin and other cryptocurrencies. People will pay for Bitcoin if they feel it is worth a certain amount, especially if they believe its value will rise in the future.

Mining software and gear generate bitcoins at a predetermined rate. Every four years, this pace is cut in half, resulting in a decrease in the amount of coins being produced. 19 As long as Bitcoin's popularity grows, its supply may not be able to keep up with demand, resulting in an increase in its price. A decrease in

popularity might lead to an increase in supply and a reduction in Bitcoin's value, unless there are other factors at play. The COVID-19 epidemic has shown that Bitcoin's price may be affected by economic factors.

Fig: Bitcoin price history in different epoch/generations

Another aspect that impacts Bitcoin's price is supply and demand; Bitcoin has also become an instrument that investors and financial institutions use to hold value and create rewards. Brokers, investors, and traders are creating and trading derivatives that are influencing Bitcoin's price even more. Bitcoin's price may also be affected by speculation, investment product hype, irrational exuberance, or investor panic and terror, because demand rises and falls with investors' moods. Bitcoin's value may be affected by the price of other cryptocurrencies. Regulators, organisations, and businesses are addressing concerns about cryptocurrencies and accepting them as valid payment and money, therefore the number of cryptocurrencies continues to grow. The last factor is whether or whether consumers and investors feel that alternative coins will prove to be more valuable than Bitcoin, which will lead to a decrease in the demand for Bitcoin and, consequently, a rise in its price.

4. Chapter 4

Issues In Assessing Bitcoin Volatility

4.1. Bitcoin's risks:

Investing in Bitcoin is fraught with peril. Risks like this necessitate thorough examination of internal controls. When it comes to risk identification, (Soh & Martinov-Bennie, 2011) say that management is frequently responsible, although serious hazards may also be discovered via an internal or external audit. If a company decides to incorporate Bitcoin into its everyday operations, a risk assessment should be conducted and any required improvements to the company's internal controls implemented Incorporating bitcoin into an organization, whether as a trading or investing tool, is fraught with risk, such as:

| Price volatility | Exchange rate risks | Future legislation | Theft or loss | E-commerce vulnerabilities |
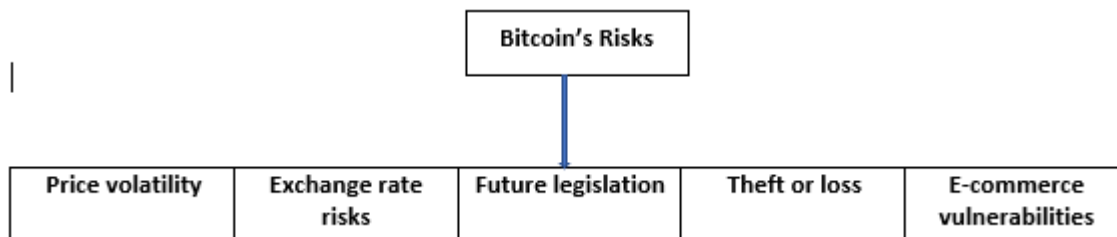
4.2. Price volatility:

Bitcoin streamlines international money transfers by removing the trouble of dealing with currency exchanges, but it still has the same hazards as conventional currencies. The price of Bitcoin has fluctuated greatly in the short time it has been in existence. Over $1,110 a bitcoin was traded for in 2013, but as of February 2015 it's trading at roughly $236. (Coindesk.com, 2015). Bitcoins acquired through an exchange and held for investment reasons by a company are exposed to this fluctuation in prices.

In order to classify bitcoins as either a trading or an available for sale security, a company's goals should be taken into consideration while determining their classification. Unrealized holding gains or losses should flow through profits and unrealized holding gains or losses should flow through other comprehensive income if the investment is in traded or available for sale securities. This transaction will be documented and reported in the same manner as any other investment made by a corporation.

A company's ability to purchase or invest in Bitcoin is facilitated by the quick availability of the money, although Bitcoin's value has fluctuated significantly over the last several years. Bitcoin's price volatility can only be removed by selling the company's investment in bitcoins.

4.2.1. Exchange rate risks:

A merchant that accepts bitcoins as payment for products or services is most likely using virtual money when they do so.

However, it is unclear that a bitcoin would qualify as a functioning money because of its restricted circulation. A retailer's profit and loss from the sale of bitcoins should thus be included in the retailer's income statement, rather than as an extraordinary gain or loss. A shop that accepts Bitcoin as a form of payment expands its consumer base, but it also raises its exposure to foreign currency risk. Because of the considerable volatility of the Bitcoin exchange rate, the company is taking on a significant amount of foreign currency risk.

Risks connected with taking Bitcoin should be discussed and considered thoroughly by all relevant stakeholders, such as the CEO, board of directors, and internal auditors, among others, prior to establishing any internal controls.

4.2.2. Future legislation:

The majority of lawmakers throughout the globe haven't made a clear choice on how to classify Bitcoin and other virtual currencies. When it comes to Bitcoin, a decentralized peer-to-peer digital money, the issue of "Who gets to govern this stuff?" emerges.

Under current rules, notably the USA PATRIOT Act and the Bank Secrecy Act, Bitcoin exchanges have been required to register with the Treasury Department as a money-services organization. Although Yellen reiterated that the Federal Reserve does not have any regulatory authority over virtual money in February of this year; nonetheless, other authorities are changing their positions. The IRS considers virtual currencies to be capital assets that are subject to profit and loss since they serve no practical use as a medium of exchange (Tracy, 2014). Bitcoin's future value is threatened by regulatory uncertainty. The value of Bitcoin might be jeopardised if it is declared illegal in certain nations. Virtual currency users and businesses should keep an eye out for any new regulation that might affect their business. Because of the uncertainty surrounding the regulatory landscape, businesses are exposed to a danger they cannot be shielded from, and instead must be closely watched.

4.2.3. Theft or loss:

There is no link between the owner of a bitcoin and the bitcoin itself, just as there is no link between a dollar bill and its owner. However, although every Bitcoin transaction is publicly available, it is very impossible to identify the persons engaged in the transaction (Brito & Castillo, 2013).

It gives privacy, but it also creates a security risk because of the distance between the bitcoin and its owner. It's conceivable that the bitcoin will be lost forever if the code for it is compromised in any way, shape, or form. Bitcoins are much like any other digital file in that they are subject to theft and loss. Because of this, data security is a critical concern for internal controls. Even if the company's current measures can manage this danger, it should carefully examine its vulnerabilities to the risk of a data breach before making the switch to Bitcoin. Because of this, a bitcoin is unlike other digital data files used to store consumer information: it has a monetary worth to the person who has it. The company has little recourse if its bitcoins are taken without FDIC or other regulatory oversight.

This means that a business's choice on how to keep and use its bitcoins is essential. You may store bitcoins on your company's internal server, an off-site, offline server or on a third-party, online exchange. Each of these options has its own set of risks for the company.

4.2.4. E-commerce vulnerabilities:

Even with current Internet security measures, such as encryption, there are still holes in the system. Transactions with Bitcoin are no different from any other online transaction in that they take place via the internet. An e-commerce security platform should incorporate authentication, identification, and user access controls, as well as intrusion detection and system integrity checks (Bosworth & Kabay, 2002). For organizations, keeping up with the rapid advancements in information security while still ensuring user friendliness and customer happiness is a continual problem.

4.3. Issues that access bitcoin volatility:
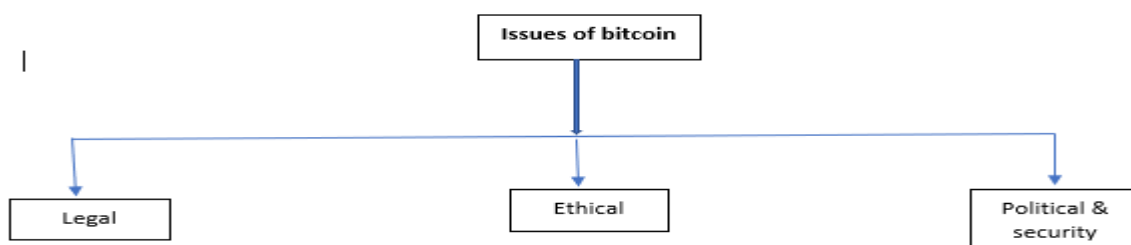
4.3.1. Legal Issues of Bitcoin:

Genus of bitcoin: currency or a commodity

With an efficient medium of exchange, products may be exchanged in the most efficient manner feasible. So minimal must be the maintenance costs of the currency that it should not degrade when it is exchanged (paper bills for example are not well qualified on this point, as when they are being used their physical quality deteriorates). To be able to pay for things everywhere, the money must be lightweight and portable, which means the product must have a high market value relative to its size and weight. If you want to get the correct amount of value for your money, you need to be able to divide it into smaller units. The function of a medium of exchange is highly regarded in the case of bitcoin. They are non-perishable since they exist only in digital form. The divisibility and fungibility of bitcoin are well-known. Since transactions are carried out on the internet, there are no transportation charges like there would be with gold or cash. Finally, the technological architecture and the usage of encryption make them impossible to forge. So that we may compare prices over time and between different merchants, there should be a unit of account. In other words, prices are measured in terms of money.

Currently, the value of bitcoin is too volatile to be used as a unit of account. It should be a long-term investment that holds its worth. In order for money to keep its worth, it must be able to be saved and used at a later date. Keeping the price stable is critical if you want to hold onto your investment's worth. Because of the volatility of the cryptocurrency market, this issue receives a medium rating. Because of these price swings, it can't be considered a reliable store of wealth. Because they are digital, cryptocurrencies, on the other hand, may be held indefinitely.

As a result, regardless of its legal status, anything that can perform all three of these activities would be considered money in the eyes of economists. However, cryptocurrencies such as Bitcoins have a systemic economic issue that is difficult to overcome. Until the year 2140, Bitcoins may only be issued at a maximum capacity of 21 million units. Because money supply will not expand in tandem with economic development if such cryptocurrencies are effective, it would have a deflationary effect on the economy.

Gold and bitcoin have a lot in common. To begin with, no one authority has jurisdiction over either. As a second point, there is a finite number of Bitcoins, which will run out in 214010 whereas currencies may be issued at any time. Finally, the price of gold changes considerably more than the price of currencies, since demand versus a finite supply fluctuates, much like the price of cryptocurrencies does. U.S. law defines cryptocurrencies as commodities, and they meet the legal definition. Furthermore, cryptocurrencies are tangible, even if they are not actual coins or in the hands of the investors. In the end, the categorization of

Bitcoin remains a divisive issue. Because of this, there may be as many different categories of Bitcoin as there are applications for it. Government authorities should outline explicitly how each regulatory framework will be applied and co-exist without stifling the promising development potential of this unique financial platform.

Impact of bitcoin on tax regime:

Because Cryptocurrencies are not taxed, they are a target for legal challenges. When utilized appropriately, bitcoin's pseudo anonymity makes it an effective instrument for concealing assets and minimizing tax burdens. Comparing bringing in little amounts of foreign currency to bringing in Bitcoin private keys is far more convenient than bringing in big quantities of foreign currency.

Even if there are legal loopholes in some nations, it is generally a felony to avoid paying taxes. What if the currency rate is so unpredictable that it's impossible to pay taxes? As a result, legislators have an uphill battle if they are to successfully resolve this matter. The financial elements of bitcoin have also drawn the attention of regulators. Legal characterization of bitcoin is the key in determining its tax consequences. When it comes to determining if cryptocurrency is a commodity (a financial asset like a stock) or a currency, there is a clear distinction: Taxes are levied on cryptocurrency transactions just like any other asset or money. Taxes on capital gains, income, transactions, and wealth may apply to bitcoin transactions. Even if a bitcoin transaction is invalid and unlawful, the IRS has the authority to tax it. When it came to taxation, in March 2014, the Internal Revenue Service in the United States decided that Bitcoin would be classified as property rather than money despite Bitcoin's ability to serve in some situations as a medium of exchange, unit of account, and store of value. Because of this, Bitcoin will be taxed as a capital gain. On the one hand, nations throughout the world debated exactly which category Bitcoin should be placed in. For example, Canada has determined that Bitcoin does not pass the currency test and therefore be treated as a commodity for tax reasons since it lacks the attribute of legal tender. Transactions using Bitcoin should be recorded like any other barter transaction, according to the Canadian Revenue Agency (CRA) in January of 2014.

This was followed by Germany and the United Kingdom deciding on a tax scheme that would be financially feasible for both countries. German tax law treats Bitcoin as private money, even though it isn't a currency under German law due of its denationalization.14 Germany elected to recognize Bitcoin as an equal to private money.

There are many other ways to classify digital currencies, but the most common is as a form of payment that can be exchanged for goods and services. As a result, it may be contingent on the transaction's nature and the legislative authority to tax it. Property taxes, inheritance taxes, transaction taxes, service taxes, value-added taxes (VAT), gift taxes, wealth taxes, capital gains taxes, and income taxes are just a few of the taxes that might be affected by the rise in cryptocurrency use.

Consumer protection:

Using a bitcoin relies on putting your faith in other users, influencers, and the system as a whole. The lack of fundamental consumer protections like refunds for disputes between businesses and customers makes Bitcoin transactions dangerous. Due to any breach, victims are unable to provide sufficient legal proof for compensation. Most of the news around cryptocurrencies focus on the system's flaws. Hacking, digital licensing, and other IT-related offences are likely to be involved in most conflicts involving cryptocurrencies. In addition, consumer protection laws, contract law, money laundering laws, intellectual property laws, and banking regulations may all be important. There are several reports of an increase in bitcoin crime as the sector continues to develop at a rapid rate. Security experts and government officials believe this drives investigator to concentrate on high-profile cases, effectively leaving small investors to their own devices. As with any other crime, people are urged to report bitcoin theft to their local authorities, noting that neglecting to do so just serves to promote criminality. However, security experts say that bitcoin theft is significantly more widespread than published numbers suggest since many victims simply do not understand its significance. Financial research firm Autonomous NEXT and Crypto Aware, which works with victims of cryptocurrency scams, estimate that between 2012 and the first half of 2018, around 15% of all cryptocurrencies have been stolen, totaling $1.7 billion. According to the figures, more than $800 million has been stolen in the first half of this year. However, Lex Sokolin, a partner and global director of fintech strategy at the business, thinks that as much as 85 percent of crimes go undetected and argues the published numbers only represent officially documented heists.

Bitcoins are now functioning in an unregulated environment. Bitcoin-related consumer hazards have been extensively covered in the media in the past year. The Mt. Gox16 breach in Japan, which resulted in the loss of $6 billion worth of Bitcoin, was an example of such a danger. In addition, victims of bitcoin fraud are left in the dark since there are no legal recourses. The perpetrator's identity is a mystery because of the anonymity of the crime. As a result, the identity of both the suspect and the jurisdiction is unclear due to the lack of specific legislation or regulation. It appears more than appropriate to give counsel on the merits

and shortcomings of bitcoin and warn customers of the hazards connected with it if consumers' need for protection derives from informational imbalance.

Bitcoin driven illegal activities:

A distinct concern is the prevention of the use of bitcoin for money laundering, tax evasion, terrorist funding, and political fundraising, which is on the fringes of the techniques of legal control, namely administrative and criminal law. Rather using cash, it appears that bitcoin is a superior option for this purpose. The widespread use of digital currencies like bitcoin, which lack legal tender status, does not impose any obligations on any government or country. One of its flaws is this. Consumers' interests aren't well-served by the bitcoin market's lack of regulation and monitoring.

With the TOR system and the anonymity provided by bitcoins, money laundering is becoming increasingly commonplace. Because they may be encrypted using complex methods like so-called "wallets," they're accessible from anywhere in the world, are simple to store, and are exceedingly difficult to access by unauthorized parties (like as law enforcement agencies). Hackers like to use Bitcoins as a form of payment. It is mostly used to buy narcotics, pornography, counterfeited papers, and guns and ammunition17 on the underground market (the Deep Web or Darknet).

Money laundering is made easier by the near-anonymity, elusiveness, and high negotiability provided by bitcoin transactions and withdrawals in real time18. According to this view of bitcoin, it is like a super tax haven, with the extra bonus of not being reliant on a bank. Two of the most significant qualities of a traditional tax haven may be found in bitcoin. In the first place, they are not taxed at the point of origin because they operate outside of any legal framework (they are "kept" in virtual "wallet" accounts). Second, a person's bitcoin holdings are completely private. It's possible for users to open as many Bitcoin "wallets" as they wish without revealing any personal information. Bitcoin (and other cryptocurrencies) provide tax evaders with an extra key benefit not offered by traditional tax havens: the functioning of Bitcoin does not depend on the existence of financial intermediaries such as banks19 Peer-to-peer transactions are the only way to use Bitcoin. Bitcoin, on the other hand, appears to be unaffected by international anti-evasion laws. With regard to tax collection, banking institutions have been removed from the picture in cyberspace. As a result, cryptocurrencies have the potential to become tax havens of the highest kind.

In light of the growing commercial adoption of cryptocurrencies like Bitcoin, regulatory and law enforcement control of their use is becoming increasingly necessary. Cryptocurrencies have the potential to help authorities uncover terrorist financing, tax evasion, and money laundering more quickly. Failure to

do so would enable the unrestrained growth of a potentially substantial financial infrastructure that might be abused by cyber-driven terrorism and corruption.

Selling bitcoin without a license:

Because of this, it should be legal to sell Bitcoin without a licence in the United States, but it does so in violation of the Banking Secrecy Act. The Department of Treasury's Financial Crimes Enforcement Network (FinCEN) has accused a neurologist from Phoenix, Arizona, with operating an unregistered money-transmitting company. Dr. Stenmetz recently received an anonymous bitcoin gift in the amount of around $10,000 to assist in the funding of his most recent study. This is an innovative approach of funding research," said he to The Republic back in 2014. When it comes to supporting cutting-edge research, it's virtually reasonable to adopt cutting-edge methods of funding. He was soon captured, and he is only one of many.

Money laundering:

Since you can literally shift money between nations in seconds, this is one of the most obvious reasons. Laundering significant quantities of money on the blockchain is exceedingly dangerous, but there are many loopholes and law enforcement is learning how to properly examine a publicly accessible ledger.

Some other legal issues are:

Issues that have come up recently include:

- Hiding your money.
- It's difficult to establish the loss of a Bitcoin private key.
- The theft of a large amount of Bitcoin has sparked an industry response.
- The absence of legal safeguards. Scams and chargebacks.

Eventually, the United States deemed Bitcoin an asset because of Bitcoin taxes. Bitcoin is not subject to VAT, as the European Union's courts have ruled. It was Mt. Gox's theft and lack of consumer protection that prompted authorities to do a better job.

An ongoing discussion over taxes in the United States finally resulted to Bitcoin being classed as an asset purely for tax reasons. Due to Bitcoin's lack of a chargeback option, it may also be used as an argument to prevent fraudulent chargebacks from occurring in the first place. Anonymity provided by Bitcoin allowed Silk Road and other online drug marketplaces to thrive for so long; nonetheless, the FBI was able to locate

Silk Road's server owing to a design flaw that became apparent over time. Although some corrupt FBI agents were involved in this procedure, they were brought to light because to (partially) blockchain's exposure.

A fresh warning against digital trading has been issued by a self-regulatory Chinese organization. This year, the National Internet Finance Association (NIFA) of China issued a statement claiming that Bitcoin and other Cryptocurrencies are a means of investment speculation and money laundering. ICOs (initial coin offerings) were recently the subject of a warning and a ban on all exchanges and other services related to them. Bitcoin's value was little affected by China's cryptocurrency ban, despite China having one of the world's largest economies, if not the largest. This suggests that bitcoin has a broader scope than China's economy.

4.3.2. Ethical issues of bitcoin:

Volatility and deflation are seen as undesired implications of cryptocurrencies from a utilitarian perspective. As a result, cryptocurrencies are often seen as having a practical disadvantage that prohibits them from being used as a store of value (I. G. Pernice et al., 2019; R. Pernice et al., 2019). However, as Dierksmeier and Seele argue, this isn't always immoral (2018). According to many, cryptocurrency trading is immoral, yet it's true that it's a viable financial asset for speculative trading reasons (Cheung & Chinn, 2001). However, because of their high volatility and little connection with other assets, they are also good diversification tools (Corbet, Meegan, Larkin, Lucey, & Yarovaya, 2018; Platanakis & Urquhart, 2020). It is possible to utilize them to protect one's money, which may be seen as a legitimate goal.

As a result, (Dierksmeier & Seele, 2018) argue that the deflationary character of cryptocurrencies would be problematic if they were used as reserve currency. The authors, on the other hand, make no distinction between deflation caused by supply-side and demand-side factors. When economic growth causes price declines, this is known as supply-side deflation, in contrast to demand-side deflation that might set off a deflationary cycle (Selgin, 1997). Reduced manufacturing costs lead to lower product prices when economic growth is driven by productivity. Supply-side deflation has little effect on profit margins, and hence the economy is unaffected. It's not an issue for the wider economy, though, since manufacturing costs may reduce even faster than revenues (Bagus & Howden, 2016; Gallih Bagus, Soepangkat, & Krisnanto, 2006) and (Hülsmann, 2008). An excellent illustration of this is the high-tech industry. Investments and profitability in this industry have not been impacted by expectations of lower pricing (or higher quality). Consumers aren't deterred from purchasing an iPhone X today despite their expectation that the iPhone X+1 would be better at a comparable price next year due to their desire for time.

Before we can begin to unravel this claim, we must first examine the features that made Bitcoin possible as a means of exchange and how they lead to cryptocurrencies having distinctive properties as software. If Bitcoin and other digital currencies are to be truly decentralised (i.e., able to operate without the interference of a central authority), they must be updated often (to continually improve). As time passed, it became evident that user rights were an integral part of this update process. When it comes to cryptocurrencies, there are only two alternatives accessible to users: modifying the existing regulations or introducing new ones (making new software incompatible with previous software) (allowing users to continue running the old software, upgrading to a new software if and when they wish). There is a chance that new, incompatible coins will be generated by the market, no matter which option you choose. Bitcoin maximalists and crypto agnostics have taken quite diverse methods when it comes to coping with this problem.

As a method to protect what Bitcoin maximalists saw as the system's distinguishing traits — the right of users to money and the knowledge of the amount of money in circulation — they chose a roadmap defined by adjustments that reduced the likelihood of a split (thus preserving the second guarantee). For cryptocurrencies, this risk can be mitigated by adopting an attitude of tolerance toward the use of incompatible softwares, believing that users should be free to use money in any way they choose and that the existence of an established and predictable supply is more of an advantage rather than an absolute right for everyone. Vitalik Buterin, the founder of the Ethereum virtual currency, has previously said that Bitcoin's trajectory is "coercive." Bitcoin users who wanted to utilize their money in new ways or with new features, in his opinion, were being restricted in their ability to do so by a vocal minority who refused to give in.

Unmentioned, however, is the fact that crypto agnostics promote a very particular perspective on user financial rights by taking this position, one that may render these rights susceptible to the market itself. It's important to understand that for those who are crypto-agnostic, the majority of users should be allowed to make whatever choice they choose about the cryptocurrency they use, including revoking the rights of others. As Buterin's favoured solution to resolving bitcoin divides demonstrates, this viewpoint does exist. "If you truly want to make a controversial adjustment... let the market figure it out." Crypto agnostics claim that if any user disagrees with the choice of the majority for any cryptocurrency, they may just operate (or start) another coin. For as long as there are viable alternatives, the person has the ability to get their hands-on money.

4.3.3. Security and privacy issues of bitcoin:

The Bitcoin is a digital money that does not exist in any form other than on a computer screen. Security concerns have always loomed large in this conversation, from the start. There are still certain challenges to this virtual money, notwithstanding the measures that have been done to safeguard the currency and its transactions and mining. Collaborative users may take advantage of security holes in the mining process and transaction to get an unfair advantage over the system as a whole. There are a number of services that allow its customers to use an online digital wallet, which makes them vulnerable to hacker assaults. Attackers may also target the exchange services.

Attacks and dangers against this coin have been examined in detail. The blockchain is a distributed, append-only public ledger that records all transactions in Bitcoin. The incentive compatible proof-of-work (PoW)-based distributed consensus mechanism used by Bitcoin's network nodes, or "miners," is critical to the currency's security. The miners are expected to honestly maintain the blockchain in exchange for the incentive. The Bitcoin economy has evolved tremendously since its inception in 2009, and it is currently estimated to be worth $170 billion. Bitcoin's skyrocketing value encourages both opponents and researchers to look for flaws in the system, come up with countermeasures, and foresee future trends.
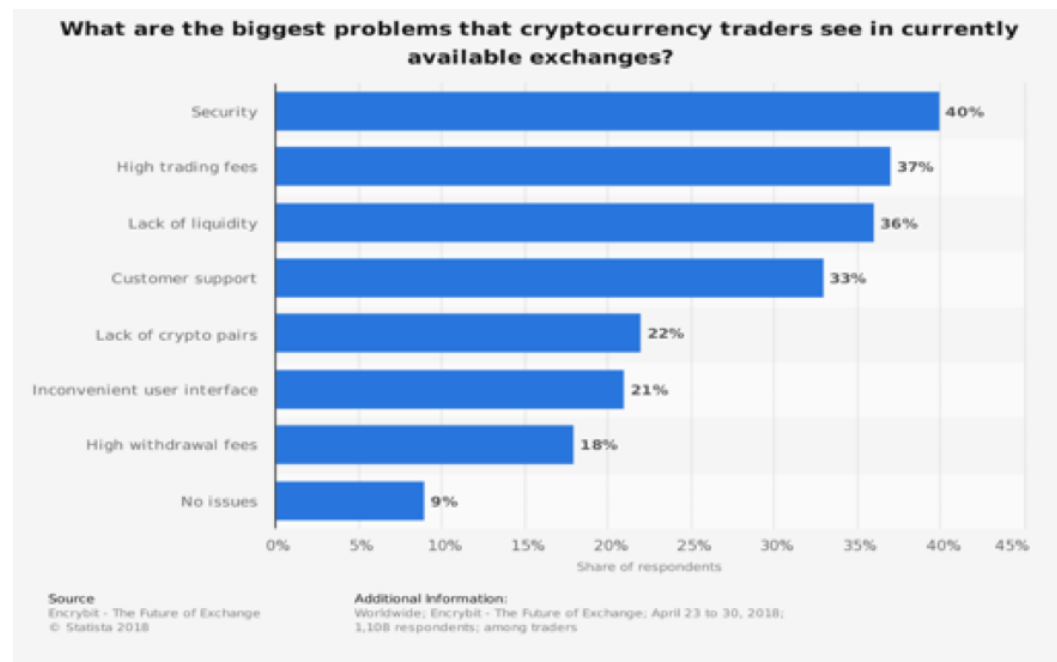
The network nodes known as "miners" execute Bitcoin transactions to ensure their integrity, legitimacy, and accuracy. Furthermore, instead of one transaction being mined by each miner, the "blocks" are a collection of transactions that are waiting for the network to execute. Mining rewards are distributed to

miners based on the number of blocks they have processed (or validated). The majority of miners in the network must then verify this block before it can be put to a distributed public ledger known as "blockchain." After successfully mining a block, a miner gets a reward from the network for their efforts. We now offer an overview of the most important technical and operational aspects of the Bitcoin that are necessary for its successful implementation.

Wallet software attack:

A bitcoin wallet is a software programme that a user uses to keep track of his or her personal Bitcoin balance and to send and receive bitcoins. Online wallet services or a node-installed wallet programme may be used by the client, depending on his preference. Online wallets, in general, are more susceptible to assaults and as a result, need encryption and off-line data backup. Wallet data and contents may be retrieved using existing backup facilities. The history of the currency may be tracked, which enables the connection between a person's identity and a Bitcoin address. DDoS attacks against an online wallet application are a real possibility.

Time jacking attacks:

There are situations when, when joining a node for a transaction, the attacker broadcasts an incorrect timestamp. It is possible for an attacker to modify a node's network time clock so that it accepts a different block chain. Due to double-spending and computing resources being wasted throughout the mining process, there are major ramifications to this.

Double spending:

Attackers may invalidate an 'honest' transaction by successfully completing several transactions using the same currency in so-called "double spending" attacks (see section 4.4). 'Fast payment' option is the most vulnerable to this kind of assault. As part of this attack, a coin A is used by an attacker to send money to a receiver and at the same time, the same coin is used to send money to a different address, which may or may not belong to the attacker. The transaction may be made to seem legitimate by changing the timestamp. If a transaction with the identical input is received by a Bitcoin peer first, that transaction will be validated and all others will be rejected. As a result, the transaction's original recipient will be unable to verify it. Inserting 'observers' into the network might be one answer to this assault.
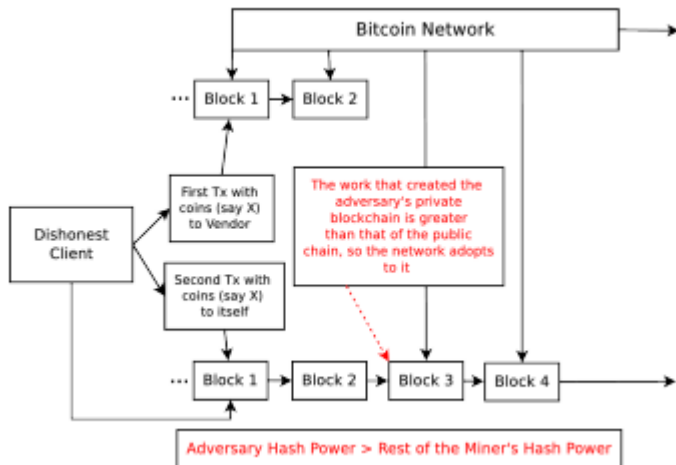
Fig: Double spending attack

Selfish mining:

'Selfish Mining,' a recently discovered property of Bitcoin mining that puts the cryptocurrency at risk, permits a big enough mining pool to earn more money than it actually expends on computing power. Using this approach, the cooperating group of miners will coerce the honest miners into wasting their time on the stale public branch. In other words, greedy miners compel honest miners to waste their cycles on blocks that will ultimately not be part of the network. Because of this, the 'honest' miners will continue to squander their computing resources on public branches while the self-serving mining group keeps their mined blocks hidden. In turn, the 'honest' miners will switch to the newly mined blocks, increasing the profits of the self-interested miners who first revealed the blocks to the public branch. When it comes to the "honest" miners, a selfish miner will try to undermine their efforts. Cornell University's answer reveals that the Bitcoin protocols need to be modified in order to lower the success likelihood of selfish mining.
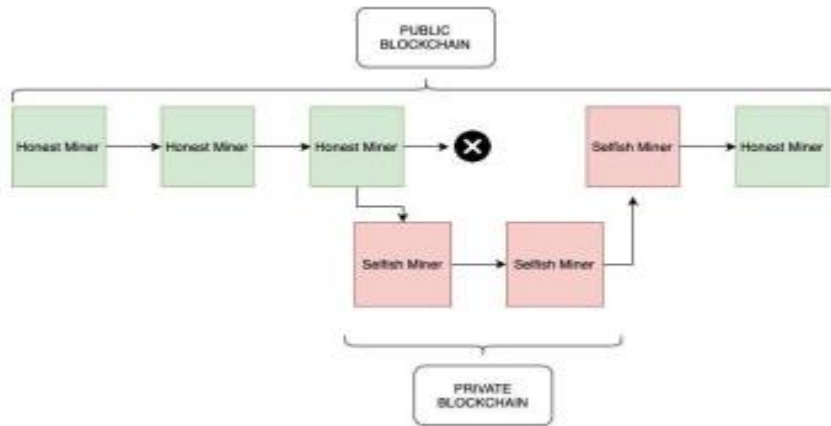
Blockchain and mining:

An append-only list-based data structure, the blockchain maintains the whole network's transaction history in blocks. Merkle Tree is used to store the transactions in each block, together with a secure time stamp and the hash of the preceding block. Bitcoin's blockchain is created and maintained in accordance with the approach. For a new block to be successfully mined (verified), miners must solve a computationally challenging PoW problem.

Because the blocks are kept in an orderly format, it is possible to browse the blockchain and establish who owns each bitcoin. To make matters worse, tampering with the contents of a block has no effect on the block's hash. Changes to a block's transaction hash have an effect on subsequent blocks, which are hashed using the previous block's hash. Due to the mining process taking place on the network, the length of the blockchain is always rising. Add a new block by following these steps: First, a miner must find and broadcast the solution to a valid hash value for a given block (i.e., a hash value that is equal to or lower than the target); second, miners must check a solution for a valid block and update their local copy of the blockchain; if the solution is incorrect, miners discard the block. The existence of blockchain splits in Bitcoin might be used by a malicious miner to disrupt the cryptocurrency's normal functioning. To produce a split on the network, a clever miner or a mining pool may mine secretly on the blockchain, which is very handy in this instance. When a malicious miner publishes her private chain on the network, other miners will begin mining on top of it as soon as they learn that the public blockchain is catching up. Efforts of genuine miners are rendered worthless since all mined (i.e. valid) blocks are thrown away.

It is generally assumed that honest participants control the bulk of computational power in Bitcoin, which is why it is considered secure in this way at all times. With the reward of 12.5 BTCs that they earn for each successful addition to the blockchain, miners have a strong incentive to verify blocks honestly. It was

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previously said that in order to validate a block, miners need to solve the related crypto-puzzle. If you employ more processing power, you have a better chance of solving the crypto-puzzle.

Risk of network attacks:

The security work that miners do would be unnecessary if there were no malevolent actors to worry about. (Conti, Kumar, Lal, & Ruj, 2018; Kaiser, Zhang, & DER PLUIJM, 2018) outline several sorts of mining-based attacks in computer science literature. (Liu, He, Chen, & Gao, 2019; Martínez et al., 2018) and their references). From (Budish, 2018) discusses two major categories from an economic perspective: double-spending and sabotage attempts. In a "double-spending" assault, the money is spent twice. an attacker aims to buy a product using bitcoins and then extort money from the buyer upon delivery Transmitting the same transfer in an alternate chain history Invalidate initial payment by depositing money into attacker's wallet in contrast, the purpose of a sabotage attempt is not to communicate the same information. The network will be harmed if repeated transactions are made using bitcoins. That's what (Rosenfeld, 2014) claims. For example, defending a company's reputation may inspire such an attempt. profitability of an existing player, such as a bank or payment system, for example Profiting from a short position in processing firms. The driving force success of an alternative cryptocurrency, in particular, might potentially be a factor It's when the same mining equipment is used. It is perhaps more powerful in terms of size. the prospect of non-profit government activities. Economic such as the US and China, as well as international organizations, such as the G20, have voiced worry over national security on several occasions, including: risks to the environment, as well as the stability of the financial system.

4.4.   Issues of volatile nature of cryptocurrency market:

Currency crises, stock market crashes, significant credit defaults, and other extreme catastrophes may lead to big losses for investors in conventional financial markets. Volatility and severe tail events are significantly more prominent in the case of cryptocurrency. As a consequence of extreme value theory, we seek to characterize the tail aspects of Bitcoin returns quantitatively. According to (Sapuric & Kokkinaki, 2014) and (Kristoufek, 2017), conventional fiat currencies and Bitcoin perform drastically differently when volatility is taken into consideration (2015). The purpose of this study is to examine at Bitcoin's tail behavior in relation to the other G-10 currencies. In the past, experts have researched the behavior of currencies in the long term, but no similar study has been done for Bitcoin's pricing.

Researchers have so far focused on Bitcoin's security protocols, fraud and criminal activities, exchange defaults (such as money laundering), encryption approaches and other areas.

The statistical dangers of investing in Bitcoin, exchange rate volatility, and Bitcoin's behavior in extreme circumstances have not yet been thoroughly examined in great depth. In order to address this hole, we'll provide a thorough examination of the Bitcoin exchange rate's statistical dangers and extreme tail behavior.

Cryptocurrency prices have always been up and down, but the previous several months have been particularly crazy. What Causes Such Volatility in The Cryptocurrency Market?

With a value of about $20,000 (around 14.85 lakh) in December 2020, Bitcoin will be trading. It reached the $40,000 (approximately 29.70 lakh) mark in January of this year. April saw it hit an all-time high of $65,000 (around 48.27 lakh). Until May, the price remained below $30,000 (about) (about 22.28 lakh). At $45,000 (roughly 33.42 lakh) for the first time in over three months, the currency regained some of its lost value. This isn't the only cryptocurrency that's been reacting similarly recently. Some people have reaped the benefits of the cryptocurrency market's extreme volatility, while others have lost money as a consequence. Because bitcoin values are so volatile, investors' main worry is why this is happening. Bitcoin's roller coaster ride began even before the bubble burst. There are just a few factors that affect the direction of the market.

Emerging market:

There is still a lot of room for growth in the cryptocurrency sector, but investors are becoming disillusioned at an alarming rate. When measured against more established currencies or even precious metals like gold, the cryptocurrency industry is still tiny. A tiny number of persons with big crypto currency holdings, for example, can thus have an impact on the market. If they solely sold Bitcoins, the market would come to a grinding halt.

Speculation:

Thus, Bitcoin owners have a strong incentive for keeping their currency, which is exactly the opposite of what's necessary for a currency like the dollar to be a viable form of exchange (Salmon, 2013).

As a currency, Bitcoins may be more prone to speculative trading than other currencies such as the dollar since there is no core "fundamental," such as a quantity of gold or the value of a revenue stream that underlies a company's shares. Speculation and profits drive the bitcoin market. Investors gamble on

whether prices will grow or decrease in order to make money. As a result of high speculative bets, money may enter or exit the market in a matter of seconds, causing high volatility.

Purely digital asset:

Cryptocurrencies like bitcoin and ether, in contrast to fiat currencies like dollars, are distributed digital assets with no physical backing. Thus, their costs are determined completely by supply and demand, which is why they are so expensive. A lack of other stabilizing factors like government backing makes it impossible to ensure that demand or supply will stay consistent.

Developing technology:

The blockchain or any alternative technology on which these currencies are built are still under development. As of this writing, Bitcoin has only been around for around 10 years. Because smart contracts are not evaluated in the period specified, there is a risk of their value plummeting suddenly.

Frangible investors:

Expertise isn't required in this industry, unlike in real estate or the stock market. As a result, most of the investors are part-time workers. In the beginning, they expect to make a lot of money quickly, but when that doesn't happen, they tend to give up. Volatility is exacerbated by this frequent participation and retreat.

4.5.   Issues of factors to access volatility:

Because of Bitcoin's significant market share (far over 70%) and high volume of trade, we feel compelled to single it out as a particular source of danger. Cryptocurrency, as an unregulated "currency," has been widely explored in the academic literature. Because of its volatile price, lack of popular acceptance, and other factors, Bitcoin is more like an investment than a currency. According to (Hafner-Bratkovič et al., 2018) and (Gerlach, Teachman, Laliberte-Rudman, Aldrich, & Huot, 2018), both CRIX (Trimborn & Härdle, 2018) and BTC exhibit significant speculative bubble characteristics (2019). (Griffin & Shams, 2018) have uncovered possible price manipulations. Bitcoin's price and volatility may be affected by sentiment or social signals, such as views and trade volume, due to the lack of intrinsic value. (Pele & Mazurencu-Marinescu-Pele, 2019) classify bitcoin as a new asset class by analysing its statistical properties. The danger of holding BTC is also

taken into consideration while constructing investment portfolios. According to the Asymmetric GARCH models (Gronwald, 2014) and (Dyhrberg, 2016a), BTC has comparable characteristics to gold as a hedge or risk-haven asset. Consumers, according to (Glaser, Zimmermann, Haferkorn, Weber, & Siering, 2014), use BTC more as an investment vehicle than a medium of trade. It is possible to influence the price of bitcoin by a number of things. Among them are the hysteria in the media and peer acceptability, political risk and unpredictability, government and regulatory moves, and Bitcoin governance.

Media hype issues:

Economists have long held the belief that investors' judgments are influenced by psychological considerations. The term "animal spirits" refers to investors making judgments based on their emotions. rigorous analysis is not used, but rather the behaviour of other market players and personal intuition. Analysis of Bitcoin's price reveals that good media attention is a major contributor. The "trough of disappointment" that follows a "peak of excitement" in new technology media coverage is well-known. Bitcoin's price surges and falls were exacerbated in the early days by widespread media coverage of the new digital currency. It's becoming more difficult to isolate the impact of the media on an issue as it becomes more widely covered and other factors are taken into account. A similar phenomenon occurs when high-profile firms go public, as investors "load in" and the value rises fast from a low foundation. As an example, consider the case of Twitter, which went public and immediately experienced a significant increase in its stock price.

Political Risks:

Political risk surrounding national currencies has an impact on Bitcoin's value because users use it to hedge against price swings in a particular currency or to quickly move large quantities of money out of a country or currency. During Greece's 2015 financial crisis, there were several reports of an increase in the number of Greeks purchasing Bitcoin. Bitcoin's global price remained constant throughout the year, hovering around $300-400. Bitcoin's price rose and the British pound's value dropped on June 23, 2016, as investors feared that the United Kingdom will leave the European Union (Brexit). The pound's value started to fall on May 20, 2016, around the time of the Brexit vote. More than 10% of its pre-Brexit value has been wiped off by the 25th of July 2017. During the same period, the price of Bitcoin went from £302 to £502. Immediately after Donald Trump was elected president, the price of Bitcoin soared over the following two months. Many blamed the US economy's uncertainty.

Regulatory moves:

Since the emergence of Bitcoin, governments throughout the world have scrambled to keep up with its rapid ascent. For example, they must decide how the tax system will approach it or if and what regulations apply to its usage. Two recent occurrences demonstrate the potential influence of rules on the pricing. Just 24 hours after the news that Bitcoin will be recognized as legal cash in Japan, the price of Bitcoin surged by 2% and by 160% worldwide for the next two months. Due to Chinese government restrictions on Bitcoin exchanges and initial coin offerings, the price of Bitcoin dropped by 29% in only 24 hours.

Bitcoin's regulation issues:

Despite the fact that Bitcoin is a decentralized currency, some decisions must be taken regarding how it will operate or evolve. This has an impact on prices as well. In order to authenticate Bitcoin transactions, developers and miners create and maintain the Bitcoin software (the global network people who verify Bitcoin transactions). Before they may make changes to the software that is used to mine and authenticate transactions, engineers must complete this step. A "fork" can be created once they have that support. A "hard fork" occurred on August 1st, 2017. Everyone who held Bitcoin was granted a new cryptocurrency called Bitcoin cash. The Bitcoin cash programme can handle 30 transactions per second, which is four times faster than Bitcoin's. Despite this, very few Bitcoin investors are programmers and so had no idea what the fork would entail. Preparation before the fork, followed by a time of high increases in prices. Bitcoin gold has since been created through another fork. Last week, a third fork was proposed, but it did not receive enough support. As a result, the price of Bitcoin dropped 20% from its peak of A$9,925 on November 8 to below $6,000 late last week, according to current prices. Despite this, the value of Bitcoin cash has climbed from A$818 to A$1,850 in the same time period.

Meme coins and scams:

Another potential threat to bitcoin's value is an increase in crypto market speculation. Early this year, the price of Dogecoin rocketed to record highs as more and more individual investors jumped on the digital asset bandwagon in quest of big returns. As a result of celebrity endorsement, dogecoin was once more valuable than Ford and other large American corporations. Since then, it has lost a huge amount of value. Decentralized financial token titan plummeted to zero elsewhere in the crypto market. Mark Cuban, the self-made billionaire investor, was an owner. The amount of frauds that have sprung up this year, according to Yu at StormX, is "another cause for concern." There have been a lot of pump and dump activity with various meme currencies, and we've seen retail investors get burnt." The government always comes in

when retail gets burnt. It's possible that the entire sector might suffer from overregulation, as we've seen with initial coin offers (ICOs) in 2018.

4.6. Issue of decentralized nature of bitcoin network:

Unlike with a centralized payment system, those using a decentralized payment mechanism do not have to rely on a third party to handle their payments. With a decentralized payment method, the parties to the transaction handle their own payment. No one except the sender and the recipient of the cash needs to know about the payment since it doesn't go via a centralized node. Hence, in terms of financial privacy, decentralized clearing tends to be more secure than centralized clearing it demands a higher level of confidence between the persons involved. Each dark node is still there. relates to the sending or receiving of money by a person. Symbolized by the black wires, the payment to be transmitted from one node to another node individually. There are no white nodes can be seen. Due to the fact that payments are cleared directly between the parties to the transaction, there are no centralized clearing organizations. Therefore, payments are performed via pairwise transactions that are unique to each recipient without the Nodes on other systems can't become involved in the transaction.

The decentralized structure of bitcoin makes exchanges seem nonsensical (Huertas-Valdivia, Gallego-Burín, & Lloréns-Montes, 2019).

The Mt. Gox attack of 2014, in which roughly 25,000 investors lost approximately 650,000 bitcoins (nearly $400 million), is an example of their vulnerability. Unregulated and uninsured markets left investors with little recourse (Bauer and Ahmad 2017). It's a double-edged sword because of the cryptocurrency' secrecy and encryption. Three-quarters of Bitcoin trading platforms have been breached, according to a US Department of Homeland Security-funded research (Michael J Gandal et al., 2018).

To put it another way, cryptocurrency hacks have a big impact on price discovery for hacked currencies. The volatility of the hacked currency and cross-cryptocurrency correlations are both exacerbated by cryptocurrency hacks (Corbet et al., 2018). All cryptocurrencies must be adequately regulated, monitored, and enforced in light of the disruption they create internally and the ripple effects they have on other crypto marketplaces. As a result of this, financial regulation is moving toward a more global perspective see also (K. K. Chan & Milne, 2019).

In the hours leading up to a cryptocurrency breach, anomalous returns may also be seen, but these abnormal returns return to normal around the moment of the hack's public revelation (Corbet et al. 2018).

Current regulatory and monitoring efforts, according to this research, are moving too slowly to provide an adequate level of protection for investors.

Cumming et al. 2015; (Cumming & Johan, 2008; Cumming, Johan, & Li, 2011; Cumming, Meoli, & Vismara, 2019) might be improved in crypto markets in the future by better regulation and automated market monitoring. Some stylized facts found in research on the volatility and price discovery processes of cryptocurrencies may help illuminate some of the more obvious differences between cryptocurrency trading and other forms of securities investing (Corbet et al., 2018). Cryptocurrencies, for example, show weekend-volatility effects, which means that the conventional post-market trading time requires a lot of monitoring. International trading periods also have a major impact on intra-day volatility, suggesting that market manipulation in crypto marketplaces might be easier to spot with cross-market monitoring. In addition, the volatility of the oil and currency markets has a considerable impact on the volatility of the crypto markets, which suggests that cross-product monitoring is necessary to identify market manipulation in crypto markets.

4.7. Cryptocurrency fraud and regulatory uncertainty:

Investments in digital assets that aren't registered with the government might provide big rewards (Roberts 2017). However, the business has not registered or securitized these assets with the appropriate authorities. As a result, the asset being offered to the public lacks credibility since there is no registered prospectus confirming the security, information about management, or financial statements.

Cryptocurrencies are becoming more and more popular, and authorities are working hard to protect investors' interests by making major efforts to regulate and regularize ICOs, which is understandable given that there isn't a clear knowledge of the business or the challenges. It was established in February 2018 that every ICO that the SEC has seen so far would be constituted a security, just recently to be disputed and invalidated by the exclusion of Bitcoin and Ether as neither securities nor currencies by the SEC itself (Oyedele et al., 2017). Regulating the world's fastest-growing company has many people astonished, bewildered, and perplexed by how quickly it is progressing. According to SEC regulations announced earlier this year, ICOs are securities regardless of how they're defined by market players, investors, and promoters, regardless of how they're marketed.

Law professors, on the other hand, are concerned about the regulatory ambiguity that comes along with various kinds of crypto assets (Clement et al., 2019). There is a wide range of decentralized crypto assets, such as asset tokens and utility tokens with many uses, that are not usually included under securities regulation, as shown in Figure by Clements (2019a).

Source: Clements (2019a)
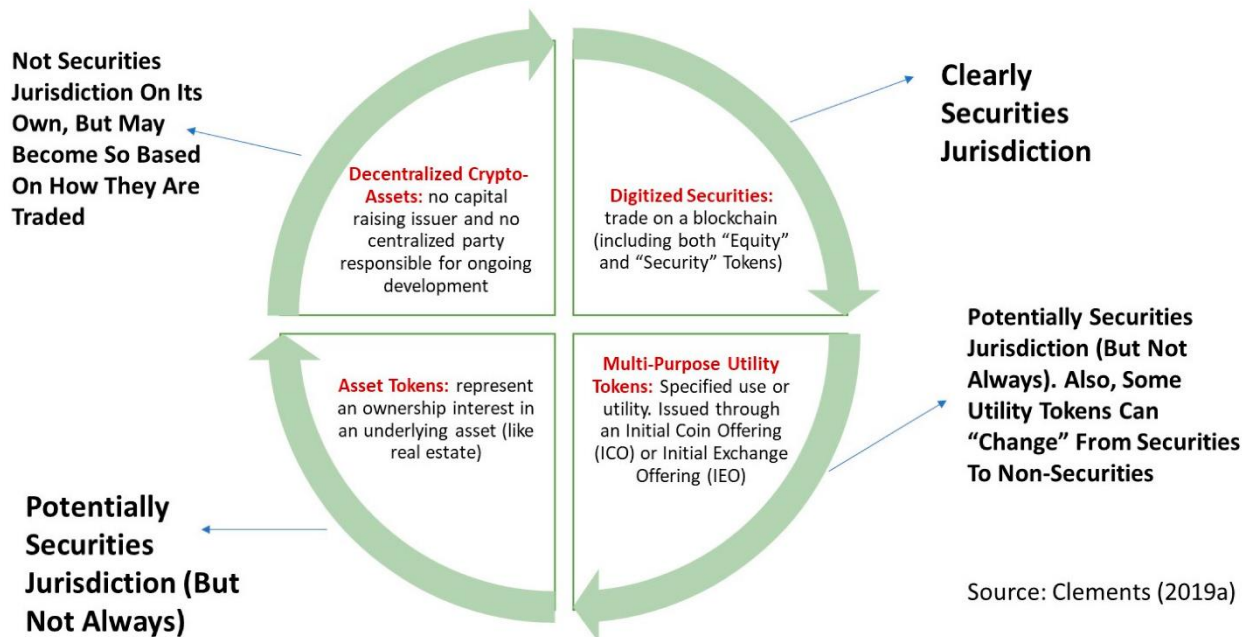
Fake investment funds:

Since asset management is one of the key drivers of growth, a slew of cryptocurrency investment funds have popped up to entice investors with the promise of unproven high returns. In most cases, multi-level marketing is used to entice investors to engage in the firm in order to maximise their financial returns. The CME and CFE have introduced Bitcoin futures, enabling investors to speculate on the asset's growth and decline. Because bitcoin is traded on well-known exchanges like these, investors have more faith in the currency.

Now that crypto-currencies have been categorized as securities and fall under the jurisdiction of securities regulators, the next step is to regulate investment funds and the advisors who deal with them. This includes mutual funds and organizations that invest in and reinvest in securities like mutual funds under the 1940 US Investment Company Act. These companies, as required by the Act, must inform investors of the investment objectives of the fund and the structure and operations of the investment company. As a result,

businesses or lone practitioners who are paid to provide financial advice to others must register with the SEC and abide by laws intended to safeguard investors under the Investment Advisers Act. To the degree that ICOs are not adequately regulated, their investment funds and advisers are also not adequately registered. The SEC will ultimately guarantee that these funds are regulated in conformity with the two statutes that govern non-digital securities.

Unregulated crypto exchanges:

False prices for a product, security, commodity, or currency are created by market manipulation. Since these assets are only loosely regulated and traded through unregulated portals, investors may be vulnerable to a wide range of market manipulation. There have been multiple examples of market manipulation, if not outright fraud, on portals, including but not limited to churning and ramping, just as there have been on more conventional exchanges for stocks and commodities. A single individual was able to boost the price of bitcoin from $100 to $1000 using bots, according to researchers (Michael J. Gandal et al., 2018). KYC paperwork requirements may not be met by all of these exchanges. These exchanges, which operate on a worldwide basis, are money laundering operations because of the lack of governmental control. They transport money across borders without much regulation. US-based GoldAge Inc. was accused "on accusations of conducting an unlawful digital currency exchange and money transfer business" in 2006, according to the indictment. With transaction costs of up to $100,000, they were tasked with transferring $30 million to digital currency accounts held by individuals with minimal identification (U.S. Department of Justice National Drug Intelligence Center 2008).

Crypto-assets may be used for fraud because of their intrinsic natures. Skepticism regarding the sector has been mostly dodged and extinguished due to several incidents of investors losing money from participating in the new products. Regulators, though, remain unclear, which raises more questions than it answers. The classification of crypto assets as money or securities is still up for debate (Agrawal 2018; Clements 2019a). There are many instances of how regulation and strong institutions may assist avert (or mitigate) economic crises, such as the Pecora Commission in the 1930s Depression and Dodd-Frank in the 2008 financial crisis. In no way, shape, or form, should the inherent "trust" characteristic of the crypto-asset technology drive or undermine the regulations that have protected the sector for decades. With regard to currency exchange, the business is protected by a variety of securities rules. When it comes to protecting both investment funds and any future economic ripple effects, these regulations are essential.

5. Chapter 5

Bitcoin Price Volatility Forecasting With The GARCH, TARCH & LSTM

5.1. Introduction:

In financial markets, cryptocurrency price predictions are critical. It is difficult to identify the elements that influence price forecasting; moreover, owing to the 24/7 trading regime, cryptocurrencies' values are subjected to huge changes, diminishing the predicting capacity of existing models. Policymakers, investors, and academics are paying more attention to crypto currencies like Bitcoin. With the use of Blockchain technology, Bitcoin is a decentralized digital money that can be delivered to anyone at any time for nearly no cost or price, subject to country-specific constraints. As seen in Fig. 1, When Bitcoin became a legal currency in the United States in late 2013, its value skyrocketed. It's estimated that the cryptocurrency industry is worth more than USD 120 billion every day, with Bitcoin being the most popular currency. (http://www.coinmarketcap.com, August 2018).

There are two ways in which Bitcoin affects the economy: With regard to international transfers and remittances, Bitcoin may serve as an alternative to the forex market (Kim, 2017). Cryptocurrency like bitcoin may be utilized as an investment because of its high levels of hedging, liquidity, and diversity (Baek & Elbeck, 2015; Bouri, Gupta, Tiwari, & Roubaud, 2017; Briere, Oosterlinck, & Szafarz, 2015; Dyhrberg, 2016a).

As a result of the lack of correlations between bitcoins and other assets, diversification benefits are available. As a result, bitcoin returns were unaffected by swings in the stock market, indicating that bitcoin may mitigate some market risk. Several studies, including those by (Nadarajah & Chu, 2017), (Tiwari, Wee, & Daryanto, 2018), (Sensoy, Kaplan, & Kandemir, 2018), and (Vidal-Tomás & Ibañez, 2018) The bitcoin market has proved that the efficient market hypothesis is true. A high-risk investment like Bitcoin, on the other hand, has the potential to have detrimental consequences on the economy.

(Cheah & Fry, 2015) and (Baur, Hong, & Lee, 2018) along with other researchers have shown that Bitcoin is susceptible to market bubbles due to speculative speculation. The bitcoin market is also inefficient compared to other asset markets, according to research by (Urquhart, 2016), (Al-Yahyaee, Mensi and Yoon, 2018), and (Jiang, Pi, and Cai, 2018).

For this reason, it is critical for investors, governments, and regulators to have a grasp of and a way to measure the underlying risk of bitcoins.

Bitcoin trading has a significant degree of volatility compared to other assets, such as gold and the US dollar (Baur et al., 2018). Jiang et al. have discovered that the Bitcoin market exhibits long-term volatility (2018). Therefore, GARCH models have been used to explain Bitcoin's price volatility in a number of academic studies (Bouoiyour & Selmi, 2016; Bouri, Molnár, Azzi, Roubaud, & Hagfors, 2017; Dyhrberg, 2016a, 2016b).

Six normally distributed GARCH models were analyzed by (Katsiampa, 2017) in order to better understand the volatility of bitcoins. Even though financial returns sometimes show heavy-tailed distributions, previous publications using GARCH-type models for bitcoin assumed a Gaussian distribution of innovations. Models like GARCH and GAS are used to model and forecast bitcoin returns as well as risk. According to GAS models, bitcoin returns may be predicted using a conditional density score. GAS models are better able to handle heavy-tailed distributions because of their flexibility. Asymmetric GARCH and GAS models have been included in a study looking at bitcoin returns. In addition, out of the sample, we compare the projected results of each model.

Additionally, we do several back testing processes for the VaR (1 percent) bitcoin return and risk estimates. Risk managers and investors should pay attention to this study since Bitcoin trading has a high degree of volatility compared to other asset classes. As a result of the Basel Accords, all regulated financial institutions must use the VaR to calculate their risk capital. Financial risk managers must accurately estimate and analyze their VaR measures in the event that financial institutions decide to invest in cryptocurrencies in order to achieve a suitable risk capital reserve. Prior research on optimum bitcoin prediction models is lacking, to the best of our knowledge.

It's hard to overstate the impact Bitcoin has had on the financial landscape since its inception in 2009. Many asset managers, major investment banks, and hedge funds now recognize the decentralized cryptocurrency as an asset class. As general adoption of cryptocurrencies continues to rise, investors are being pushed to try new things like crypto options and futures.

The volatility of Bitcoin has long been recognized as greater than that of regulated stocks and commodities. Its most recent rise, which occurred in late December 2020 or early January 2021, has raised many questions about the financial climate's future. Considering that it began off in 2020 at about USD 7,200, Bitcoin is now worth just under USD 50,000 as of the date. (end August 2021).

It is the goal of this chapter to estimate the next seven days' average daily Realized Volatility (RV) of the BTC-USD using two separate methods: the standard econometric technique to volatility prediction of financial time series GARCH and the state-of-the-art neural networks.

5.2. Price forecasting:

Bitcoin has been regarded as an investment asset following its price boom and fall. In order to make informed investing decisions, accurate Bitcoin price forecasts are necessary. In the wake of only one inquiry, an intense debate has sprung out. What is the basis behind Bitcoin's value? Understanding what influences Bitcoin's value. Financial value is a critical consideration for both researchers and practitioners alike. Finding a reasonable cost Predictors aid investor in predicting future price movements and estimating expected returns.

Before using Bitcoin as a payment mechanism, retailers and major organizations must be aware of the price fluctuation. Aside from Bitcoin and its Blockchain technology, researchers have also showed tremendous interest. As a FinTech invention, Bitcoin is considered as a disruptive force in the current payment and monetary systems. Hence, in order to better comprehend Bitcoin and promote its theoretical development, researchers need to identify the relevant elements in the spread of new financial technologies, including Bitcoin in particular.

It's only logical to wonder what criteria should be considered when making Bitcoin price predictions. In earlier studies, researchers relied on their own domain expertise and did not take the return and risk into account. The price of Bitcoin may be predicted using a variety of methods.

5.3. Research Problem:

It is a way to gauge the frequency and size of price swings in a particular financial asset. The more volatile an instrument is, the more extreme its price movements are. In the research, volatility is often considered to be the best indicator of market risk, and volatility forecasting is utilized in a variety of applications. Risk management, market making, portfolio optimization, and option trading are common uses of Realized Volatility Forecasting models. A variety of trading methods are based on spotting occasions when this volatility mismatch arises, according to (Sinclair, 2020).

$$P/L = Vega |\sigma_{implied} - \sigma_{realized}|$$

To calculate P/L, multiply Vega|sigma implied-sigma-realized| end-alignment by P/L. For example, calculating an option's price reaction to changes in general volatility by using $sigma$. To solve the second portion of the equation, we would need to predict Realized Volatility (RV), which can be done using models like the Black Scholes Model.

There have been a number of empirical studies and theoretical inquiries in academia focusing on volatility forecasting and modelling, but effective predicting of volatility remains an important difficulty for researchers. On top of that, there hasn't been a lot of study done on this Bitcoin volatility predicting since crypto option trading is still relatively new. Cryptocurrencies, unlike standard regulated stocks and commodities, have unique characteristics that must be taken into consideration.

5.4. Data:

The Yahoo Finance API yfinance was used to acquire the historical data of Bitcoin Open, Close, High and Low prices. Free and simple to start up yet with a large variety of data and offers.

Every day, I download the BTC-USD price using the ticker BTC-USD. Yahoo didn't integrate Bitcoin until 2014, therefore yfinance only has data from September 2014 to the present day, despite the fact that Bitcoin was initially exchanged in 2009. (August 2021). I'd have roughly 2,500 data points spanning about seven years of trade days to work with.

5.5. Types of volatility and how they are measured:

Vix is a measure of the volatility of a stock.

(Source: https://www.investopedia.com/terms/v/vix.asp)

Volatility is a term used to describe how much a financial instrument's price changes over the course of a certain time period. The more volatile an instrument is, the more extreme its price movements are. There is no clear correlation between volatility and price movements. It's because all differences are squared when computing the standard deviation (or variance), therefore all negative and positive differences are added together to form one number. The greater the volatility of a financial instrument, the more volatile it is likely to fluctuate in value over a particular period of time." According to Wikipedia, Volatility may be stated in percentage terms as either historical or implied.

Realized Volatility, also known as Historical Volatility (HV), measures how volatile an asset has been over a certain time frame, such as the previous months or years. Standard deviation of returns, which measures the dollar change in price as a percent of the previous day's price, is often used to evaluate realized volatility.

In contrast, implied volatility (IV) refers to the amount of volatility suggested by the current option price for the underlying asset.

In mathematical modelling, the log returns are often preferred because the assist reduce time series data's non-stationary features and stabilize it:

Formula is returned from the log. $r_{t,t+i} = \log(P_{t+i}/P_t)$

Log returns also have the benefit of being cumulative over time: $r_{t1,t2} + r_{t2,t3} = r_{t1,t3}$

There are several differences between the two:

- A little bit of a downturn.
- It is considered to have positive kurtosis when the traditional normal distribution is exceeded in terms of peak height and tail length (leptokurtic)

-
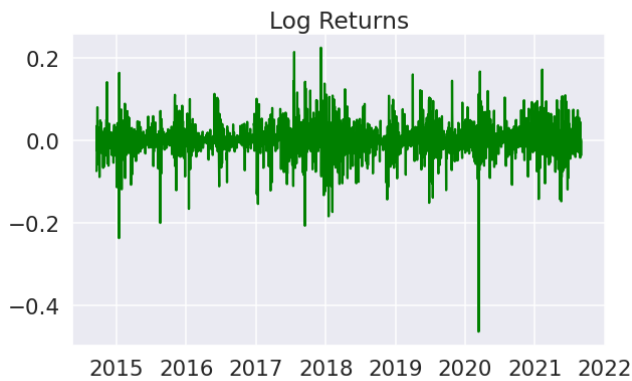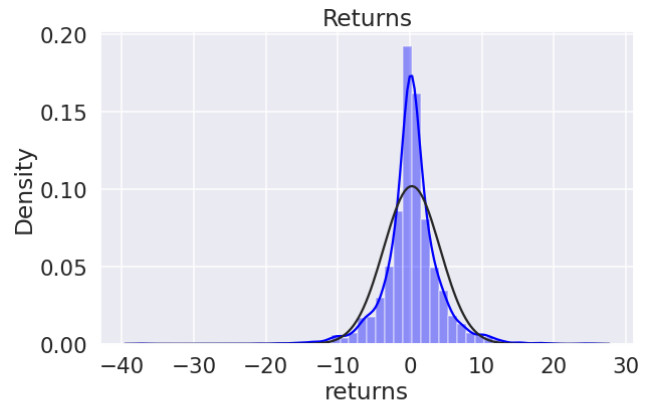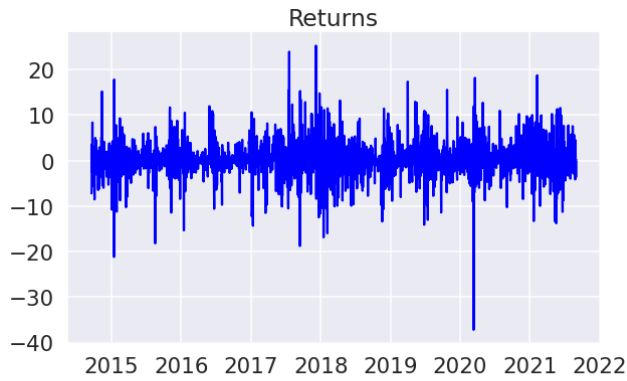
Log returns calculated over longer or shorter durations will have a different standard deviation. The standard deviation of log returns, or the square root of the sum of squares of log returns, represents the volatility for this particular project's fixed interval window (INTERVAL WINDOW):

$$\sigma_{interval} = \sqrt{\sum_{t-1,t} r^2}$$

We then multiply the daily volatility by the square root of the frequency (weekly, monthly, annually) in terms of day divided by the interval minus 1 (INTERVAL WINDOW - 1) to scale the daily volatility by that frequency. For instance:

$$\sigma_{daily} = \sqrt{\sum_{t-1,t} r^2} \ * \sqrt{1/interval-1}$$
$$\sigma_{annualized} = \sqrt{\sum_{t-1,t} r^2} \ * \sqrt{365/interval-1}$$
$$\sigma_{monthly} = \sqrt{\sum_{t-1,t} r^2} \ * \sqrt{30/interval-1}$$
$$\sigma_{weekly} = \sqrt{\sum_{t-1,t} r^2} \ * \sqrt{7/interval-1}$$

Interval window selection:

I choose a 30-day timeframe for this particular project (equivalent to roughly 1 month of trading for cryptocurrencies). In this case, the purpose is to anticipate the average realized volatility of the next n future 7 days utilizing all prior accessible data points (GARCH models) and a number of immediate past/historical data points (n past) using Neural Networks (growing forecasting windows) (sliding window forecasting).
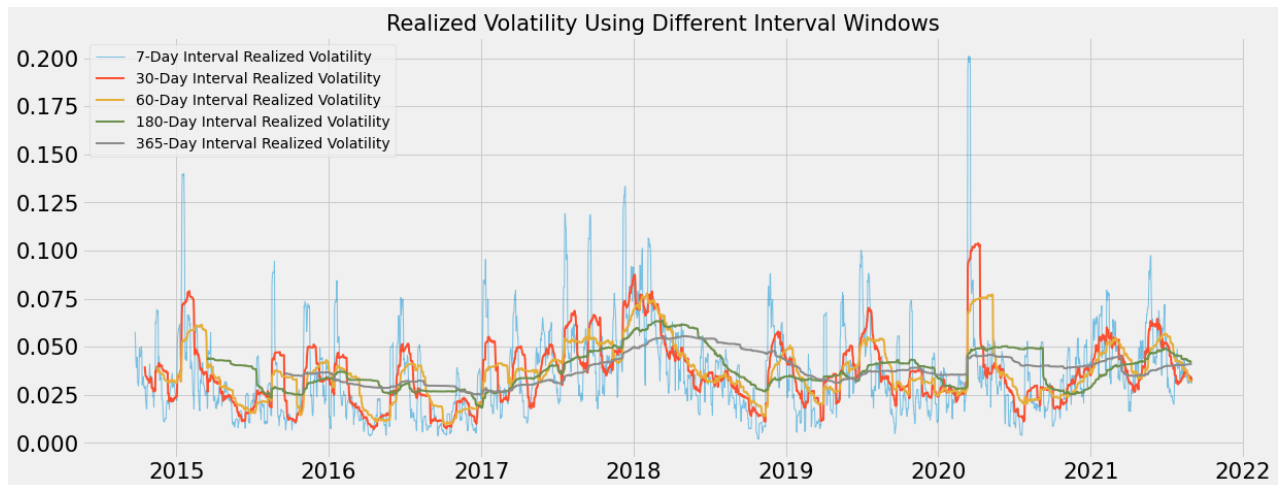

For this experiment, a period of 30 days seems to be the ideal duration since it appears to smooth out volatility and tend to return to the mean over a longer time period. The dataset wouldn't be overloaded at the outset if we used a 30-day interval window instead of a longer one.

Time-series forecasting models are forecasting models based on time-series data. Volatility shifts backward in time to produce the "future" data that we want. Due to the "future" nature of this week's Monday, I can simply use it as the "future" output for last week's Monday for Neural Networks training and model performance evaluation by just pushing the volatility back by 7 days.

Exploratory data analysis:

In the beginning, I would just plot out my desired goal outputs vol future with regard to present volatility vol current. As you can see, my first figure displays all 7 years of data, whereas the second plot just shows 365 days of data.

Future vs. Current Daily Volatility
Using 30-Day Interval

Zooming in the Last 365 Days
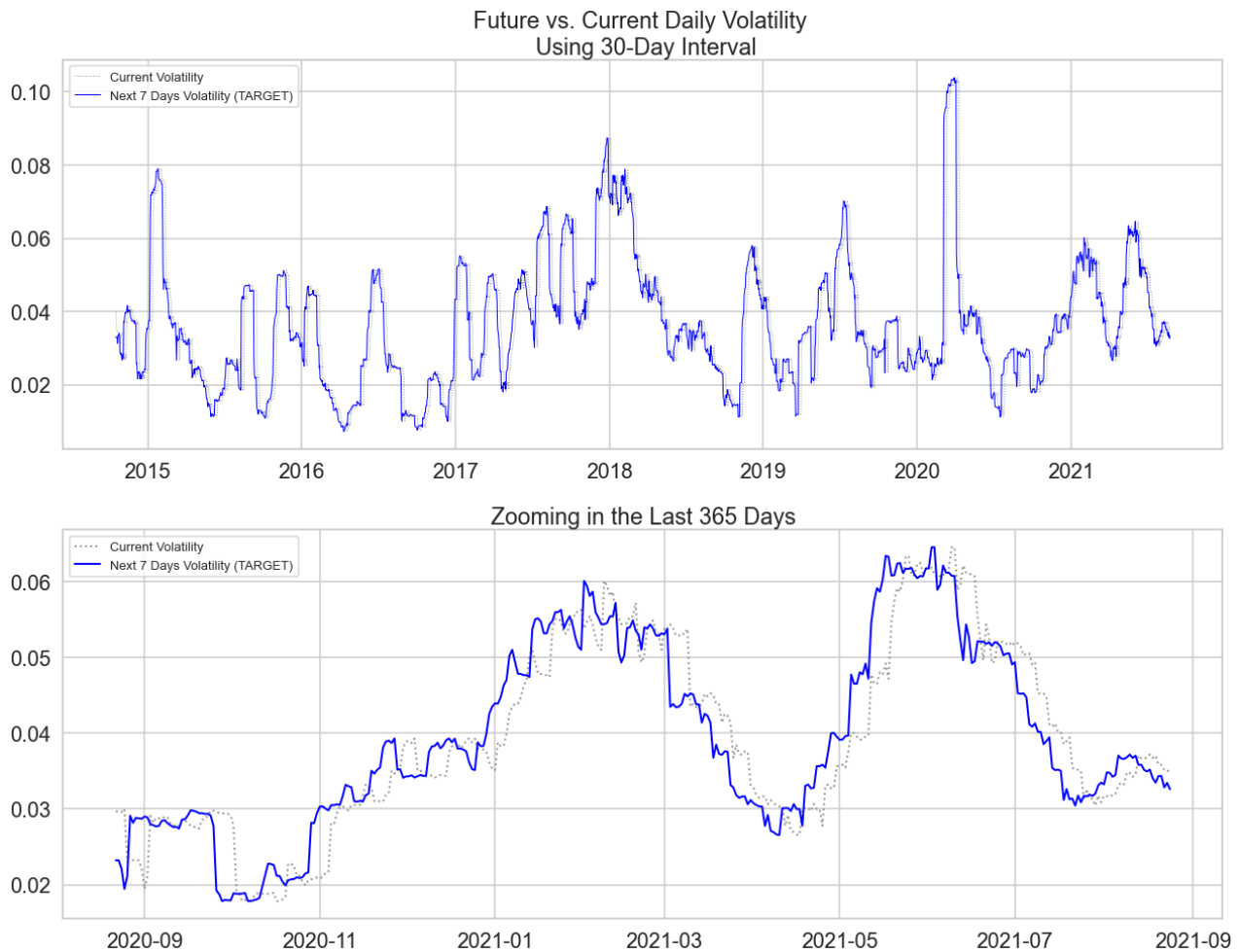
The blue line in the graph above depicts the target future value, which is where I'd want to get to in the end.

A dotted grey line depicts real-time volatility. My ultimate objective is to have an understanding of how current volatility is shifted in order to reach future values.

Volatility grouped by year:
Volatility has been directly influenced by certain major structural developments in the recent few years, such as:

- Deribit introduced Crypto Options in 2016.

- In 2017, CME began offering Bitcoin Futures, and in 2020, CME provide Bitcoin Options.

- Because of this, historical data before to 2016 is likely to be fundamentally different and follow distinct trends than data collected after that year.

The graph above shows these important events, with Bitcoin's 2017 record high at USD 19,800 at the end of December being one of them. 2020 saw a surge of more than 200 percent for outliers. At the beginning of 2020, Bitcoin was trading at USD 7,200. On 12/15/2020, it achieved USD 20,000 on most exchanges, and then only 17 days later, it touched USD 30,000, which is no minor achievement. Just to give you an idea of scale, the Dow Jones made the same shift in almost 3 years. Then, on January 7, 2021, it crossed the $40,000 mark. The BTC-USD exchange rate is above USD 49,700 at the time of writing. Overall, the daily volatility in 2021 has likewise been on the high side. "

Daily Volatility Grouped By Year
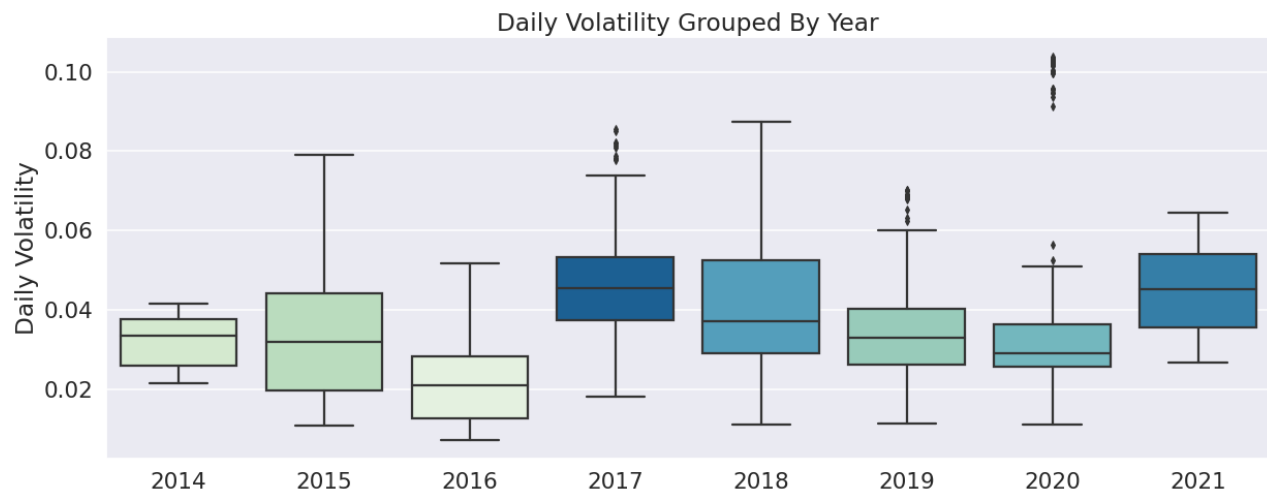
5.6.   Data processing:

5.6.1. Feature normalization:

It would be preferable to normalize the volatilities in order to standardize the forecasts provided by multiple models since I want to develop numerous sorts of models based on different techniques and diverse types of inputs. MinMaxScaler proved to be the most effective of the various Scalers that I tried.

Training Volatilities Distribution after Scaling
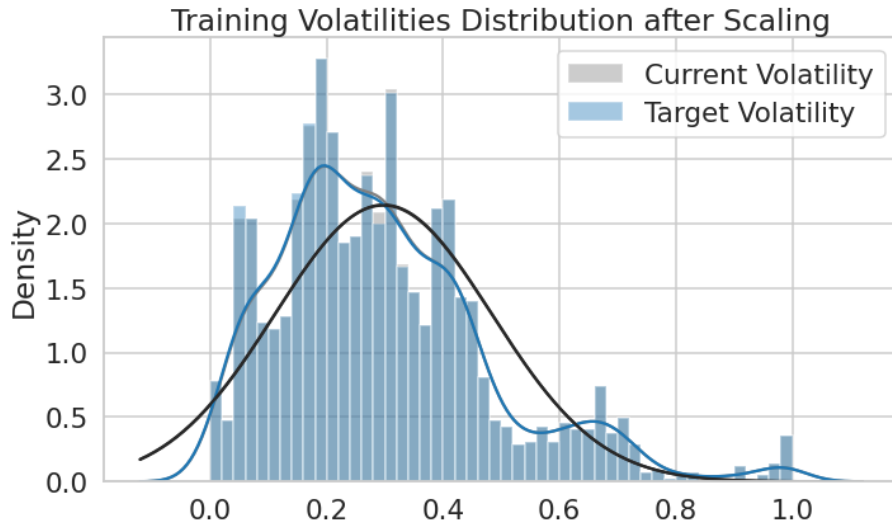
5.6.2. Train validation, Test-visualization:

Target Future Volatility Before Scaling

Target Future Volatility After Scaling
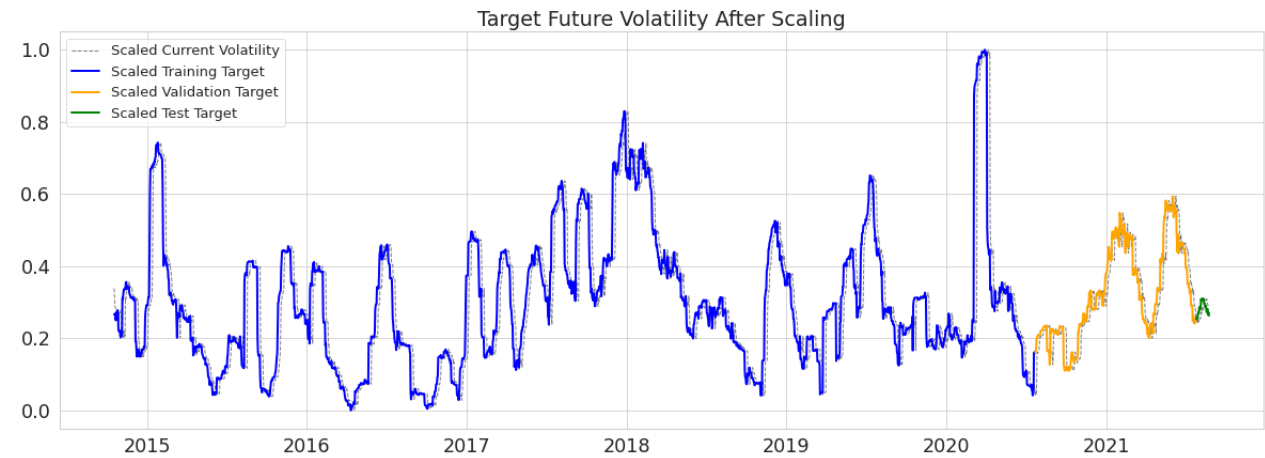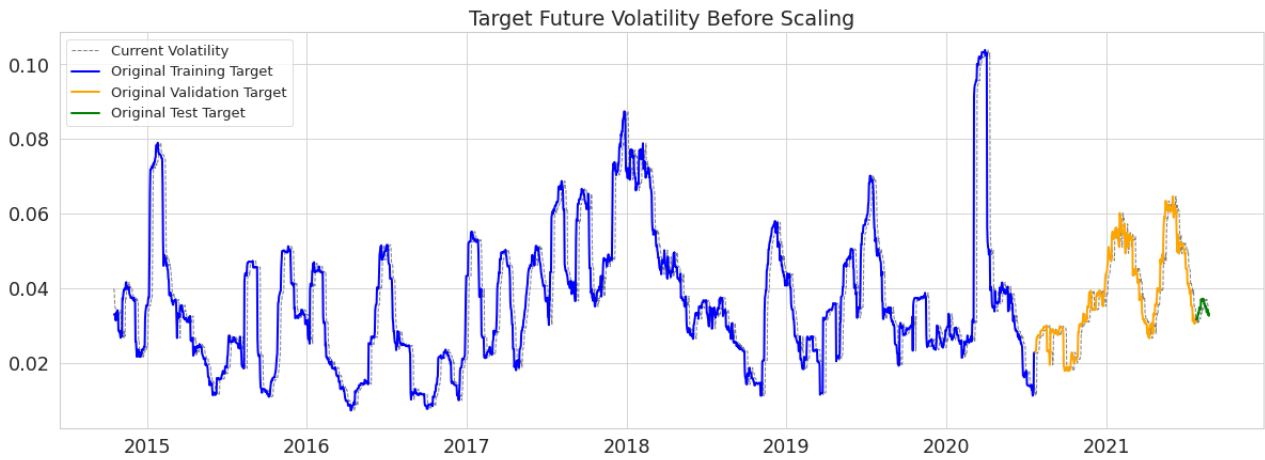
The y-axis is the most noticeable change between the two displays. Volatilities are now in the [0,1] range rather than the [0, 0.12] range they were previously.

5.7. Modeling:

5.7.1. Performance matrix:

It's virtually always possible to uncover an in-sample profitable approach if we move through the historical data using various methodologies, parameters, and timelines. Forecasting is supposed to predict the future using information that is presently accessible, whereas the best models for training data may not be the greatest for generalizing outcomes outside of a sample size (or overfitting). Avoiding/minimizing overfitting is even more crucial when dealing with unpredictable financial markets.

It is my preference to utilize RMSPE (Root Mean Squared Percentage Error) over RMSE (Root Mean Square Errors) as my preferred measure. The degree of latitude in selecting the frequency/interval window means that time scaling is critical in calculating volatility. So, I believe that the degree of inaccuracy in comparison to the intended target values may be better captured by RMSPE than other measures. For this reason, I wish to use RMSPE instead of the more commonly used MAPE (Mean Absolute Percentage Error). We'll keep track of the RMSE and RMSPE across various models' predicting performance on validation sets so we can see how well they generalise to out-of-sample data.

5.7.2. Base line model:

Mean base line:

Volatility's long-term mean-reversion is one of its most important qualities. As a result, my initial model would be a very basic one that merely predicts the whole training set's average current realized volatility.

Baseline Model Using Training Data's Average Daily Volatility as Prediction on Validation Data
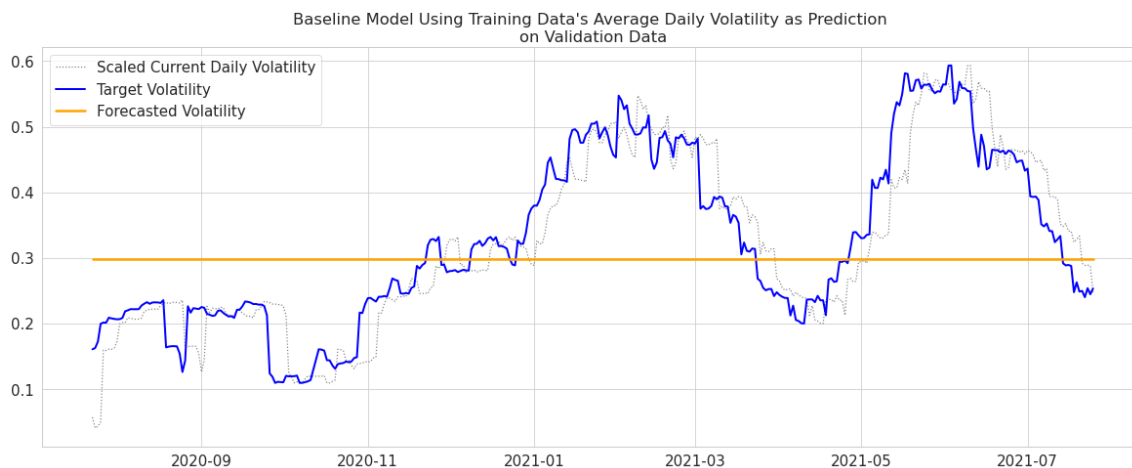
Random walk naïve forecasting:

Volatility tends to be autocorrelated and tends to cluster in the short-term, a well-known phenomenon. Just by utilizing the current day's daily volatility, a simple model can be built that forecasts what the market will do next based on that day's volatility. Vol current at time step t and vol future at time step t will be used in this scenario to anticipate the following 7 days of INTERVAL WINDOW's average daily volatility.
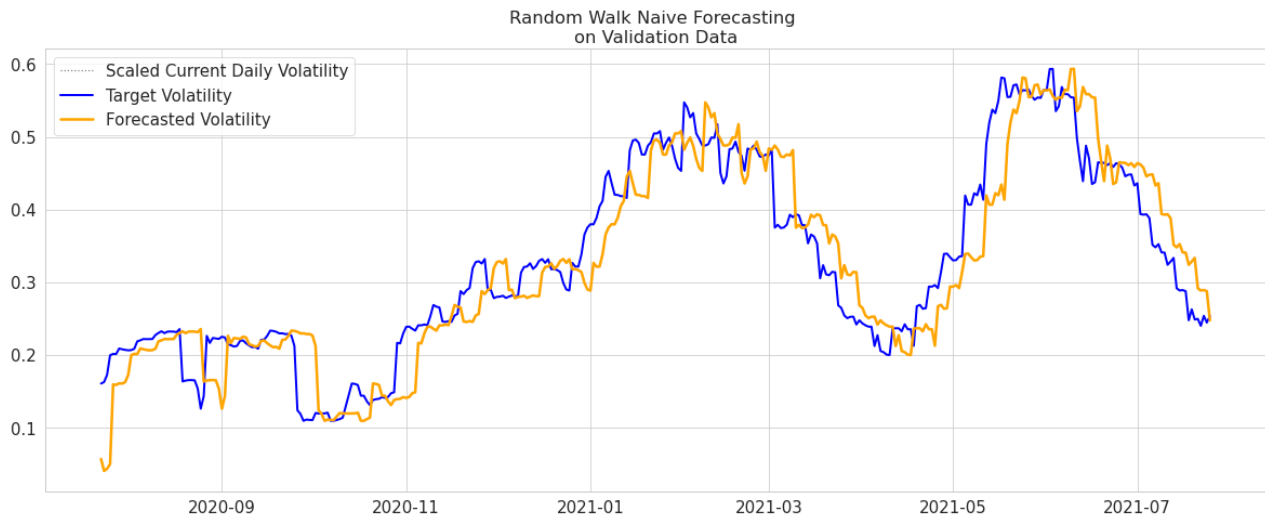
In time series forecasting, naive forecasting may be surprisingly hard to exceed.

5.8.   GARCH model:

An expansion of the ARCH model, GARCH is known as Generalized Autoregressive Conditional Heteroskedasticity (Autoregressive Conditional Heteroskedasticity). When it comes to predicting the volatility of financial time series, Garch is an old-school method that uses variance factors and residual errors from a mean process to forecast future volatility. The mathematical representation of GARCH is as follows:

σ2t=ω+∑iqαiϵ2t−i+∑1pβiσ2t−i

where t is the time step, and t-1 is the model residuals at time step t.

So:

   σ_t^2 (conditional variance of ϵ_{t-I})

   p (number of autoregressive lags)

   q (number of moving average lags)

ω (constant)

ε^2t-i (residuals from previous period)

σ^2t-j (the variance from previous periodsα)

β (GARCH parameters)

There are just first-order lagged terms in GARCH (1,1) and the mathematical equation for it is:

σ2t=ω+αϵ2(t−1)+βσ2(t−1)

α, β and ω which adds up to 1, and the long-term variance is denoted by ω.

(Reference: Positional Option Trading - Euan Sinclair)

Even while GARCH is generally accepted to be a smarter alternative to the naïve belief that future volatility would be the same as the past, some volatility experts say it is overrated as a prediction. Volatility in the short and long run will likely imply reversion to the historical long-term average, since GARCH models reflect these important properties of volatility.

In this approach, the most recent observations are given more weight than those from the past. It is challenging to estimate different parameters in this model because of the presence of several delays (Tsay & Chen, 2018). GARCH was designed by Bollerslev (1986) as a way to include the ARCH model, which uses decreasing weights but does not allow the weights to fall totally to zero (Engle, 2001). In finance, this provides an easy-to-use model that has been particularly effective in forecasting conditional variances.

According to the two equations for the conditional mean and variance, this model has been built (Alexander, 2008). T, the error term in the conditional mean equation, illustrates the returns' unpredictable nature. The model is first-order regressive, as shown in Equation (Alexander, 2008).

$$r_t = c + Q r_{t-1} + \ \varepsilon_t \qquad\qquad \text{with } \varepsilon_t \sim \text{i.i.d.} \left(0, \sigma^2\right) \text{and } |Q| < 1,$$

r t (return)   rt-1 (last period's return)

c (constant)   εt (error term)

Q (parameter)

To get an idea of the error terms, this conditional mean equation uses prior period's returns as σ_t^2

input (Alexander, 2008). Conditional variance then incorporates the error term. The variance of the present period may be used to predict the volatility of the next period. It has been stated that the GARCH (1,1) model, the simplest and most robust since its inception, is the most robust (Engel, 2001). GARCH (1,1) does not outperform alternative volatility models utilizing exchange rate data, as shown by (Hansen & Lunde, 2005) who conducted a comparison between them and found no evidence that it does. From the following equation, Since the variance is determined using the squared residual and the most recent estimate of variance, it is obvious. In 2012, Hull Jr. The GARCH (1,1) model was used for this landmark research on bitcoin because of its strength and simplicity.

Equation: GARCH (1,1)

$$\sigma_t^2 = \omega + \alpha_1 \varepsilon_{t-1}^2 + \beta_1 \sigma_{t-1}^2 \qquad 0 \le \alpha1 \, , \beta1 \le 1, (\alpha1+\beta1) < 1$$

Assumption of normal distribution is common when using these models (Bai, Dent, Olsson, & Schaepman, 2008). In spite of this, financial data is well recognized to exhibit leptokurtism. It is because of this that (Bollerslev, 1987) assumed a t-distribution, which may better fit volatility dynamics and kurtosis than the normalcy assumption, leading some academics to abandon the normality assumption altogether. Bollerslev's study in which he stated that the GARCH (1,1) model might be used to calculate bitcoin returns will be examined to see whether a similar result can be obtained.

Following the example of Vlastakis and Markellos, the GARCH (1,1) model is revised to test whether the variables given in section 5.2 have an influence on the volatility of bitcoin (2012). The GARCH model's conditional variance equation includes these new variables to account for the modification (1,1). The model is shown in the following equation.

$$\sigma_t^2 = \omega + \alpha \varepsilon_{t-1}^2 + \beta \sigma_{t-1}^2 + \gamma \pi_t + \delta \phi_t + \zeta \xi_t + \vartheta \tau_t + a\varphi + bv + c\square + d\eta + e\Omega + f\varpi$$

Where: π = information demand,

φ= trade volume, ξ = world market indexτ = trend, ɸ = Cyprus, v = Silk Road, Υ = Baidu, η = USA, Ω = China, ϖ = MtGox

Specifications for GARCH models vary widely. E-GARCH model (Nelson, 1991) does not require parameter restrictions and views volatility as a multiplicative function of previous innovations, while the GJR-GARCH model of (Glosten, Jagannathan, & Runkle, 1993) takes into account the asymmetrical effects of returns by including additional coefficients for negative shocks in the GCH (1,1) model.

For example, the (Creal, Koopman, & Lucas, 2013) generalized autoregressive store model (GARCH) which includes many different observation-driven models. GARCH family models were used in earlier research to study bitcoin volatility. (Bouoiyour & Selmi, 2016) examined the sub-period volatility of bitcoin using several GARCH type models, and A study by (Katsiampa, 2017) looked at the GARCH family models throughout the course of time. According to their research, et al. (2017) discovered that the amount of bitcoin trade does not accurately predict bitcoin volatility their link to one another.

Volatility in financial assets is characterized by the formation of clusters. Volatility is easy to notice in daily data, but fades away over time in monthly and yearly data sets because of this. Engle created the Autoregressive Conditional Heteroscedasticity [ARCH] model in 1982 to account for these anomalies, which are also known as heteroscedasticity (Engle, 2001).

5.8.1. Basic GARCH:
According to the autocorrelation plots, there seems to be a substantial link only until the 7th lagged lag.

On the basis of returns, GARCH models are trained. In part, this is due to my inability to determine with certainty which timescale GARCH conditional volatility is calculated on (likely daily) and the fact that the outputs here appear to be on a completely different scale than the volatilities previously calculated, which led me to normalize the volatility across the board. They look much better together when I scaled them.
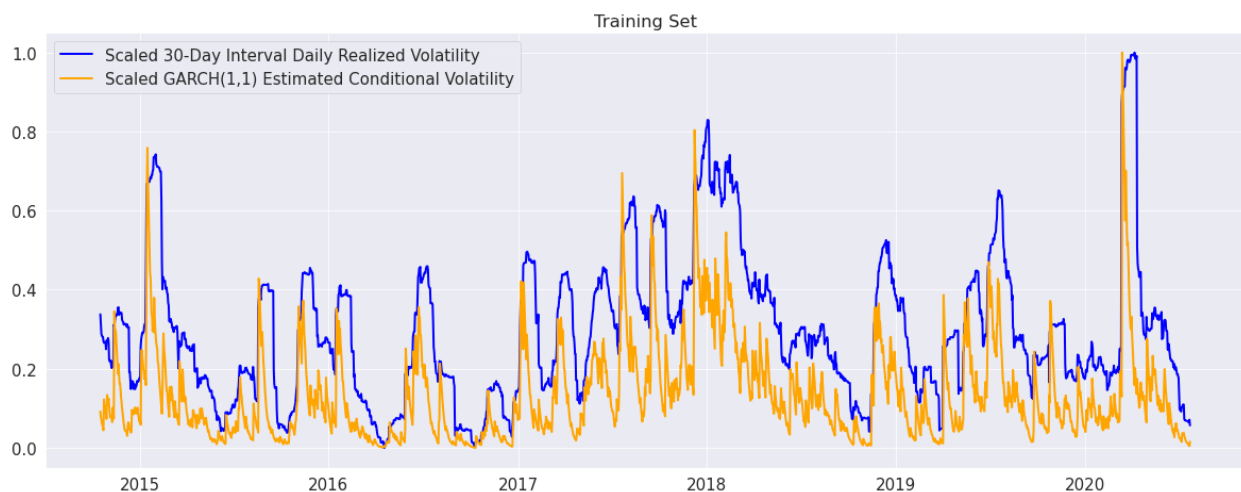
5.8.2. Analytical base forecasting:

In order to provide predictions for the next n future days, I'm using rolling one-step forecasting, in which I first fit the model to all of the data available up to a certain time step. As an example, if I wanted to anticipate vol future at time step t, I would fit the model using all returns up to that point and then calculate the average predicted volatility for the next seven time points. When employing GARCH models using % returns as input, the volatility estimates have a completely different scale than when using log returns. In order to normalize the anticipated volatility based on the model's conditional volatility output from the training data, I am going to compare the scaled versions of volatilities on the Validation set.

Analytical Forecasting GARCH(1,1) Constant Mean Normal Distribution on Validation Data
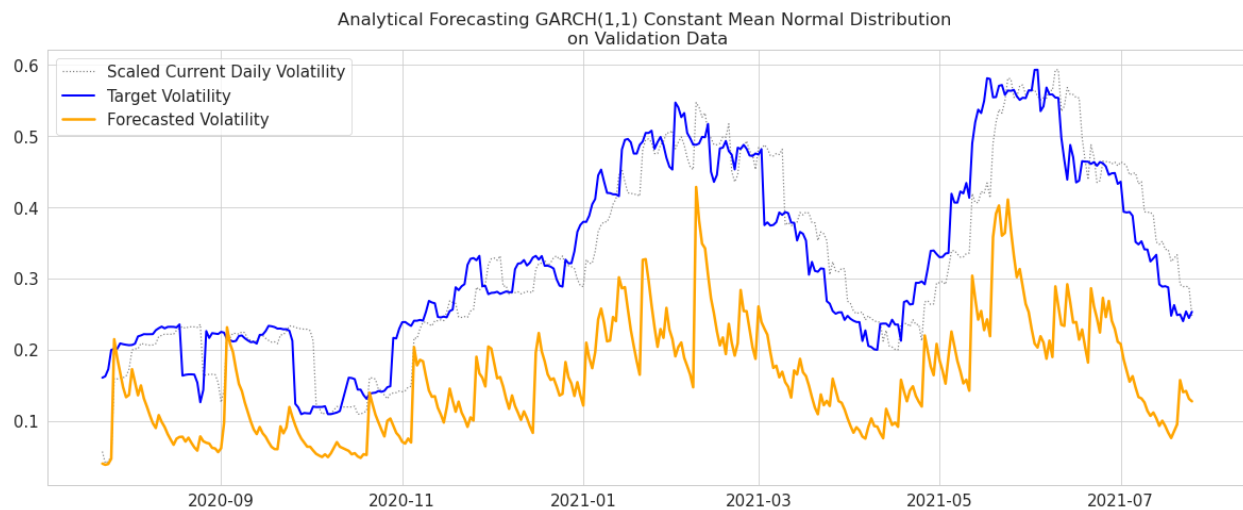
As a result, forecasting for the next seven days is still falling short of objective levels. Garch's predicted volatility seems to be lower than that of its training volatilities (after normalization).

5.9. TARCH:

TARCH, an acronym for Threshold Autoregressive Conditional Heteroskedasticity, is another member of the GARCH family (and also known as ZARCH). TARCH makes use of absolute values while simulating volatility (instead of squares). This model's default power of 2.0 corresponds to variance processes that develop in squares, hence the power is set to 1.0 by specification. In addition, a dummy variable is used to introduce asymmetric influence into the GARCH framework.

TARCH(1,1) models' volatility is described by the following equation:

$$\sigma t = \omega + \alpha |\epsilon t{-}1| + \gamma |\epsilon t{-}1| I[\epsilon t{-}1 < 0] + \beta \sigma t{-}1$$
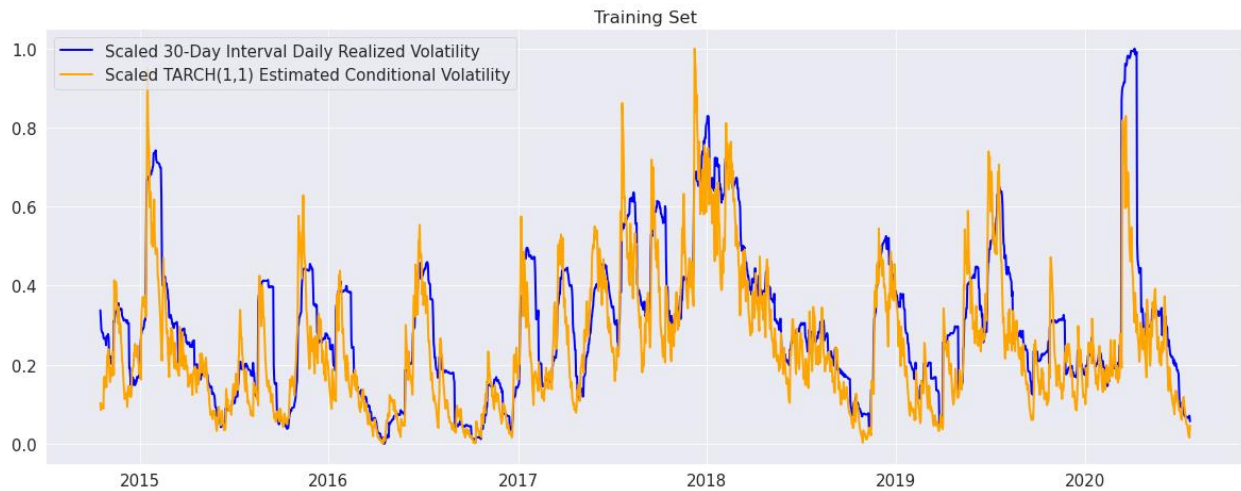
5.9.1. Bootstrap-based Forecasting for TARCH(1,1)

For horizons greater than 1, TARCH models lack closed-form (analytical) predictions, necessitating simulation or bootstrapping.

Only the values used to model the process in bootstrap predictions are generated from historical data rather than from an assumed distribution of residuals. As a result of this procedure, simulated forecast pathways are returned in an ARCH Model Forecast Simulation.
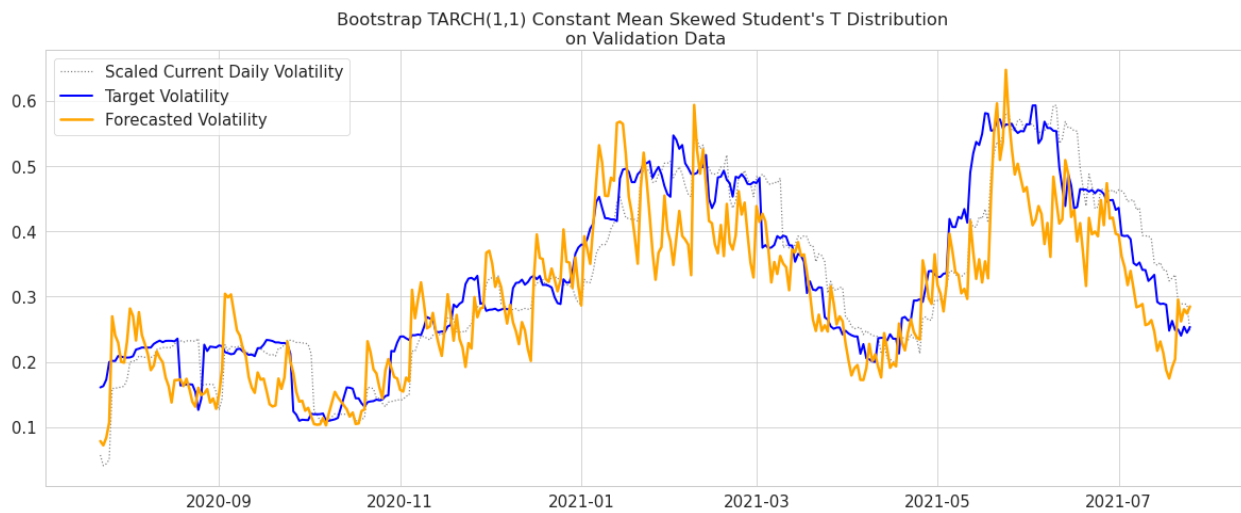
All other models missed the mark when it comes to expected volatility, but this one seems to perform a better job. This has the potential to be quite positive...

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The Validation RMSPE of Bootstrap TARCH(1,1) is lower than that of Naive Forecasting! Even if the RMSE is a little higher, thus far this has been the finest GARCH model I've come across.
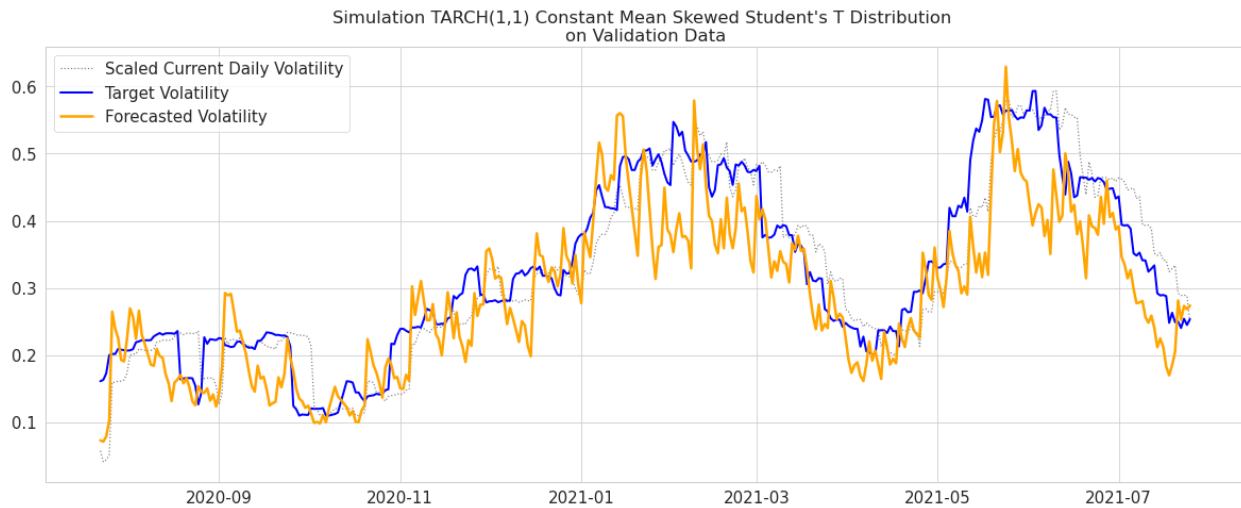
Bootstrap seems to outperform the other forecasting approach on TARCH (1,1). Probably because bootstrap utilises historical data to calculate rather than an imagined distribution of residuals, which is what bootstrap does.

5.9.2. Final GARCH Model - TARCH(1,2)

As a follow-up, I'll record each model's performance on unseen data using RMSPE for each of the three variables of p, q, and o. I'll remove p from the list of permutations since it can't accept a value of zero.

Bootstrap TARCH(1, 2, 0) Constant Mean Skewed Student's T Distribution on Validation Data

	Model	Validation RMSPE	Validation RMSE
0	Mean Baseline	0.507040	0.132201
1	Random Walk Naive Forecasting	0.224657	0.052533
2	GARCH(1,1), Constant Mean, Normal Dist	0.530965	0.185607
3	Analytical GJR-GARCH(1,1,1), Constant Mean, Skewt Dist	0.276679	0.090312
4	Bootstrap TARCH(1,1), Constant Mean, Skewt Dist	0.209654	0.069814
5	Simulation TARCH(1,1), Constant Mean, Skewt Dist	0.215751	0.073293
6	Bootstrap TARCH(1, 2, 0), Constant Mean, Skewt Dist	0.200954	0.066851

5.10. Neural Networks

Machine Learning, particularly Neural Networks, has been more popular in recent years as a way to anticipate volatility in the financial markets. GARCH remains the gold standard for conventional financial organizations.

The Efficient Market Hypothesis (EMH) asserts that the market is intrinsically efficient and that it is difficult to continually beat the broader market. It is impossible to estimate the results of a fully efficient market since the more efficient it is, the more random and unpredictable it is.

Behavioral Finance has a strong case against EMH as well: the market has only been present for a short time in comparison to human history, which spans 200,000 years. Since the CBOE started in 1973, stock options have only been sold in a liquid, transparent market; and the average lifespan of an S&P500 firm is around 20 years. People's psychological proclivities may be traced back to as far back as 200,000 years. This implies we can expect to see a similar pattern repeat itself in future financial markets. It is thus

impossible for a market system to be completely random. Many forces interact and influence the market, making it incredibly difficult to exploit these trends.

Seeing how Neural Networks stack up against GARCH models would be fascinating.
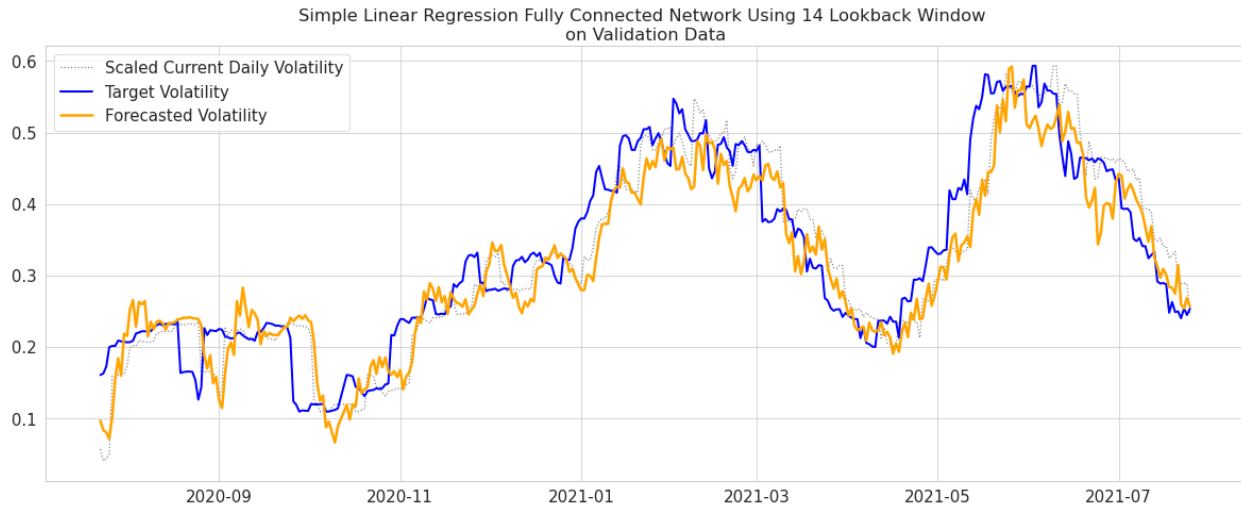
The projection roughly follows the current volatility line, although it lags below my goal values by a significant margin.

5.11. Univariate Long Short-Term Memory (LSTM)

"Predicting the future" is possible using Recurrent Neural Networks (RNN). Time series data, like as stock prices, are well-suited for RNN, which can also handle inputs like words, documents, and audio samples. Autonomous driving systems employ RNNs to predict vehicle paths and prevent collisions, which is another usage for the technology (Geron, 2019)
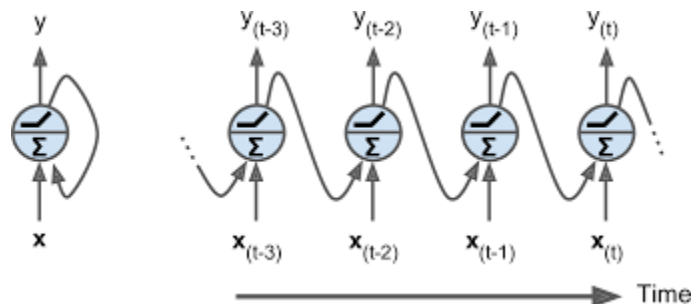
At each time step t, the recurrent neuron receives input xt and output yt1 from the previous time step. Since the output of a Recurrent Neuron is a function of all the inputs from previous time steps, it has some

kind of memory and may store information across time. RNN's state maintains little information from initial inputs because of the changes that data experiences as it progresses through an RNN.

Long Short-Term Memory (LSTM) was introduced by Sepp Hochreiter and Jurgen Schmidhuber in 1997. (LSTM). The crucial component of LSTM is that the network can learn what's significant and needs to be preserved in the long-term state, and what may be disregarded. It appears like a conventional RNN cell, however the state of the LSTM is divided into two:

for a brief period of time: ht

to maintain a long-term condition

LSTM is a black box, and may be utilised as a simple Recurrent Neural Network (RNN) cell. However, it tends to perform considerably better, helps training converge quicker, and also find long-term relationships in the data. It is strongly suggested to run the second half of the notebook on Google Colab since it employs an optimised LSTM implementation when running on a GPU.

1-Layered LSTM RNN (20 units) with 14-Day Lookback Window
on Validation Data
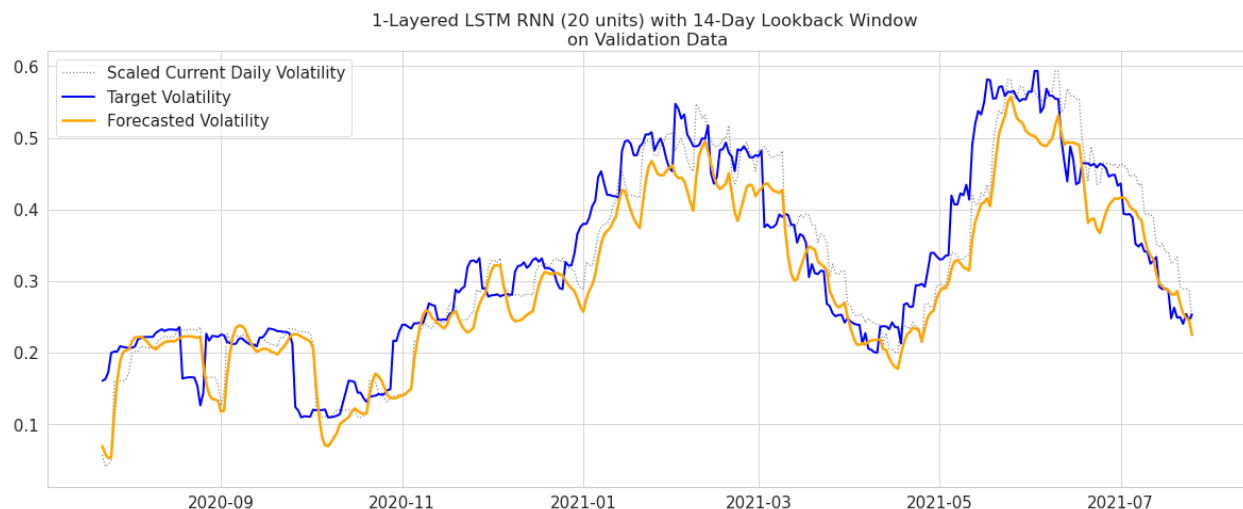
There is only one hidden LSTM layer of 20 units in the first LSTM model. My current setup is adam and I plan to experiment with other optimizers later if necessary. Forecasts closely follow vol current and the prediction line has flattened down, but it is still trailing behind the intended goal compared to the predictions of fully connected NNs.

5.11.1. Univariate Bi-directional LSTM

This case may benefit from a cell extension of the LSTM cell known as bidirectional LSTM, which provides extra context to the models. It is possible to train two LSTMs instead of one on the same input sequence since all timesteps of the input sequence are already available: one on the inputs as-is, the other on an inverted copy.

An added benefit of doing so is that it may assist offer extra context for the networks, which in turn helps them learn about the issue quicker and more thoroughly. In order to determine whether the model can better catch specific patterns, I'm going to increase the number of hidden layers and raise n past to 1 month using LSTM.

Training vs. Validation Learning Curves

2-Layered Bidirectional LSTMs (32/16 units) with 30-Day Lookback Window on Validation Data
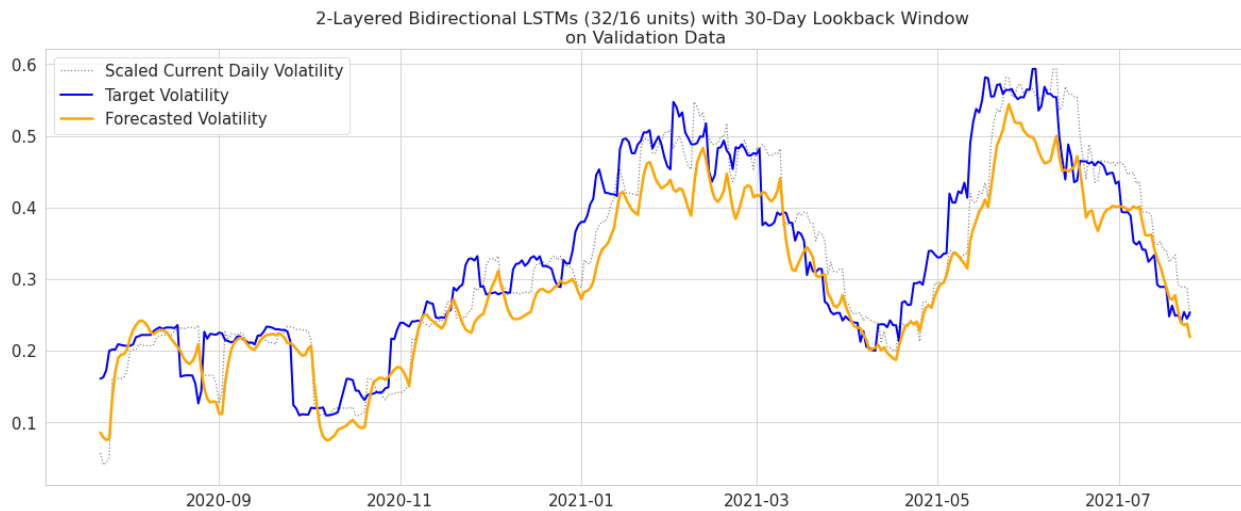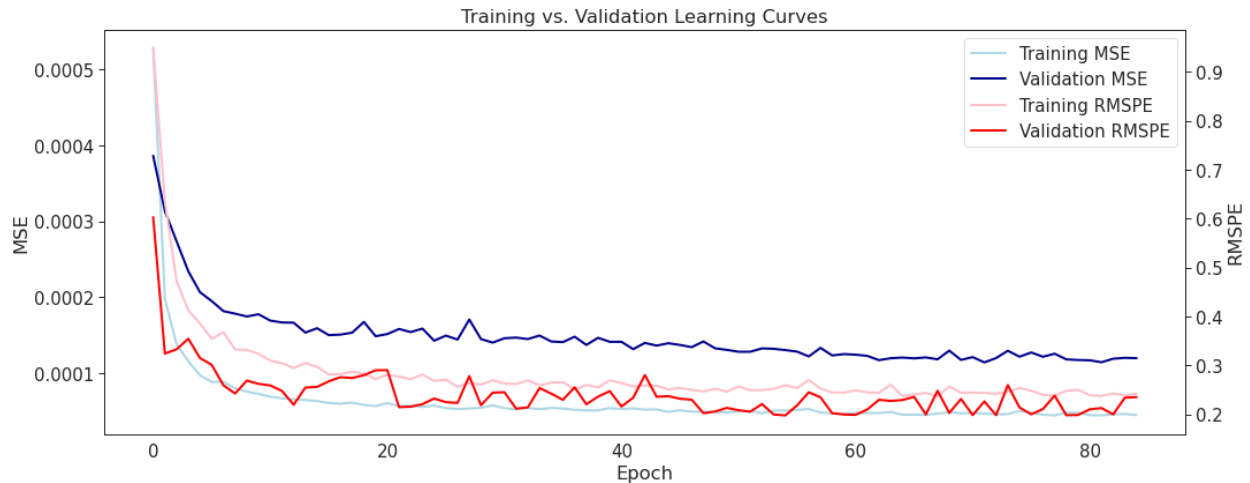
A 30 day lookback window and two layers of bidirectional multilayer stochastic gradient descent models (LSTMs) surpass the best GARCH model (TARCH(2,2)). There are a variety of activation functions and network topologies that have been examined in previous Exploratory Notebooks, such as: changing batch size, increasing the number of LSTM layers, and increasing the number of units in each LSTM layer.

These algorithms have not beaten the basic architecture mentioned above (2 layers of Bi-directional LSTMs with 32 and 16 units and n past=30).

5.12. Multivariate LSTM:

All of my current models use basic 1-dimensional inputs, which may not be adequate for financial data. That might explain why most of the models listed above fail to outperform Naive Forecasting in terms of accuracy. Inadequate data will almost always lead to poor outcomes, regardless of the model's complexity or the number of neurons or hidden layers it employs.

After that, I'll experiment with multivariate neural networks to see if they can boost performance any more.

With two hidden layers of Bidirectional LSTM, my first Multivariate LSTM model would be quite easy (quite similar to the Univariate structure above). Dropout layers, on the other hand, will be inserted between the two. Dropout layers may assist decrease model overfitting when there are more features in the model.
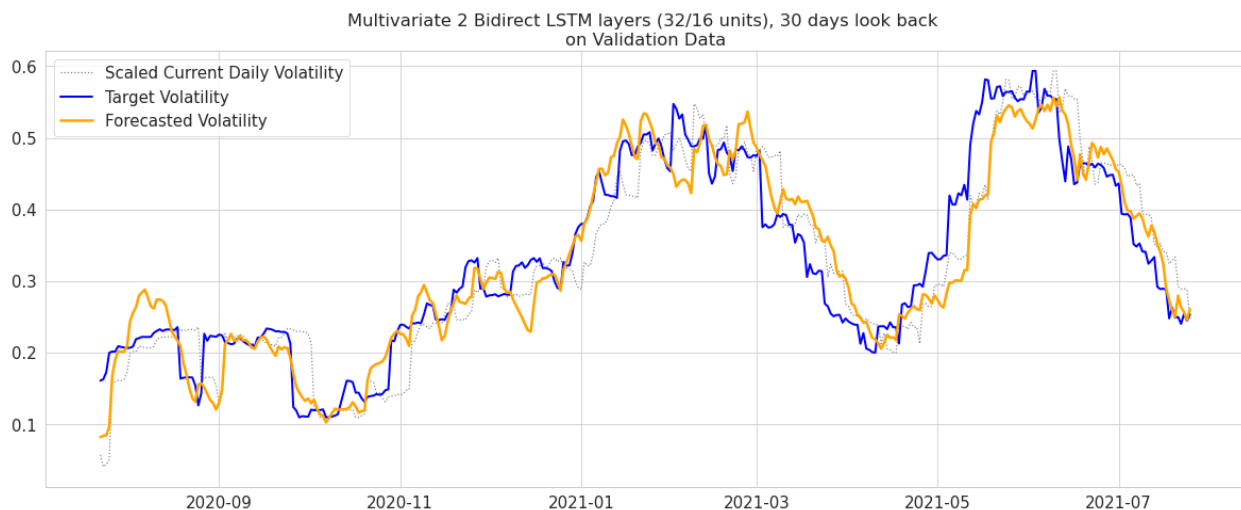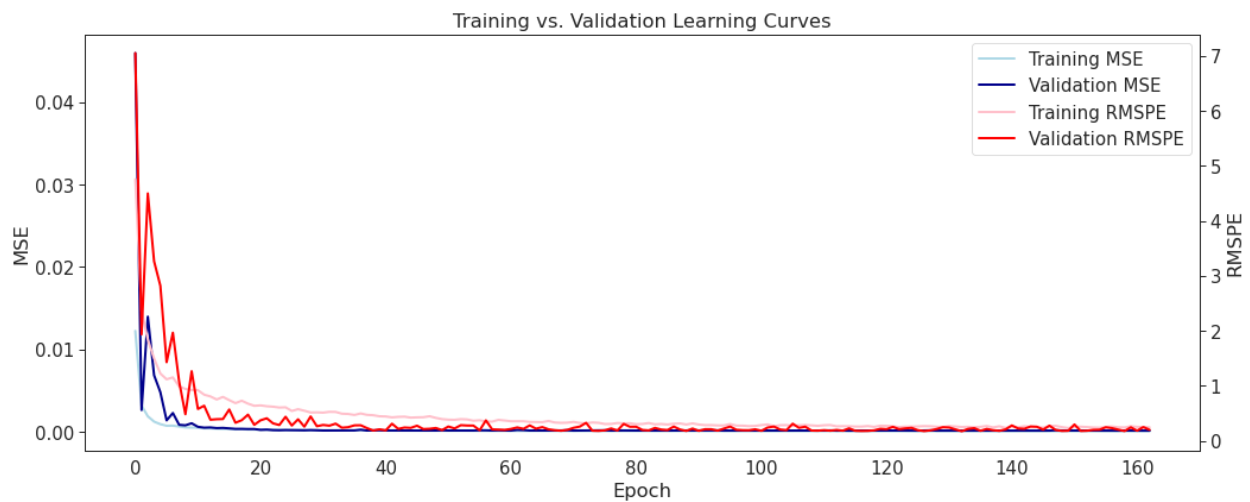
Training vs. Validation Learning Curves

Multivariate 2 Bidirect LSTM layers (32/16 units), 30 days look back on Validation Data

Between November 2020 and February 2021, the forecast line has moved horizontally closer to the target lines, and has actually tracked the expected output extremely closely. This is a significant step up from the previous generation. Unlike some of the others, this one doesn't seem to be as cluttered.

5.12.1. Multivariate 3-Layered Bidirectional LSTM

As a further step, I'm going to experiment with adding additional LSTM layers to see if that helps boost performance.

Training vs. Validation Learning Curves

Multivariate 3 Bidirect LSTM layers (64/32/16 units), 30 days look back on Validation Data
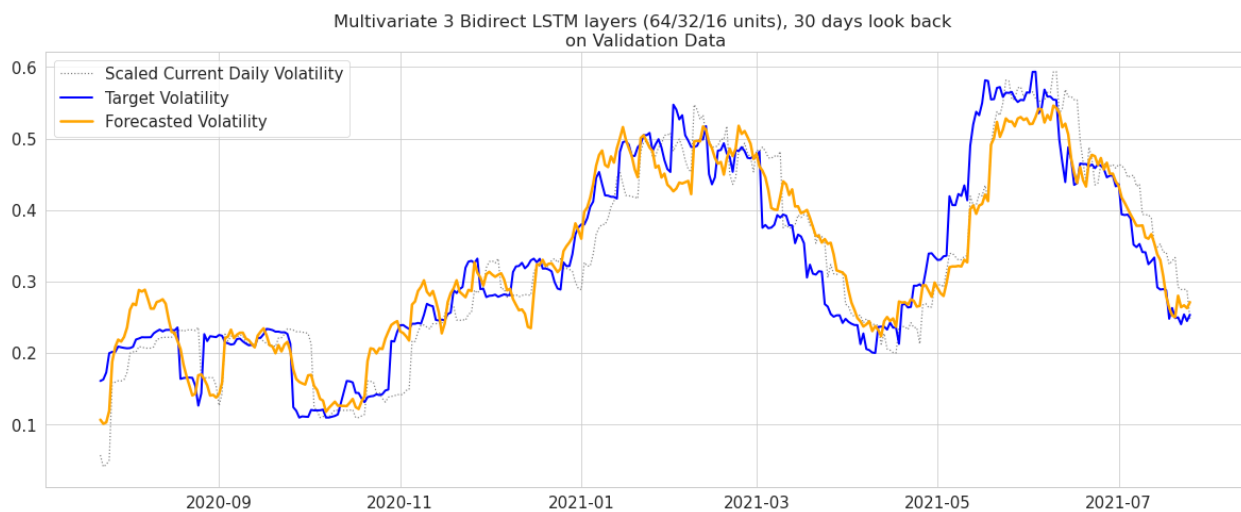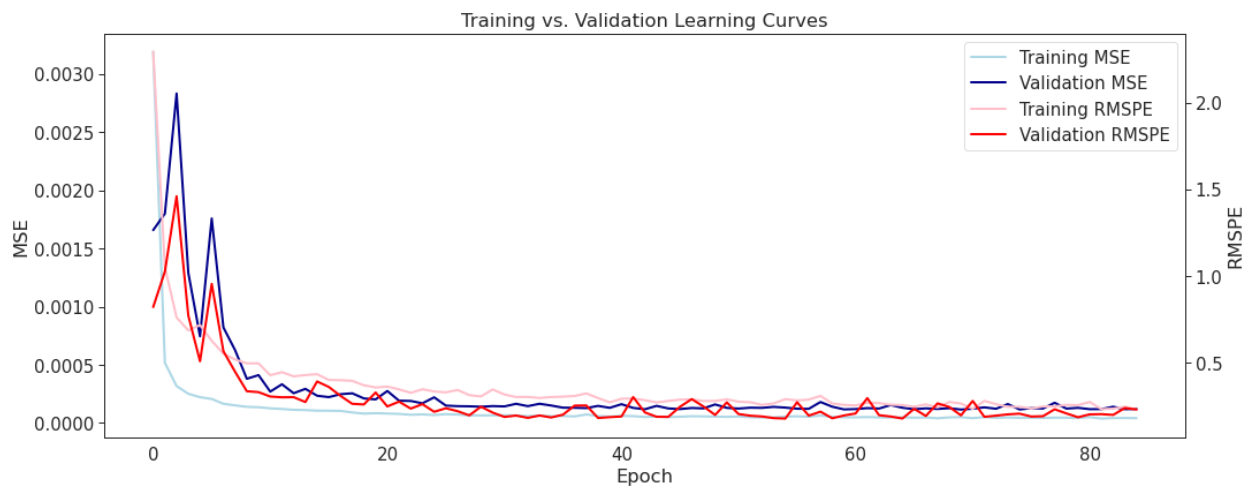
However, the RMSPE has actually increased somewhat (from 0.046139 to 0.044660) by adding an additional LSTM layer (from 0.156677 to 0.164623).

	Model	Validation RMSPE	Validation RMSE
0	Mean Baseline	0.507040	0.132201
1	Random Walk Naive Forecasting	0.224657	0.052533
2	GARCH(1,1), Constant Mean, Normal Dist	0.530965	0.185607
3	Analytical GJR-GARCH(1,1,1), Constant Mean, Skewt Dist	0.276679	0.090312
4	Bootstrap TARCH(1,1), Constant Mean, Skewt Dist	0.209654	0.069814
5	Simulation TARCH(1,1), Constant Mean, Skewt Dist	0.215751	0.073293
6	Bootstrap TARCH(1, 2, 0), Constant Mean, Skewt Dist	0.200954	0.066851
7	Simple LR Fully Connected NN, n_past=14	0.238177	0.055336
8	LSTM 1 layer 20 units, n_past=14	0.223199	0.057603
9	2 layers Bidirect LSTM (32/16 units), n_past=30	0.202388	0.057865
10	1 Conv1D 2 Bidirect LSTM layers (32/16), n_past=30, batch=64	0.230372	0.062146
11	2 Bidirect LSTMs (32/16), n_past=30, batch=64, SGD lr=6.9e-05	0.399735	0.165500
12	Multivariate Bidirect LSTM 2 layers (32/16 units), n_past=30	0.156677	0.046139
13	Multivariate Bidirect LSTM 3 layers (64/32/16 units), n_past=30	0.164623	0.044660
14	Multivariate 4 Bidirect LSTM layers (128/64/32/16 units), n_past=30, batch=64	0.167586	0.050386
15	Multivariate 2 Bidirect LSTM layers (32/16 units), n_past=30, batch=32, tanh	0.163605	0.050781

5.13. Final Model:

Between November 2020 and February 2021, the forecast line has moved horizontally closer to the target lines, and has actually tracked the expected output extremely closely. This is a significant step up from the previous generation. Unlike some of the others, this one doesn't seem to be as cluttered.

Training vs. Validation Learning Curves

Final Model Prediction on Test Set
(Zooming in the Most Recent 365 Days)

Final Model Predictions (Zooming in the Most Recent 365 Days)
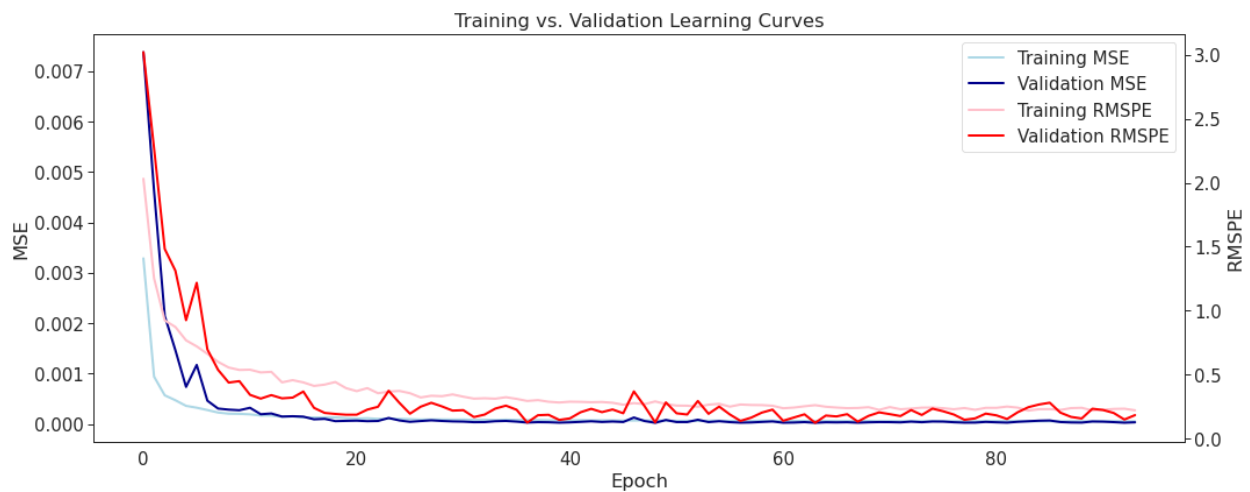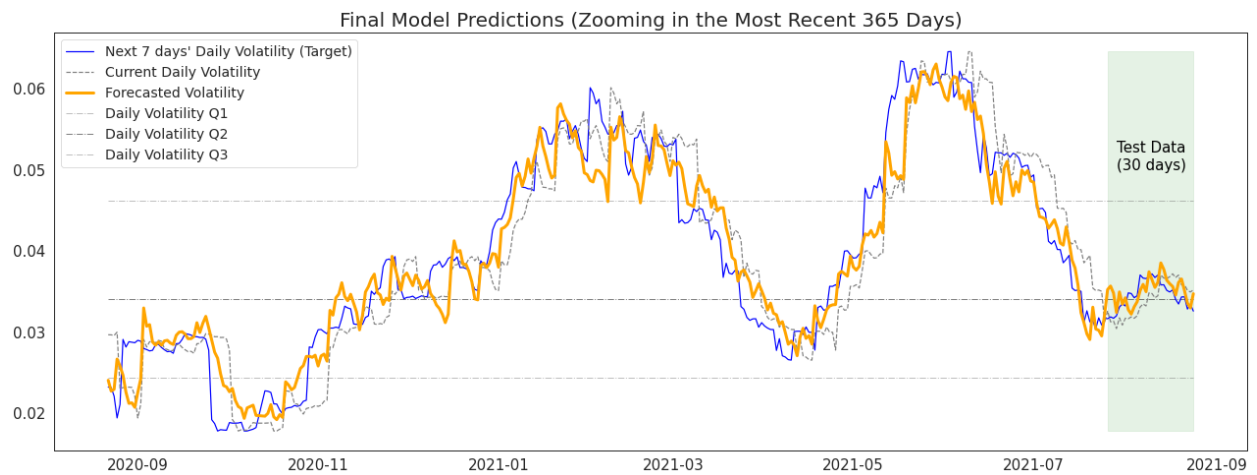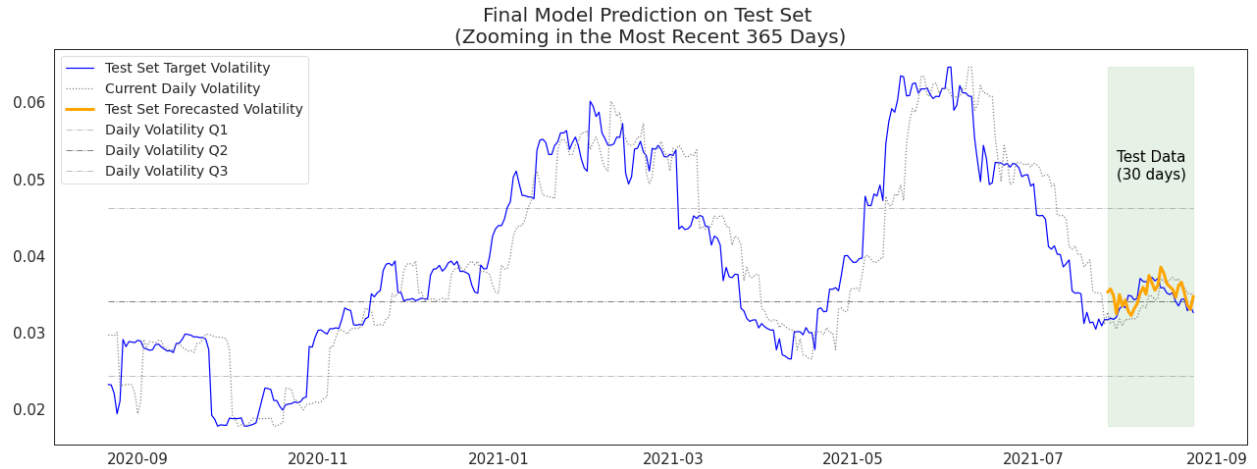
To be clear, the model was trained using data from both the training and validation sets this time around. As a result, it will follow the objective more closely until the conclusion of validation in the third week of July 2021.

	Model	Validation RMSPE	Validation RMSE
12	Multivariate Bidirect LSTM 2 layers (32/16 units), n_past=30	0.156677	0.046139
15	Multivariate 2 Bidirect LSTM layers (32/16 units), n_past=30, batch=32, tanh	0.163605	0.050781
13	Multivariate Bidirect LSTM 3 layers (64/32/16 units), n_past=30	0.164623	0.044660
14	Multivariate 4 Bidirect LSTM layers (128/64/32/16 units), n_past=30, batch=64	0.167586	0.050386
6	Bootstrap TARCH(1, 2, 0), Constant Mean, Skewt Dist	0.200954	0.066851
9	2 layers Bidirect LSTM (32/16 units), n_past=30	0.202388	0.057865
4	Bootstrap TARCH(1,1), Constant Mean, Skewt Dist	0.209654	0.069814
5	Simulation TARCH(1,1), Constant Mean, Skewt Dist	0.215751	0.073293
8	LSTM 1 layer 20 units, n_past=14	0.223199	0.057603
1	Random Walk Naive Forecasting	0.224657	0.052533
10	1 Conv1D 2 Bidirect LSTM layers (32/16), n_past=30, batch=64	0.230372	0.062146
7	Simple LR Fully Connected NN, n_past=14	0.238177	0.055336
3	Analytical GJR-GARCH(1,1,1), Constant Mean, Skewt Dist	0.276679	0.090312
11	2 Bidirect LSTMs (32/16), n_past=30, batch=64, SGD lr=6.9e-05	0.399735	0.165500
0	Mean Baseline	0.507040	0.132201
2	GARCH(1,1), Constant Mean, Normal Dist	0.530965	0.185607

5.14. Conclusion

RMSPE of final LSTM model is 0.1567, That's 4.42 percentage points better than the best-performing GARCH model I found, TARCH(1,2), which has 0.20095 RMSPE. This is a significant improvement. It is sufficient for traders to produce forecasts that are both right and more correct than the common consensus in order to have a favorable expectation while engaging in the markets. Multivariate LSTM has the potential to improve forecasting accuracy over the widely used GARCH model, which is still the most widely used volatility forecasting model.

The final LSTM model's RMSPE on the Test set is 0.054. (which is the most recent 30 days of which future volatility data is available for comparison). With an RMSPE of 0.034, the average 7-day daily volatility forecast between July 24 and August 22nd, 2021, is predicted to be 94.6 percent accurate.

Since financial data is always changing, no model can dependably predict with high accuracy for eternity. With an alpha model's predictive capacity degrading over time (typically 6 months to 5 years), a phenomenon known as "alpha decay" has been seen. The release of a new "edge" or abnormality in markets, according to Sinclair (2020), reduces returns by up to 58 percent.

In order to stay current and react to the market, these models must be regularly altered and refined based on the most recent information available.

6. Chapter 6

Conclusion

The financial world is a buzz with the debut of Bitcoin, a brand-new digital currency. When compared to other financial assets, this digital currency reveals distinctive qualities that demand a range of problems and trade-offs for its investors to consider. In November 2008, Satoshi Nakamoto presented the idea of Bitcoin in a white paper, and it became a reality in 2009 when the first bitcoin was mined. Even though it isn't the first virtual money, Bitcoin has overcome many of the fundamental difficulties that impeded earlier efforts. By combining encryption and a public/private key combination, Bitcoin's use is nearly fully anonymous. This removes the need for any central authority to monitor every transaction. Using this approach, a currency may be generated in a known amount without the need for interference from a central governing agency, which would be tempted to devalue it by producing new money at whim. There are over 21 million bitcoins in circulation, of which around 12 million have been mined. Though Bitcoin's total quantity is restricted, a fraction of one bitcoin can be utilized to perform a transaction due to the digital currency's nature as a fractional currency (Fowler, 2014). (Fowler, 2014). The "satoshi," or 0.00000001 of a bitcoins, is the lowest unit of currency in the Bitcoin system. According to current forecasts, the final satoshi will be mined in the year 2140.

To put it another way, Bitcoin is a decentralized peer-to-peer electronic cash system that eliminates the need for a centralized authority to settle and confirm currency transactions. Since Bitcoins are decentralized and unbacked by any government, they don't pay interest or dividends like traditional currencies. It's a decentralized currency that doesn't have a government or central bank supporting it. Instead, Bitcoins are created through a process known as mining, in which miners provide the Bitcoin network with the required processing power in return for Bitcoins. Satoshi Nakamoto, a pseudonym for the creator of Bitcoin, unveiled it in October of that year under the names "Bitcoin" and "Bitcoin Cash." Digital currencies have a problem known as "double-spend," which the decentralized Bitcoin network can resolve. To authenticate Bitcoin transactions, a network of nodes (miners) validates the integrity of each transaction using earlier transactions documented in a ledger known as the blockchain. The whole decentralized network relies on a concept known as proof-of-work to validate each new transaction that is added to the blockchain. The number of Bitcoins in circulation is constantly increasing due to the mining process. On the other hand, traditional currencies have a finite quantity of money, which is why their value fluctuates over time. Bitcoin's total market value is over $230 billion as of January 2018 and there

are close to 17 million of them in circulation (i.e. 80 percent of its hard-limit total money supply, which will be achieved in the year 2140).

Libertarians, speculators, and criminals alike are driven to Bitcoin for a variety of reasons, including the opportunity to earn money faster and more efficiently than their competitors, as well as the cryptocurrency's extraordinary volatility. Additionally, it is worthwhile to inquire about how and by whom the Bitcoin price is determined. The price of Bitcoin is determined by both internal and external factors, such as macro-variables and pricing in other financial markets. When it comes to Bitcoin pricing, claim that there is no significant association between the latter (external fundamental economic factors) and Bitcoin price fluctuations. They interpret this as evidence that the Bitcoin market is still in its infancy and is characterized by excessive speculation.

Volatility refers to the degree to which the value of a financial asset changes over time. When the value of an asset changes significantly during the day, it is deemed volatile and hence unwise to hold onto it. As an asset's volatility grows, investors' desire to limit their exposure to it increases proportionately. Volatility also has an effect on hedging expenses, which are a significant component of the cost of merchant services. As a consequence, Bitcoin's volatility will decrease, cutting the cost of exchanging Bitcoin for other currencies.

Risk management, market making, portfolio selection, derivative pricing and hedging, and a variety of other activities are all highly dependent on market volatility. Controlling Bitcoin's volatility is a critical first step toward determining its risk profile. On the market, several models of volatility may be available. This objective may be served by models based on daily returns data, such as GARCH and HART, as well as high-frequency data-based heterogeneous autoregressive models with realized variance.

Bitcoin's value has varied significantly since its debut in 2009. The comparison to other cryptocurrencies, on the other hand, will have a big influence. The extent to which the price of Bitcoin deviates from its average over a specified time period indicates its volatility.

((Bitcoin's starting price – Price at N)/N) Standard deviation = ((Bitcoin's opening price – Price at N)/N). Calculate the volatility of a stock over a certain time period using the following formula: Timeframe multiplied by the volatility of Bitcoin's price.

The markets for bitcoin and other virtual currencies thrive on speculation. Bitcoin investors profit by betting on whether the cryptocurrency's price will climb or fall. As a result, the value of Bitcoin might fluctuate at any time, resulting in volatility.

Following the public launch of Bitcoin in 2009, the price of a single token skyrocketed from fractions of a dollar to $0.09 at the moment. Its price has fluctuated by thousands of dollars in a couple of days during the previous several years. Bitcoin's price fluctuations can be related to a variety of things. Investing, trading, or simply monitoring its development may all be facilitated by understanding the market factors that affect its price.

• Much like other commodities, assets, investments, or other products, the value of bitcoin is heavily determined by supply and demand.

• Since Bitcoin was quickly embraced by investors and traders alike, a substantial portion of its present worth is decided by market speculation on price movements. • Investors' anxieties are fuelled by media outlets, influencers, vocal industry moguls, and well-known cryptocurrency advocates.

The majority of the time, the causes of Bitcoin's volatility remain unknown. Bitcoin's volatility may be explained by examining the components of the currency's price evolution. Demand-related variables are critical for determining the cost of a product. As long as investors are susceptible to market conditions and current events, the perceived value of Bitcoins will fluctuate according to public perception. Future events have a significant influence on the current value of Bitcoin (Brandvold, Molnár, Vagstad, & Valstad, 2015). Bitcoin's volatility, according to this line of thought, may be explained by swings in the currency's perceived worth. The number of purchasers entering the market is closely related to the price changes (Ciaian, Rajcaniova, & Kancs, 2016). Due to increased demand, sellers can swap Bitcoin at a higher price. Sellers have an incentive to operate in this manner since they are primarily selling Bitcoin to generate capital gains. In other words, everything that attracts new entrants to the market is likely to increase prices. Alternatively, sellers seeking to convert their Bitcoins to fiat currency must reduce their prices when buyers exit the market.

According to Brière et al. (2013) and Chowdhury (2014) in their working papers on the issue, bitcoin's price volatility is far larger than that of stocks, bonds, hard currencies, and commodities. Additionally, its lack of inherent value and absence of regulation distinguish it from a large number of other assets.

According to (Madhavan, 2000), market structure and informational efficiency give insight into how prices are established. This is a contentious issue in finance. According to FAMA, 1970, information is integrated into price as soon as it becomes accessible, however behavioural finance maintains that investors' emotions and attention spans have a significant impact in the market's capacity to react fast to new information.

the massive price fluctuations that bitcoin saw in 2013 and early 2014. While scanning news headlines during periods of great volatility, various fascinating impacts become apparent. In April of that year, the BTC value fell by 160 dollars in a single day (Rushe, 2013b). However, in the two months leading up to today, the value of Bitcoin has surged from 20 USD/BTC to an astonishing 266 USD/BTC. According to some, Cyprus' capital controls encouraged demand in denationalized currencies, resulting in this price increase (The Economist, 2013).

When Satoshi Nakamoto, the enigmatic developer of the first cryptocurrency, issued Bitcoin (BTC), he predicted that cryptocurrencies will someday supplant the traditional financial system. Nobody believed him when he prophesied that this would occur between 2020 and 2021. Only when the value of all of the world's assets declines as a result of the epidemic do "safe havens" such as gold and oil increase.

The price of bitcoin fluctuates in response to investors' enthusiasm and frustration with its promise. Following the 2008 financial crisis, Bitcoin's anonymous developers, dubbed "Satoshi Nakamoto," envisioned it as a way to circumvent traditional banking institutions and be used for daily transactions. Traders wagering against the currency's fluctuating value have taken notice of the currency's growing popularity as a medium of trade. On the other side, Bitcoin may be used to store money and function as an inflation hedge. Although this new story has more credibility, previous price changes were mostly driven by individual investors and traders betting against an increasing price without regard for rationale or facts. However, the narrative around Bitcoin's pricing has shifted dramatically since then. Institutional investor regulations are being created in tandem with the maturation of the cryptocurrency markets. Despite its volatility, Bitcoin is increasingly being utilized by the general public for purposes other than speculation.

When bitcoin was released for the first time, it was unknown and undervalued. Because demand was so minimal, you could transfer any quantity you pleased. Software and business models for gambling services were unable to cope with the lack of congestion. Satoshidice utilises the infinite-capacity blockchain as a signaling layer to issue a 1-satoshi dividend to losing bets. Everything was complimentary.

Bitcoin was a mystery as a brand-new and little-known technology. It was impossible to envision what this would mean in the future while attempting to comprehend how its components interacted. This was exacerbated by a variety of situations, including the following:

It drew a large number of fraudsters because to the anonymity and lack of central authority, which prevented true information from spreading and also caused widespread mistrust.

Due to the system's success, others have sought to replicate it (often for the only goal of profit), almost always with a lack of understanding of the system as originally conceived.

Apart from the traditional tribalism associated with freshly established groups, early adopters clearly had a financial stake in adoption. As a result of the resulting euphoria, it was exceedingly difficult for any unpalatable realities to reach the greater ecosystem.

Finally, there was astonishingly little understanding that this age of "free money" was not a natural state for bitcoin. Due to their awareness of the issue, the developers of the reference client provided various customizability options to mitigate worst-case scenarios. Adding a modest charge, keeping minor payments from being relayed, and upgrading the scripting language to reduce the amount of space used up by unspent outputs had little effect on bitcoin's default behavior.

Bitcoin's volatile market and bursty statistical nature of block production created capacity constraints. There was a rising perception that the First Era was under threat as a result of these difficulties, which had previously been resolved with code optimizations and miner-modified settings. It was a foregone conclusion that many would seek to continue the free ride. This pressure was increased as a result of software and services being unprepared for dynamic fee conditions, as well as the intrinsic difficulties of dynamic fee conditions. It was difficult to anticipate with certainty the amount that would permit a transaction to proceed to the next block.

Numerous factors contributed to the developers' refusal to approve the ill-advised increase.

• Previously, due to the network's expansion, over half of the network was under the control of a single pool. • This would be the first time since Bitcoin's birth that a tweak would be backwards-incompatible.

It's dangerous to provide a "one-time" boost since expansion is perceived to be less expensive and time consuming than developing improvements.

Although the move was anticipated, neither software nor services were prepared. Perhaps they lacked confidence in the shift's ability to occur. Developers tend to follow the community rather than lead it. Significant financial or political ramifications strengthen the perception that developers are too dependent. Transitions in a large, complex system should be made as gradually as possible to avoid unintended repercussions. As the Third Era approaches, the Second Era provides an opportunity for a gradual transition, allowing software and services to gain competence with bitcoin in its ultimate form.

Bitcoin's economics are shifting, and as a result, fees may increase. Congestion was decreased as a result of a variety of programmatic modifications. To accommodate the network's present capacity, a number of significant and far-reaching enhancements have been undertaken. Block propagation has been accelerated by the use of a global network of node relays and novel propagation algorithms. Transactions can be replaced (by increasing the charge) and recipients' transactions can be enhanced. Algorithms for estimating fees become increasingly sophisticated.

Opt-in block expansion was enabled, which would progressively triple network performance once the supporting software is upgraded. Despite concerns about the concentration of larger blocks. To increase throughput without raising the danger of centralized control, more transactions are squeezed into a single block.

It's natural that such attempts were regarded insufficient to maintain the First Era. Due to the fluctuation in block times, utilizing Bitcoin as a payment network has always been unsettling. It was now substantially more difficult: transfers of less than $20 were no longer possible in their entirety. They lusted after different money from their own first era and pressed for release from this predicament. At this moment, a huge mining monopoly joined these attempts.

Investing in Bitcoin is risky. Such risks need an in-depth review of internal controls. When it comes to risk identification, (Soh & MartinovBennie, 2011) assert that management is typically accountable, yet major dangers may also be uncovered via an internal or external audit. If a business decides to incorporate Bitcoin into its daily operations, it should undertake a risk assessment and adopt any necessary enhancements to the company's internal controls. Incorporating bitcoin into an enterprise, whether as a trading or investment instrument, entails a number of risks, including price volatility, currency exchange rate risks, future regulation, theft or loss, and cyber-security vulnerabilities.

Products may be traded in the most efficient manner possible with the use of an efficient medium of exchange. The currency's maintenance expenses must be so low that it does not degrade throughout

exchange (paper bills for example are not well qualified on this point, as when they are being used their physical quality deteriorates). To be able to pay for goods and services everywhere, money must be small and portable, which implies the commodity must have a high market value compared to its size and weight. To obtain the best value for your money, you must be able to divide it into smaller components. In the case of bitcoin, the role of a means of exchange is highly valued. They are non-perishable due to the fact that they exist exclusively in digital form. Bitcoin's divisibility and fungibility are well-known. Due to the fact that transactions are conducted via the internet, there are no transportation costs associated with gold or cash. Finally, due to the technological architecture and the use of encryption, they are impenetrable. A unit of account should exist so that we may compare prices over time and across various sellers. In other words, prices are expressed in monetary terms.

Due to the fact that cryptocurrency is not taxed, it is a target for legal challenges. When used properly, bitcoin's pseudo-anonymity makes it an efficient tool for hiding assets and reducing tax liabilities. When comparing bringing in small amounts of foreign cash to bringing in Bitcoin private keys, bringing in little amounts of foreign currency is significantly more convenient than bringing in large amounts of foreign currency.

A different problem is preventing the use of bitcoin for money laundering, tax evasion, terrorist financing, and political fundraising, all of which fall outside the scope of traditional legal control measures, such as administrative and criminal law. Rather to using cash, it looks as though bitcoin is the best alternative. The widespread usage of non-legal tender digital currencies such as bitcoin imposes no duties on any government or country. This is one of its faults. The lack of regulation and oversight in the bitcoin industry is detrimental to consumers' interests.

Recent concerns include the following: • Hiding your money. • Establishing the loss of a Bitcoin private key is difficult. • The theft of a substantial quantity of Bitcoin provoked an industry response. • The absence of legislative safeguards. Scams and chargebacks are rampant.

The United States eventually classified Bitcoin as an asset due to Bitcoin taxation. As the European Union's courts have determined, bitcoin is not subject to VAT. Mt. Gox's theft and lack of consumer protection forced authorities to improve their performance. Bitcoin is a sort of electronic money that exists only on a computer screen. From the start, security concerns have dominated this discussion. There are still certain issues with this virtual currency, despite the safeguards put in place to protect the currency, its transactions, and mining. Collaborative users may use security flaws in the mining and transaction

processes to get an unfair advantage over the system as a whole. Numerous services let their clients to utilise an online digital wallet, making them exposed to hacker attacks. Additionally, attackers may target exchange services.

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Cryptocurrency price predictions are essential in financial markets. It is difficult to identify the factors that impact price forecasting; also, due to the 24/7 trading regime, the prices of cryptocurrencies fluctuate dramatically, reducing the predictive power of existing models. Policymakers, investors, and researchers are becoming interested in digital currencies such as Bitcoin. Bitcoin is a decentralized digital currency powered by Blockchain technology that may be given to anyone at any time for almost no cost or fee, subject to country-specific restrictions. As seen in Figure 1, Bitcoin's value jumped when it became a legal tender in the United States in late 2013. The cryptocurrency business is expected to be worth more than USD 120 billion daily, with Bitcoin being the most popular currency.

Bitcoin has an effect on the economy in two ways: Bitcoin may act as a substitute for the FX market in terms of international transfers and remittances. Due to the high degrees of hedging, liquidity, and diversification inherent with cryptocurrencies such as bitcoin, they may be used as an investment.

Diversification benefits are possible as a result of the lack of correlations between bitcoins and other assets. As a consequence, bitcoin returns were unaffected by market volatility, showing that bitcoin may act as a hedge against market risk. The bitcoin market has established the efficacy of the efficient market theory. On the other hand, a high-risk investment such as Bitcoin has the potential to have a negative impact on the economy.

Since its birth in 2009, it's difficult to overestimate the influence Bitcoin has had on the financial landscape. Numerous asset managers, big investment banks, and hedge funds have recognized decentralized cryptocurrency as an asset class in recent years. As cryptocurrency use continues to grow, investors are being encouraged to experiment with new products such as crypto options and futures.

Bitcoin's volatility has long been acknowledged to be higher than that of regulated stocks and commodities. Its most recent surge, which began in late December or early January 2021, has aroused several concerns about the future of the financial climate. Given that it debuted in 2020 at around USD 7,200, Bitcoin is currently valued slightly under USD 50,000 as of the date of publishing of this essay (end August 2021).

The purpose of this project is to estimate the BTC-average USD's daily Realized Volatility (RV) for the next seven days using two distinct methods: the traditional econometric tool for financial time series volatility prediction, GARCH, and state-of-the-art neural networks.

Following its price boom and bust, bitcoin has been viewed as an investment asset. Accurate Bitcoin price estimates are required to make educated investment decisions. An extensive argument has erupted in response to a single query. What is the fundamental reason behind Bitcoin's value? Recognize the factors that affect Bitcoin's value Financial considerations are crucial for both researchers and practitioners. Obtaining a reasonable price Predictive models assist investors in forecasting future price changes and assessing expected profits.

Prior to accepting Bitcoin as a payment method, shops and large organizations must be aware of the currency's price volatility. Apart from Bitcoin and the Blockchain technology that underpins it, academics have shown a great deal of interest. Bitcoin, as a FinTech creation, is seen as a disruptive force in today's payment and monetary systems. Thus, in order to get a deeper understanding of Bitcoin and further its theoretical development, academics must identify the factors that contribute to the proliferation of new financial technologies, particularly Bitcoin.

It's natural to question what criteria should be used to forecast Bitcoin prices. Earlier studies focused on the researchers' subject expertise and ignored return and risk. Bitcoin's price may be forecast in a variety of ways.

It is a method for determining the frequency and magnitude of price movements in a certain financial asset. Volatility indicates the degree to which an instrument's price swings are extreme. Volatility is frequently regarded as the best indication of market risk in research, and volatility forecasting is used in a range of applications. Realized Volatility Forecasting models are frequently used in risk management, market making, portfolio optimization, and option trading. Numerous trading strategies are built on identifying instances when this volatility mismatch occurs. Volatility is a phrase that refers to the amount by which the price of a financial asset varies over a certain time period. Volatility indicates the degree to

which an instrument's price swings are extreme. Volatility and price changes do not exhibit a clear association. This is because while determining the standard deviation (or variance), all differences are squared, and so both negative and positive differences are summed together to make a single value. The greater a financial instrument's volatility, the more volatile its value is expected to change over a given period of time." Volatility, according to Wikipedia, can be expressed in percentage terms as historical or inferred.

Volatility realized, also known as Historical Volatility (HV), is a term that refers to the volatility of an asset over a certain time period, such as the prior month or year. The standard deviation of returns, which expresses the change in price as a percentage of the previous day's price, is frequently used to quantify realized volatility.

In comparison, implied volatility (IV) refers to the amount of volatility implied by the underlying asset's current option price.

In mathematical modelling, log returns are frequently used because they help decrease the non-stationary characteristics of time series data and stabilize it.

It is almost always feasible to identify a lucrative technique inside a sample if we traverse the historical data utilizing a variety of approaches, parameters, and periods. Forecasting is intended to forecast the future using currently available data, however the best models for training data may not be the best for generalizing results beyond a sample size (or overfitting). Avoiding/reducing overfitting becomes even more critical when dealing with volatile financial markets.

RMSPE (Root Mean Squared Percentage Error) is my favorite metric above RMSE (Root Mean Square Errors). Due to the degree of freedom in choosing the frequency/interval window, time scaling is crucial for determining volatility. As a result, I feel that RMSPE captures the degree of inaccuracy in contrast to the intended target values better than other methods. As a result, I'd want to utilize RMSPE rather of the more widely used MAPE (Mean Absolute Percentage Error). We'll compare the RMSE and RMSPE of various models' predictive performance on validation sets to determine their generalizability to out-of-sample data.

GARCH is an acronym for Generalized Autoregressive Conditional Heteroskedasticity (Autoregressive Conditional Heteroskedasticity). When it comes to estimating the volatility of financial time series, Garch is a time-honored approach that forecasts future volatility using variance components and residual errors

from a mean process. While GARCH is widely acknowledged as a more rational alternative to the naive idea that future volatility would be the same as it was in the past, some volatility specialists believe it is overvalued as a forecasting model. Volatility in the short and long run will almost certainly indicate reversion to the historical long-run average, since GARCH models capture these critical characteristics of volatility.

Recent observations are given greater weight than those from the past in this technique. It is difficult to estimate various parameters in this model due to the existence of several delays (Tsay & Chen, 2018). Bollerslev (1986) created GARCH as a means to include the ARCH model, which employs lowering weights but does not enable them to reach zero completely (Engle, 2001). This presents a simple-to-use methodology for forecasting conditional variances in finance.

TARCH is an abbreviation for Threshold Autoregressive Conditional Heteroskedasticity (and also known as ZARCH). TARCH simulates volatility by utilizing absolute values (instead of squares). The default power of 2.0 of this model corresponds to variance processes that evolve in squares; hence, the power is specified as 1.0. Additionally, a dummy variable is included into the GARCH framework to introduce asymmetric influence.

Because the output of a Recurrent Neuron is a function of all previous time steps' inputs, it possesses some type of memory and is capable of storing information over time. Due to the modifications that data undergoes as it passes through an RNN, the state of an RNN retains minimal information about the initial inputs.

Sepp Hochreiter and Jurgen Schmidhuber proposed the concept of Long Short-Term Memory (LSTM) in 1997. (LSTM). The critical feature of LSTM is that it can learn what is significant and should be retained in the long run, and what may be ignored. It looks to be a normal RNN cell, however the LSTM's state is separated into two categories:

for a little time: ht to sustain a long-term state

The LSTM is a black box that may be used as a straightforward Recurrent Neural Network (RNN) cell. However, it performs far better, speeds up training, and also uncovers long-term links in the data. It is

strongly recommended that the second part of the notebook be run on Google Colab, as it uses an optimized LSTM implementation when run on a GPU.

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Because financial data is always changing, no model can reliably anticipate with high accuracy for an infinite period of time. A phenomenon known as "alpha decay" has been seen when an alpha model's predictive power degrades with time (usually 6 months to 5 years). According to Sinclair (2020), the introduction of a new "edge" or anomaly in markets diminishes returns by up to 58 percent.

To remain current and responsive to the market, these models must be revised and modified on a regular basis based on the most up-to-date information available.

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