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Bitcoin's role in a new financial system

Bitcoin vaidmuo naujoje finansų sistemoje

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INTRODUCTION

In 2009 the first decentralized cryptocurrency, Bitcoin, was created by an anonymous figure named Satoshi Nakamoto. It functions as a digital currency that permits irreversible transactions between its users while also being based on open-source software (Simser, 2015). Moreover, Bitcoin being decentralized means that no single entity can control it, it operates by a combined effort of many users from all around the world which sets it apart from different currencies since it is not redeemable nor backed by tangible assets such as gold.

The fact that Bitcoin is available everywhere is a significant advantage. Geographical location does not restrict its user's ability to transact or make payments. In addition, Bitcoin decentralized peer-to-peer transaction system allows for substantially lower transaction fees than other assets that require third parties for validation (Reynolds and Irwin, 2017). Nevertheless, Bitcoin's infrastructure can be described as a sophisticated yet very well-designed system. This infrastructure is built on key pairs, which consist of private and public keys. Where private keys are necessary to establish ownership of these addresses, public keys function as virtual IDs or addresses.

Initiating a Bitcoin transaction suggests creating a unique digital signature using the private key to establish ownership of the Bitcoins being transacted, the recipient's public key and the transaction details. All this information is then transformed into a unique digital identification, in a process referred to as hashing. Bitcoin utilizes the SHA-256 cryptographic hash function, which is a mathematical algorithm that encrypts the transaction details, the owner's private key, and the new owner's public key to produce an output that must be verified to complete the transaction, ensuring its security and authenticity (Simser, 2015).

Bitcoin transactions are verified by a process called Proof of Work, where various users around the world compete to solve an irreversible hash function that includes data from multiple transactions. Upon successful resolution, the transaction block is distributed to all nodes within the Bitcoin network. Other network participants then inspect the validity of the Proof of Work. When the verification process is completed, the transaction block is integrated into the blockchain, a permanent ledger containing a comprehensive history of all Bitcoin transactions since its inception. The individuals validating these transactions are known as miners, accordingly, rewarded with a fixed quantity of bitcoins for their contribution. This protocol ensures that only one block can be solved approximately every ten minutes, effectively mitigating the challenge of double spending.

Likewise, Bitcoin's consensus algorithm offers a solution to potential blockchain forks, with miners consistently adopting the longest blockchain, the one that requires of the most extensive computational effort (Gervais, Karame, Capkun & Capkun, 2014; Garmoli, 2020).

While some studies suggest that Bitcoin can function as a currency, driven by its decentralized system and low transaction fees, others suggest that it fails in fulfilling the fundamental characteristics of a currency, primarily because it is more commonly used as an investment due to its noticeable price volatility (Cox, Green, Brodako, Mikolajewicz-Wozniak & Schiebe, 2015; Yermack, 2015). In practice, Bitcoin predominantly serves as an investment and is often presumed as a diversification strategy within investment portfolios, as it exhibits weak correlation with traditional asset classes like commodities, bonds, and equities. Nevertheless, its price volatility, vulnerability to fraud and theft, and the absence of comprehensive regulation underlines its risky nature, making it a less appealing investment option during economic turmoil, when investors tend to seek refuge in safer assets like gold (Shahzed, Bouri, Roubaud, Kristoufek & Lucey, 2019; Dhyrberg, 2016).

Bitcoin's price fluctuations have been studied by many researchers who have tried to predict its sharp price variations. Traditional financial models, which rely on supply and demand or trading volume, are not easily applicable to Bitcoin. Unlike traditional assets, Bitcoin's finite supply and absence of governing legal entities make it challenging to apply conventional valuation models, such as the dividend discount model used for bonds and equities, which rely on cash flows (Burggraf, Huynh, Rudolf & Wang, 2020). An alternative approach to predict Bitcoin prices is relying on Metcalfe's law, suggesting that the value of a blockchain network is proportionate to the square of the number of connected users. When Bitcoin's value deviates disproportionately from this square-root relationship, it may indicate a market bubble and an overvalued price. Over time, Bitcoin prices tend to revert to an equilibrium value in accordance with Metcalfe's law (Peterson, 2018).

Some researchers on the other hand suggest that behavioral finance theories could also reveal the cause behind Bitcoin price fluctuations. The Bitcoin market, primarily driven by retail investors, often exhibits emotional biases and psychological motivations rather than purely rational decision-making. Therefore, investor psychology and sentiment play fundamental roles in determining Bitcoin's price changes. Researchers use metrics like Google search intensity and tweet counts to measure the impact of rumors and viral news on price shocks and deviations from equilibrium (Sabalionis, Wang & Park, 2021).

Bitcoin is largely used by investors as an investment whether to diversify their portfolios or to use as a hedge against economic distress, in this paper we analyze Bitcoin's properties as a safe-

haven asset and a hedge tool against market downturns specifically during the COVID-19 pandemic that caused great economic turmoil.

Aim of the research:

The purpose of this research is to investigate whether Bitcoin can function as a reliable safe-haven asset or an effective hedge against market downturns.

Main objectives of the research:

1. To analyze Bitcoin infrastructure as explored in the literature
2. To investigate the motives driving Bitcoin adoption as a currency or an investment asset.
4. To investigate the relation between Bitcoin, Gold and other financial assets during the COVID-19 pandemic.
5. To compare the safe haven characteristics of Bitcoin to Gold during the COVID-19 pandemic and determine if Bitcoin can be used as an effective safe haven instrument.

THEORETICAL ANALYSIS OF BITCOIN DECENTRALIZED STRUCTURE AND SAFE HAVEN ATTRIBUTES

1.1 Bitcoin Components

1.1.1 Bitcoin Keys

Bitcoin transactional system is regarded as an anonymous system, although a ledger of all Bitcoin transactions is public, distributed and everybody can have access to. Bitcoin derives its anonymity from the fact that its users have a public key what gives its users a certain level of confidentiality. This public key, which could be described as a unique combination of letters and numbers is used as a user's public identity and it is what grants Bitcoin users a degree of pseudonymity since it allows them to operate under different cryptographic pseudonyms. However, it is important to differentiate that despite its anonymity, the transparency of Bitcoin transactions means that certain activities can potentially be traced back to a single entity, revealing the true identities of users (Simsler, 2015). After the successful validation and addition of a transaction to the blockchain, the associated public keys can essentially be discarded. Moreover, for each succeeding transaction, users have the option to generate a brand-new public key which would provide bitcoin users with more security and privacy, as it becomes hard for anyone to be able to connect various transactions to a single user or entity. (Inci and Lagasse, 2019).

It is also worth mentioning that this public key or address only becomes operational after a Bitcoin user makes his first transaction. In order for a user to send or receive Bitcoins, the public key is combined with a matching private key that creates a unique digital signature that serves as a proof that the transaction has been sent by the rightful owner of the Bitcoins, this in turn makes the Bitcoin network safer. Significantly, ownership and control of a Bitcoin address are assigned exclusively to users who own both private and public keys (Simsler, 2015).

To securely store and manage Bitcoins, users must follow a structured process that begins with the download of a Bitcoin software, while there exists many softwares that would provide access to the Bitcoin network, Bitcoin Core is considered the most established and authentic choice since Bitcoin Core was the primary software released in 2009, and its historical significance gives it a foundation of trustworthiness and reliability. Following the installation of the Bitcoin software, the next important part of the process is the Bitcoin wallet as it the basis to anything related to cryptocurrencies including Bitcoin, offering users the ability to view, send, and receive their digital

assets. While most importantly, the Bitcoin wallet allows users to have complete control over their digital financial assets (Voltey, Saini, Mcghin, Liu & Choo, 2019).

Bitcoin wallets come in different shapes and forms while each serving distinct needs and preferences of Bitcoin users. One of the traditional Bitcoin wallets is the local storage wallets, these wallets allow users to retain their keys in a file or a local database on their personal devices. This wallet allows users to have direct access to their keys which is something that people that prioritize independence and control over their digital financial assets favor. In contrast, password-protected wallets improve security by encrypting the locally stored wallet file, requiring users to generate a password to access their Bitcoins. This approach makes using Bitcoin more secure (Eskandari, Clark, Barrera & Stobert, 2018).

A different approach to key storage is proposed through offline storage. Where users can decide to employ physical mediums such as USB devices or paper wallets to preserve their keys. A paper wallet is nothing more than a document containing cryptographic keys, this physical aspect of paper wallets provides a greater degree of protection since offline storage is widely recognized for its resilience against malware and cyberattacks. However, it's important to note that even in offline storage, users are not entirely secure since when the time comes to spend their Bitcoins or to send them to other user or exchange, users have to connect to the bitcoin network and by doing so they expose themselves to potential malware and theft. Therefore, offline storage often serves as a cautious backup plan (Eskandari et al., 2018).

(Eskandari et al., 2018) also suggests that given the complexity of cryptographic procedures, many Bitcoin users, especially those who are not experts in this field, and don't want to be bothered with the specifics required to self-custody, rely on third-party web services to host their accounts. These web services allow new users and non-experts to send and receive Bitcoins using simple authentication mechanisms such as passwords or two-factor authentication. This user-friendly approach allows individuals to send or receive Bitcoins without the need to extensively study the infrastructure of Bitcoin and digital currencies and the details of cryptographic processes that permit transactions to occur. Furthermore, exchange services usually also offer a similar accessibility by providing wallets made for the specific needs of investors and speculators involved in the exchange of Bitcoins.

However, trusting a third party with your digital signature makes users vulnerable to greater risks, especially the potential for fraud or theft since some of these wallets may lack vigorous privacy-enhancing protocols which in turn would leave users vulnerable to privacy violations. Additionally,

some hosted wallet services in order to secure their Bitcoin may opt to keep a significant portion of their assets offline which, while enhancing security, can lead to increased transaction times. (Eskandari et al., 2018) (Biryukov and Tikhmorov, 2019).

In conclusion, users must ensure that they select the proper storage method in order to use Bitcoin in a safe and secure manner. In particular, users can adjust their approach to align with their priorities and preferences because a wide range of storage options have become available since its inception. While some users may choose to rely on third-party services, use offline methods, password-protected wallets, or local storage, each option is based on personal needs and preferences because users must weigh the trade-offs between convenience, security, and control when selecting the best and most appropriate Bitcoin storage solution. Cryptocurrencies are still improving day by day and innovations in the custody options of Bitcoin will continue to improve to offer more choices for different kinds of users.

1.1.2 Blockchain Technology

Bitcoin's is built on a new technology called blockchain, or Digital Ledger Technology, it is a revolutionary innovation that operates as a decentralized and distributed database, which is replicated identically among all computers connected to the network. This innovation essentially structures the functioning of Bitcoin and defines the framework at which Bitcoin currently operate in. After a Bitcoin transaction is initiated, it undergoes a careful validation process. This validation relies on an automated consensus protocol that provides proof of the transaction's legitimacy (Malherbe, Montalban, Bedu & Granier, 2019).

Blockchain technology plays an important role in Bitcoin's operations since it allows users to verify transactions and process payments by using cryptography technology where users are able to make digital signatures and solve cryptographic hash functions. Digital signatures facilitate transactions between Bitcoin users by allowing them to securely transfer bitcoins from one address to another while on the other hand cryptographic hash functions helps in securing these transactions since only after the hash function is solved these transactions are allowed to be included in the blockchain (Nakamoto,2008)

Each Bitcoin transaction references specific users, these transaction details include the sender of the Bitcoins and the receiver, by their virtual pseudonyms, which are known as Bitcoin addresses. These addresses are paired with a unique public-private key combination, providing the cryptographic foundation for secure transfers of bitcoins. The transaction process occurs when a user signs a hash of the previous transaction in which the last bitcoin was spent together with the public key of the new

owner then this transaction is recorded and distributed across the Bitcoin network. This process ensures the integrity of the transaction and its place within the blockchain (Badev and Chen,2014) (Nakamoto,2008) this process is first demonstrated in the white paper issued by Nakamoto which is considered the document to introduce the concept of Bitcoin, as shown in figure 1.

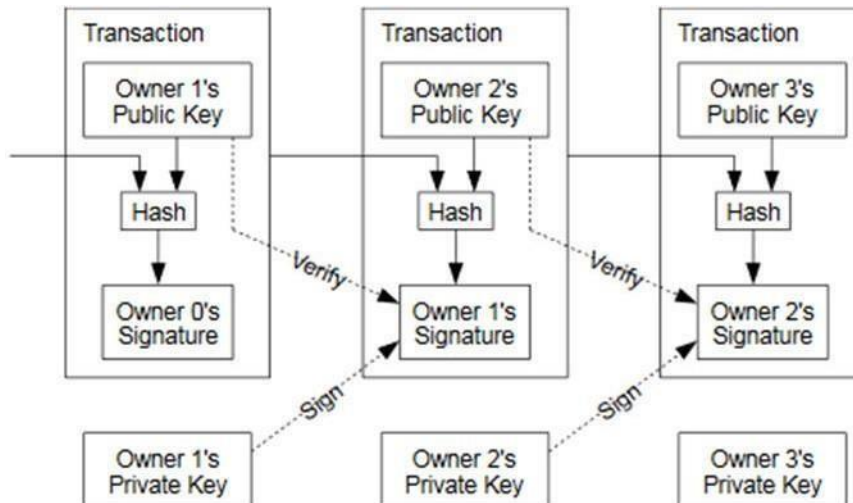


Figure 1 Bitcoin Transaction process adopted from (Nakamoto, 2008)

Additionally, another part of the Bitcoin infrastructure is SHA-256, which is a cryptographic hash function used to secure Bitcoin transactions. These hash functions are considered to be the most integral part in securing the Bitcoin network since they are very hard to reverse making the authenticated transactions very secure. They work by taking an initial input which includes the transaction details and public and private key and transforming it into a unique output. The cryptographic hash function like SHA-256 is irreversible since guessing or finding out the private key from the output and the public key is almost impossible using traditional technology, all of these characteristics of the SHA-256 cryptographic hash function make it a reliable tool for securing data and ensuring the integrity of the Bitcoin network (Pilkington, 2016).

Moreover, for a Bitcoin transaction to be broadcast across the network for anyone to see it first have to go through a very thorough verification process, after the verification process is completed, the transaction is added to the Blockchain. The order of the blocks in the blockchain and the ability for anyone around the world to check the authenticity of the blockchain is what makes Bitcoin as secure as it is. (Pilkington, 2016).

The blockchain is chronological ordered where blocks are only added to the Blockchain after thorough verification by various nodes around the globe where nodes are used to refer to individual computers connected to the Bitcoin network. The chronological order of the blockchain and synchronicity between all these nodes ensure that changes to the blockchain are virtually impossible without detection by all other nodes. This feature is the essential characteristic that allows Bitcoin to be a trustless asset since it eliminates the need for a central authority or intermediary to validate and secure transactions. The synchronized and decentralized nature of the blockchain, combined with SHA-256 cryptographic hashing, guarantees that Bitcoin transactions are not only secure but also resistant to manipulation or unauthorized alterations (Malherbe et al., 2019).

This process of decentralized verification coupled with the strength of cryptographic hash functions creates a resilient infrastructure for Bitcoin. It enhances Bitcoin users' trust and confidence that their transactions are secure and transparent, without needing a third-party to review and authenticate these transactions. As a result, Bitcoin clearly demonstrates how blockchain technology, decentralized consensus processes, and cryptography can all be used together to enable transactions without the need for middlemen.

Moreover Blockchain technology is of great importance in the future, it plays a major role in making bitcoin what it is but more importantly this technology can be used in many other ways , primarily in transforming financial services by enabling digital currencies, smart contracts, and decentralized finance platforms, that although their adoption is still in their early stages they still in some ways offer faster and more efficient transactions, while reducing the reliance on traditional intermediaries and enhancing financial inclusion for many people around the world who don't have access to banks and financial markets especially if they are living in underdeveloped countries. Moreover, blockchain's transparent and resistance to being changed by third parties allow this ledger to potentially improve auditing, while at the same time reduce fraud, and facilitate regulatory compliance, making it a very innovative technology that have a great potential to improve and grow the financial industry and eventually the global economy as a whole.

1.1.3 Bitcoin Mining

In his research, (Gervais, 2014) describes the Bitcoin mining procedure. Upon completion of a Bitcoin transaction, the network's nodes which are individual computers linked to the network cooperate to guarantee the transaction's legitimacy. Nevertheless, numerous nodes may collaborate to solve a single Bitcoin block. Once the verification process is finished and the transaction is confirmed to be authentic, it is broadcast to all other nodes in the Bitcoin network. The process of

verification requires these computers to use their own computational power to attempt solving cryptographic algorithms that, when solved, allow for the confirmation of the authenticity of the transaction.

Additionally, digital currencies in general face another challenge which is double spending which means sending the same bitcoin to more than one user or when a user tries to spend the same digital currency, more than once, basically creating counterfeit money. Double spending is particularly important because traditional physical currencies, such as cash or coins, do not face this issue since they are physical in nature making it impossible to spend the same currency more than once simultaneously. Therefore, to address this issue Bitcoin employs a mechanism known as proof of work which provides a simple method of checking the proof of computational effort, ensuring that each transaction is legitimate, and that double spending is effectively prevented (Gervais, 2014).

(Xu, Bai, Hu, Tian & Wu, 2020) suggest that proof of work requires both energy and significant computational power. It revolves around solving irreversible hash functions, in the case of Bitcoin it is the SHA-256 hash function, that incorporate data from multiple transactions. Once a user successfully solves the proof of work, the transaction block is shared with all other computers in the network. These nodes, in turn, analyze and examine the proof of work's validity, ensuring its accuracy. Subsequently, when the transaction is validated and examined by multiple nodes for authenticity the transaction is added to the blockchain, marking it as a verified and legitimate transaction.

The process of validating transactions relies on volunteers who are often referred to as miners. These miners devote their resources to solving these computational puzzles and creating new blocks to the blockchain. Although it is not entirely volunteering since to incentivize their participation and support of the Bitcoin network, miners are continuously and methodically rewarded with a fixed number of Bitcoins every time they successfully solve the complex mathematical calculations required for block verification. (Gervais, 2014).

However, it's essential to note that this fixed reward amount is subject to a halving event, The Bitcoin halving event, happening approximately every four years after every 210,000 blocks, is a programmed mechanism incorporated within the Bitcoin software intended to introduce scarcity into the Bitcoin ecosystem by halving the block reward, therefore reducing the rate at which new Bitcoin are created. This built in mechanism in which Bitcoin is methodical reduced is designed to support Bitcoin's deflationary nature, which in turn encourages long-term investment, and increases the value of existing Bitcoins as the time goes by. The event's predictability allows participants to

plan accordingly, while its effect on mining economics, dependence on transaction fees, and historical associations with price surges make it a significant and closely watched and closely anticipated event, determining Bitcoin price changes and the sentiment regarding investing in Bitcoin around the halving event (Delgado-Mohatar, Felis-Rota, & Fernandez-Herraiz, 2019).

The complex process of validating and securing Bitcoin transactions through proof of work which requires capital and time investment from miners, since miners have to spend money to buy the equipment and computers required to generate enough computational power to solve the complex hash functions, highlights the network's strength and decentralization. This model promotes trust in the Bitcoin network, enabling users to conduct transactions with confidence and transparency, while mitigating the risk of double spending.

The Bitcoin network operates on a pre-determined time schedule that is incorporated inside the Bitcoin software, with each block typically taking around 10 minutes to be successfully mined. However, this time frame is subject to adjustments to accommodate the growing number of miners from all over the world and their increasing computational power. The network achieves this by periodically increasing the difficulty of the cryptographic hash functions miners must solve. This change of the amount of time needed to mine a single block ensures that the rate at which blocks are solved and, consequently, the rate at which new Bitcoins are generated, remains close to about 10 minutes for a block. This complex and sophisticated mechanism is vital in maintaining the integrity of the system and protecting the predetermined cap of 21 million Bitcoins, which is basically estimated to be reached by the year 2140 (Simser, 2015).

During the early days of Bitcoin, Bitcoin's creator, Nakamoto, mined the initial 50 Bitcoins personally. This historic event occurred in January 2009 and is considered as the genesis block as it was the first time Bitcoin was mined (Simser, 2015). Initially and in the early days of Bitcoin, miners operated individually, which was known as solo mining. In this process, successfully solving a new block meant that the miner received the entire reward. However, the increasing interest in Bitcoin led to a growing number of miners joining the network, increasing the computational effort required to mine new blocks. Thus, this increase of computational effort required to solve the Hash functions encouraged pool mining, where individual miners combine their computational power to mine new blocks collectively. The rewards are then distributed among the participants in accordance with their respective contributions to the block-solving process (Xu, Bai, Hu, Tian & Wu, 2020).

While proof of work efficiently addresses the issue of double spending, the Bitcoin network also faces another challenge known as the Byzantine consensus problem, commonly referred to as

Byzantine failures. This problem draws its name from a historical scenario where generals try to reach a consensus in the presence of traitors, ultimately failing due to faulty components in a distributed system (Garmoli, 2020).

Byzantine failures can happen in the Bitcoin network when miners have different opinions about the blockchain's current state, either because of malicious activity or irregular delays. The conflict that occurs about which is the authentic blockchain may result in a significant event called a fork, in which the blockchain splits into two or more branches forcing the Bitcoin community to work together different blockchains. Two types of forks exist, Soft and hard forks, where hard forks are incompatible with one another, while soft forks are not. Some hard forks, those adopted by a substantially large number of miners, have led to the creation of new cryptocurrencies in the Bitcoin family. Examples of such forks or spin-offs include Bitcoin Cash, Bitcoin Gold, Bitcoin XT, Bitcoin Unlimited, and Bitcoin Classic. A timeline of the Bitcoin hard forks is shown in figure .2 (Islam, Mantymaki & Turunen, 2019).

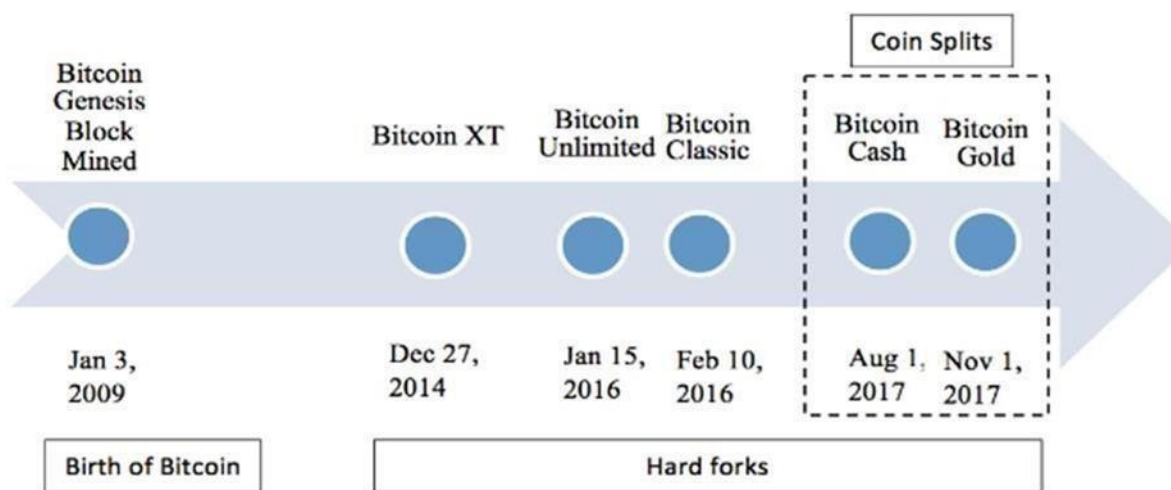


Figure2 Bitcoin Hard Forks Timeline. (Islam et al., 2019)

While the Bitcoin consensus algorithm strives and attempts to maintain a 10-minute block creation interval, actual blockchain splits are relatively rare. This rarity can be attributed to the fact that blocks are typically mined during periods when other miners are broadcasting transactions to the network. Therefore, the Bitcoin protocol has a built-in mechanism to address forks. In the event of a fork, nodes within the network hold to a simple principle that is they select the longest blockchain, which represents the one that required the most computational effort to create. This longest chain is recognized as the authentic blockchain (Garmoli, 2020).

This approach to resolving forks is through the selection of the longest chain, by doing so miners ensure that the network maintains its stability and consistency and that all participants follow a single main blockchain, preventing the fragmentation and the splitting of the network into multiple, conflicting branches.

Moreover, a major threat to the whole bitcoin system is when one single miner controls 51 percent of the computation power in the network, which theoretically would allow this miner to create alternative blockchains and unauthentic transactions, which would cause the bitcoin network to crash and Bitcoin to lose its value. This is possible since the top 10 percent of miners have 90 percent of the total computational power, but the largest miner's computation power is only 15 percent meaning that in order for the bitcoin system to crash 5 or more miners should unite and work together using sufficient computational power to execute such an attack (Xu et al., 2020)

In conclusion the network's security and validity are guaranteed by the complex mechanisms of Bitcoin's transaction verification, which are made possible by proof of work and cryptographic methods. Because of rewards and recurring halving events which occur once every 4 years, the system's reliance on miners has changed from individual to collaborative efforts, demonstrating the network's flexibility. Since the protocol relies on the longest chain mechanism, network stability is maintained even in the face of irregular problems such as Byzantine failures that could result in forks. But there's a big risk when mining power is concentrated in the hands of few miners. There are worries regarding the network's susceptibility to manipulation and unauthorized transactions given the possibility of a dominant coalition gaining 51 percent of the computing power. This emphasizes how crucial it is to keep the Bitcoin system decentralized. Even though Bitcoin has proven its resiliency, increasing miner participation is essential to reducing the risk of centralization and maintaining the integrity and security of the network against possible attacks.

1.2 Bitcoin Price Determinants

The price history of Bitcoin has seen significant fluctuations since its inception. Bitcoin's value experienced consistent upward momentum, reaching a historic peak in December 2017. However, this remarkable increase in price was followed by a substantial and significant decline of approximately eighty percent in 2018. This price behavior bears similarities to the dot-com bubble crash, emphasizing the fact that the innovative nature of Bitcoin and cryptocurrencies, in general, can attract investors seeking rapid wealth increase (Burggraf et al., 2020).

Bitcoin, being a relatively new and innovative asset class distinct from traditional currencies and assets, has gained enormous popularity as an investment. This has led to an increase of attention

from both speculators and traditional investors although institutional investors remained hesitant, in part due to the high volatility and the potential for substantial profit margins that could be gained by investing in Bitcoin. This increased interest in Bitcoin as an investment vehicle has led to an increase in trading and investment activity, which led to Bitcoin’s extreme price fluctuations (Vadar and Aydogan, 2019).

Comparing Bitcoin to other traditional asset classes, a study by (Li, Naqvi, Rizvi, & Chang, 2021) suggests that there is a substantial amount of instability in the prices of commodities, as well as Bitcoin. In contrast, equity prices and fixed income assets have exhibited a steadier and more progressive increase in price and upward trajectory in general. This dynamic is illustrated in Figure 3, highlighting the different price movements across various asset classes and showcasing the relative stability of both stocks and fixed income assets when compared to the apparent volatility of Bitcoin and commodities.

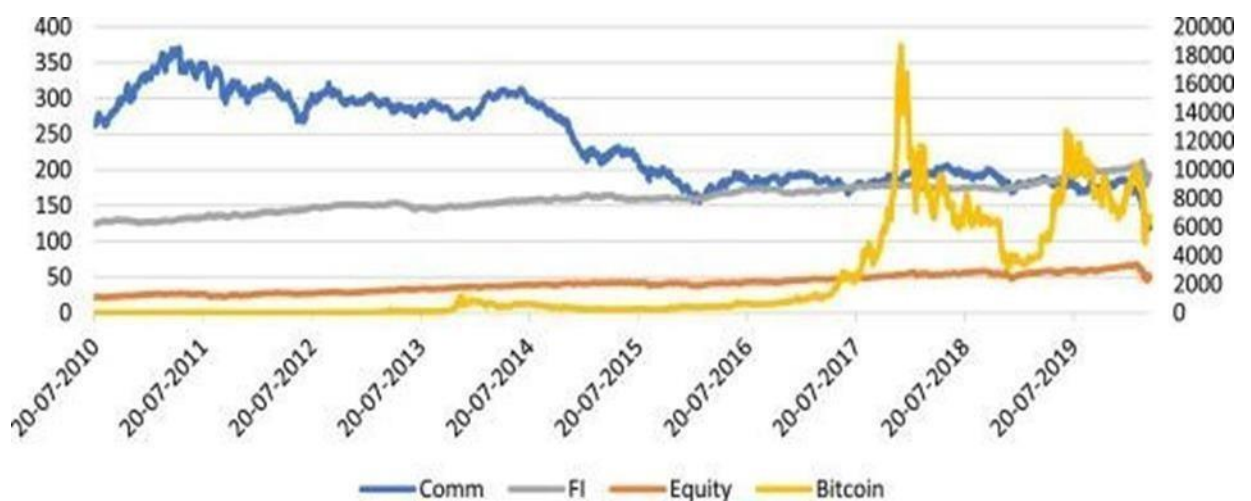


Figure 3 Long Term Movement in the Prices of Asset Assets. adopted from (Li et al., 2021)

The inherent volatility of Bitcoin, coupled with its potential for substantial and significant returns, has made it an attractive although risky investment. It has drawn the attention of both individual and institutional investors as well as speculators and risky investors trying to achieve great gains in short periods of time.

Determining price indicators for Bitcoin has presented a unique challenge for academic researchers since traditional financial models, which rely on concepts like supply and demand or trading volume, often can’t explain price fluctuations when applied to Bitcoin. Unlike traditional fiat currencies, Bitcoin operates independently of any central authority and has a finite supply. This makes

applying traditional price determinants impractical. Additionally, standard valuation models employed for assets like bonds or equities, such as the dividend discount model, are not suitable for Bitcoin. Unlike these traditional assets that generate cash flows through dividends or coupon payments, Bitcoin lacks inherent value (Burggraf et al., 2020).

Hence in order to determine and predict Bitcoin prices researchers, unable to apply traditional price determinant models of finance, have adopted alternative approaches. One notable proposition, suggested by Peterson (2018), is the application of Metcalfe's Law. This law theorizes that the value of a network, in this case, the Bitcoin blockchain network, is directly proportional to the square of the number of users connected to the network. Essentially, when the value of Bitcoin experiences disproportionate growth in relation to the square number of users on the network, it suggests that the Bitcoin market may be overvalued, indicating the presence of a market bubble. According to this perspective, Bitcoin prices should decline to reach an equilibrium point (Peterson, 2018).

Likewise, although bitcoin is highly volatile and its growth is unstable and full of bubbles, a closer examination of its price data reveals an underlying pattern of exponential growth when viewed on a long-term scale. This suggests that Bitcoin prices are not entirely random in the long run. Instead, they exhibit a specific pattern that tends to converge towards the value calculated by Metcalfe's Law. Nevertheless, in the short term, Bitcoin prices remain highly volatile, as illustrated in Figure 4 when comparing Bitcoin's price to the Metcalfe value (Peterson, 2018).

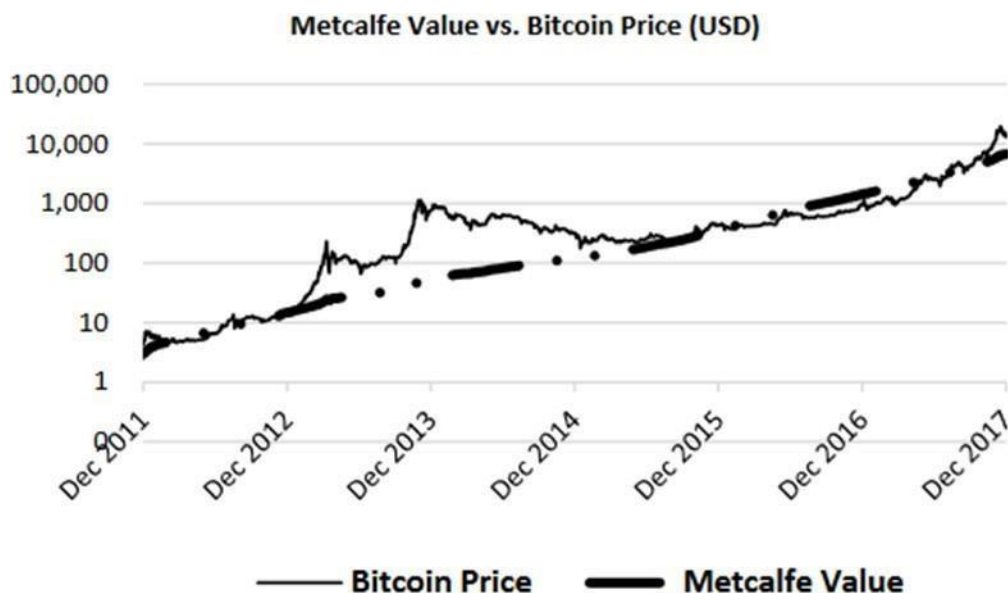


Figure 4 Bitcoin Price vs. Metcalfe Value (USD) Adopted by (Peterson, 2018)

These alternative approaches to Bitcoin price assessment shows that Bitcoin unlike other assets, which are considered traditional such as gold, bonds and stocks, require a more in depth

understanding of this unique asset before being able to predict its price changes and unusual market dynamics, the lack of a single approach or a uniform method to calculating its price projections clearly shows the challenge facing researchers and investors alike in determining the price determinants of Bitcoin . It also shows that when applying traditional financial models to Bitcoin they simply can't justify or predict its price and price fluctuations. This suggests the need for some new and innovative methods for understanding and predicting its price movements.

Behavioral finance theory, as discussed by (Sabalioni et al.2021), highlights the significant role that psychology and emotional biases play in the decision-making processes of retail investors, particularly in the context of the cryptocurrencies market including Bitcoin. Since In contrast to institutional investors who often rely on data and research for investment decisions, retail investors are more likely to be influenced by their psychological preferences and emotional reactions. This distinction is particularly evident in the Bitcoin market, where individual investors are more prevalent than institutional investors.

Information about Bitcoin is circulated primarily through internet platforms such as websites, forums, blogs, and social media outlets, and this information is often interpreted by individual investors through their own preferences and emotional biases. Therefore, investor sentiment can fluctuate rapidly, leading to high levels of volatility in the Bitcoin market, including the formation of price bubbles.

To assess investor sentiment, researchers employ various metrics that allow for more understanding of what motivates investors to invest in Bitcoin. By capturing online activity related to Bitcoin, such as Google search intensity and Twitter data allows for analyzing the increase in public interest in Bitcoin, as reflected in heightened search activity and social media interactions, corresponds to an arrival of new investors and increased capital flow into the market. This approach helps measure the impact of rumors, viral news, and online sentiment on price shocks and deviations from the equilibrium price as discussed earlier according to Metcalfe's law. Therefore, Google search intensity and the volume of tweets serve as practical and often viable indicators for assessing and understanding investor sentiment and opinion. (Sabalioni et al.2021)

(Burggraf et al. 2020) further highlights the inclination of individual investors to follow the crowd rather than making market assessments based on objective data and analysis. When Bitcoin's price experiences an increase especially if this increase is significant, retail investors tend to exhibit a strong desire to own Bitcoin and invest in this cryptocurrency. On the other hand, during price declines, they tend to follow the trend and want to sell their Bitcoins. This behavior can intensify

market movements and contribute to fluctuations in Bitcoin's price while also leading to significant gains as well as significant loss of capital.

Furthermore, it is often emphasized that Bitcoin, as well as other cryptocurrencies, are considered complex and inherently risky investments. In times of market distress or economic uncertainty, investors often seek to avoid risky investments and therefore they move toward safer and more liquid assets. Bitcoin, being a high-risk asset, does not traditionally serve as a hedge against downturns in equity markets, as more and more risk averse investors tend to sell and move toward safer and more reliable assets, this contributes to its vulnerability to sentiment-driven decisions during turbulent market conditions. (Burggraf et al. 2020)

In summary, since psychology, emotions, and sentiment play a major role on how investors view Bitcoin, this led to increase price fluctuations which became more of a unique and prominent characteristic of the Bitcoin market. This makes it more important to understand and measure investor sentiment for comprehending and understanding the dynamics and price movements of Bitcoin, particularly in a market where most investors are individual investors who not always follow objective information and market analysis, this together with rapid information distribution now more prevalent through online channels such as social media, vlogs, online forums, and podcasts. This sentiment-driven decision-making process is the primary reason for the inherent volatility of Bitcoin and other cryptocurrencies.

1.3 Bitcoin Classification

1.3.1 Bitcoin as a currency

Since its inception many researchers considered the potential of Bitcoin to be widely used as an everyday currency, comparable to national currencies. Advocates, as described by (Cox et al. 2015), argue that Bitcoin's decentralized characteristic and its elimination of third-party intermediaries in payment transactions could enable nearly free of charge transfer of payments. This efficiency could encourage an increasing amount of people to adopt Bitcoin for daily use for payments, especially since Bitcoin transactions are often significantly cheaper than those in traditional fiat currencies, this is particularly important in developing countries and third world nations where many people are not included in the financial markets.

However, many researchers express skepticism regarding Bitcoin's ability to function as a practical everyday currency. As claimed by (Yermack, 2015), Bitcoin is not yet extensively used as a medium of exchange in spite of its widespread users throughout the globe. The majority of Bitcoin

transactions are related to speculative activities and investment services or the acquisition of computer software and hardware whereas a limited number of transactions actually are used for the purchase of goods and services, even among businesses that accept Bitcoin as a form of payment. Therefore, since many users don't use Bitcoin as a medium of exchange, it is one of the main obstacles that Bitcoin faces to become potentially used as a currency.

Moreover, Bitcoin's price volatility also poses a significant obstacle in its adoption as a currency since Bitcoin's value is known to fluctuate rapidly and Bitcoin prices have gone through many events that lead to a significant decrease of value while sometimes to a rapid increase and sharp decline afterwards. Therefore, holding onto Bitcoins for even brief periods carries inherent risk. This volatility is totally opposite to the characteristics of a reliable store of value, which is a fundamental requirement for any currency to function effectively. Such price fluctuations undermine Bitcoin's suitability as a unit of account, which is one of the most important functions for a currency to have and which many traditional currencies tend to maintain. (Yermack, 2015)

This perspective supports the viewpoint of (Nian and Chuen, 2015), who also identify Bitcoin's market volatility as a significant obstacle to its acceptance as a medium of exchange since even businesses that do accept Bitcoin payments are often inclined to convert their Bitcoin holdings back into traditional fiat currencies to mitigate the inherent risk associated with exposure to this volatility.

Furthermore, Bitcoin functions on a continuously updated Blockchain, with participants continually adding blocks as more transactions are verified. However, a fundamental characteristic of Bitcoin is its limited supply, since there is a finite number of bitcoins available for mining and circulation. This unique feature creates a unique model where Bitcoin appreciates in value and would incentivize holders to save rather than spend their bitcoins. This might be encouraging for investors who would hope in the long term to have an appreciating asset, in the short term it is a great obstacle in the face of Bitcoin adoption as a currency.

The popularity of hoarding, which is the inclination of Bitcoin owners to hold their coins for a very long time rather than spending them is a major reason why the Bitcoin network is not widely considered a currency. Since the increase in hoarding among users leads to less transactions and the decrease in transactions will affect the profitability of miners, who earn rewards for verifying and adding these transactions to the blockchain, and since as discussed before miners play a very important role in securing the Bitcoin network, if the number of Bitcoin transactions decreases significantly, it will lead to an increased weakness in the system's ability to defend itself from

fraudulent activities and scams. All of this can lead to a decrease of trust in Bitcoin among users and ultimately lead to a collapse in its value and utility (Barber, Boyen, Shi, & Uzun 2012).

In conclusion many investors and users claimed that Bitcoin can serve as a common, everyday currency similar to national currencies or traditional fiat currencies. Some think that it can be possible since it has a decentralized structure, low transaction costs, and the ability to transform financial systems. Still, many other investors don't accept the notion that Bitcoin could be used as a currency.

One of the reasons for this is that Bitcoin is still not widely used as a medium of exchange because most transactions involving Bitcoin are speculative activities rather than regular purchases of goods and services. Another major obstacle that faces its adoption as a currency is its instability as a dependable store of value or unit of account, which are widely considered the two essential roles for any currency. Due to its limited supply, Bitcoin encourages hoarding among users and holding to their Bitcoins awaiting a surge in Bitcoin prices. This in turn lowers the volume of transactions. Reduced transactions have an impact on network security and miners' profitability, which could endanger its utility and trust. Some researchers are concerned about the sustainability and resilience of Bitcoin due to its limited supply, hoarding, and transaction volume. Nevertheless, Bitcoin's potential as a currency requires overcoming many obstacles which may not be possible due to its inherent characteristics such as price volatility, and the effects of hoarding behaviors which are major obstacles that Bitcoin needs to be overcome before this digital currency can become widely accepted as a functioning currency.

1.3.2 Bitcoin as a safe haven.

An important goal for investors looking for stability and steady returns on their investments is minimizing risk in their portfolio. Investing in a variety of assets that have little correlation with one another and, in some instances, even a negative correlation with more traditional assets is a fundamental strategy for achieving this goal. This process is known as diversification, and while potentially generating additional profits, this strategy protects investors' money from market fluctuations.

Assets characterized by negative or insignificant correlations with the core investments in a portfolio are often referred to as hedges. However, when a hedge goes beyond simply being uncorrelated and actively showcases a negative correlation with the underlying assets, especially during periods of market turbulence and uncertainty, it is then could also be considered a safe-haven

asset. The addition of such safe-haven assets in a portfolio during economic downturns serves for preserving capital and helping to mitigate losses (Klein, Thu, & Walther, 2018).

As a relatively new financial instrument, Bitcoin has gained increasing popularity in recent years and its application and potential for use in diversified portfolios is still being examined and researched, such as the research done by (Dhyrberg's 2016) to evaluate Bitcoin's hedging potential. Using different metrics, it was found that Bitcoin can be used effectively as a hedging tool, particularly against the U.S. dollar, and stock market in the UK. These findings demonstrate that, when it comes to reducing risk in investment portfolios, Bitcoin can function similarly to gold, which is regarded as a conventional safe haven asset.

These findings are consistent with the research conducted by (Shahzed et al.2019), which indicated that Bitcoin, gold, and commodities share similarities in their safe-haven properties when considered in the context of the global stock market index. Furthermore, this research also suggested that Bitcoin exhibits certain characteristics similar to gold, especially when facing severe downturns in the world stock market index, making it a valuable addition to stock diversification strategies. However, in well-established and developed markets, gold tends to maintain its status as the leading safe-haven asset. In contrast, in emerging economies and China, despite government-imposed restrictions, Bitcoin may serve as a safe-haven asset for investors.

Similarly, the study conducted by (Bouri, Molnár, Azzi, Roubaud, & Hagfors, 2017) supported the notion that Bitcoin possesses strong hedging capabilities against movements in Chinese stocks. It also functions effectively as a diversifying asset when incorporated into the Chinese and Asian indices. The research further explained Bitcoin's role as a safe haven, particularly in the context of extreme market movements within Chinese and Asia Pacific stock markets. This outcome implies that during periods of financial crisis in the Asia Pacific region and China, investors tend to seek refuge in Bitcoin, viewing it as a reliable store of value and a hedge against market instability.

Likewise, the research conducted by (Selmi, Mensi, Hammoudeh & Bouoiyour 2018) provides additional insights into the role of Bitcoin within investment portfolios. Their findings indicate that portfolios that incorporate both Bitcoin and oil, when compared to those featuring gold and oil, demonstrate an ability to reduce overall portfolio risk. In fact, Bitcoin and gold tend to outperform portfolios comprised exclusively of oil. This observation is also true even when evaluated across different market scenarios involving Bitcoin and gold. Despite Bitcoin's reputation for high volatility, its addition to portfolios effectively mitigates risk and can yield substantial profits. Notably, Bitcoin and gold differ in their characteristics as hedges or safe-haven assets. Bitcoin exhibits a much

higher degree of price volatility, marked by extreme price swings in the short term more specifically, whereas gold, being a traditional safe haven, offers a more stable and universally accepted safe haven. Central banks and investors typically turn to gold during periods of economic turmoil due to its established reputation as a reliable store of value, while Bitcoin's role is still under scrutiny and examination.

Additionally, a study conducted by (Wang, Tang, Xie, & Chen, 2019) points out the importance of investors being aware of Bitcoin's speculative and uncertain nature when contemplating and considering it as an investment. While Bitcoin's potential for generating a higher return on investment compared to other assets is attractive and appealing, its inherent volatility presents a significant disadvantage. Bitcoin's profitability is usually accompanied by substantial risks while also price bubbles are more common in the Bitcoin market, and when these bubbles burst, investors may face substantial capital losses.

Moreover, it is also crucial for investors to recognize that while Bitcoin can serve as a hedge for stocks and bonds, it does not offer the same protective role and hedging capabilities for commodities, since Bitcoin's returns tend to align with those of commodities and gold when extreme market price fluctuations occur although commodities price movements might not be as sharp and prominent. Consequently, investors who turn to Bitcoin as a safe haven during downward price movements in the commodities and gold markets may experience more significant losses.

When considering hedging properties, Bitcoin demonstrates effectiveness as a hedge for stocks and bonds, while also serving as a diversification tool for commodities. Bitcoin shows a negative correlation with stocks and bonds which in turn contributes to the creation of safer investment portfolios during financial turbulence. Furthermore, Bitcoin can effectively reduce the non-systematic risk associated with portfolios that include commodities or foreign exchange since in diversified portfolios consisting of a variety of assets, Bitcoin can function as a valuable means of diversification and a hedging asset. These insights and study results demonstrate that as long as investors carefully consider Bitcoin's characteristics such as its unpredictability and volatility while also considering its suitability within particular market scenarios and portfolios, Bitcoin can play an important role within investment strategies, and it has the potential to improve certain portfolio's performance. Especially when there is a significant decline in the markets, investors can reduce risk and build well-balanced investment portfolios by adding Bitcoin. (Wang, Tang, Xie, & Chen, 2019)

The disastrous COVID-19 pandemic has left a significant impact on the global economies of the world and many countries economic growth. The pandemic's consequences are characterized by

the great uncertainty it has spread, together with the continuing struggle to mitigate its catastrophic results. Additionally, it had a significant influence on investor sentiment, which has been notably weakened especially when considering that historically, investors usually have a much higher aversion and sensitivity to losses, particularly severe ones, when compared to their response to gains.

The current economic and financial distress resulting from the pandemic has encouraged a reevaluation of preferred portfolio selections among investors. Many are turning to safe-haven assets to protect themselves from escalating financial turmoil and increased investment risks. While gold traditionally is considered the traditional and ideal safe haven against bonds and stocks, investors now have been critical about its efficacy, particularly in the face of low interest rates and the increased use of gold for short-term profit and speculative gains over long-term economic stability and sustainable growth following the global financial crisis of 2008. This allowed for the emergence of alternative safe-haven assets, such as Bitcoin. (Huang, Duan, & Mishra, 2021).

There are a number of important reasons why Bitcoin can be considered a safe haven. First it shows a weak correlation with conventional financial assets, which offers some protection against the fluctuations of the market. Moreover, the fact that Bitcoin functions independently of monetary policies adds to its appeal as a safe-haven investment. But it's important to remember that academic research hasn't always supported Bitcoin's hedging and safe-haven qualities. This is partly because investing in Bitcoin is by its very nature speculative, which can add a degree of uncertainty and unpredictability. (Huang, Duan, & Mishra, 2021).

Similarly, a study by (Ghorbel and Jeribi 2021) examines how the COVID-19 pandemic and the parallel manipulation of oil prices by some nations affected the world financial system. During this period of destabilization that began in early 2020 there was a sharp drop in oil and global stock markets. Investors seeking to protect their wealth turned to gold, which had proven to be a reliable asset during previous crises such as the financial crisis of 2007. Despite being obviously different from other assets, bitcoin and gold nevertheless have certain things in common because they are both free from the influence of the governments and central banks. But it's important to note that there are key distinctions and variations between Bitcoin and gold. The appeal of Bitcoin for investors is its poor correlation with conventional assets like bonds and stocks, but not as poor correlation with commodities, all of this makes Bitcoin a desirable option for diversification.

However, in contrast to gold, Bitcoin is not universally considered a safe haven during the COVID-19 pandemic and the economic crisis that followed the outbreak of coronavirus. The volatility and risk associated with digital currencies set them apart from gold, making them less

favorable during times of economic crisis and bearish market sentiments. Instead, Bitcoin tends to be more appealing during periods of stability with increased positive investors sentiment or when the financial markets experience growth. (Ghorbel and Jeribi, 2021).

In research conducted by (Conlon & McGee, 2020), the safe haven properties of Bitcoin during the COVID-19 pandemic, were thoroughly examined. The primary focus was on determining whether allocating a portion of an investor's wealth to Bitcoin could effectively mitigate downside risk when compared to a portfolio comprising only equities, particularly the S&P 500. The findings revealed that during the COVID-19 pandemic and the following financial turmoil, investors who allocated a portion of their portfolio to Bitcoin alongside the S&P 500 did not experience a protective effect against downside risk. Instead, portfolios that included Bitcoin exhibited an increase in downside risk, with the degree of risk rising in proportion to the Bitcoin allocation. Notably, the research indicated that any allocation exceeding 28% led to a 50% increase in the baseline level of downside risk.

Furthermore, apart from its volatility, Bitcoin is susceptible to fraud, which mainly is caused by the the unreliable security of Bitcoin wallets. These wallets can be the target of malicious activity and fraud, which puts investors at serious risk. On the other hand, gold is considered more dependable and trustworthy and is therefore a more secure option in traditional markets. Bitcoin as an investment tool is also very complex, which can be difficult for investors to understand. Because of this, it's possible that many investors are unaware of the characteristics of Bitcoin and the reasons influencing its price swings. On the other hand, a lot of scholarly research supports gold, which makes it a more reliable asset. Overall, the data indicates that investors in Bitcoins are a different group from those who use gold as a hedging instrument. These variations demonstrate how special and unique Bitcoin is as an investment (Dhyrberg, 2016).

Research done by (Selmi, 2018) suggests another major factor that could have a big impact on Bitcoin's value as an investment or a safe haven is the regulatory environment. While Bitcoin has certain benefits, like its decentralized structure and independence from the political or economic policies of a single nation, its legal status is still developing and frequently unclear in many other nations. The legal status of Bitcoin as to this day is not definite and is subject to constant changes and revisions in numerous jurisdictions across the globe with each country taking a different approach, where some countries choose to embrace Bitcoin, while others choose a different approach and may add restrictions on its use and trade. The acceptance and use of Bitcoin as an investment asset may be impacted by this inherent uncertainty, which poses a serious regulatory risk. Therefore, Bitcoin's

standing as a predictable investment vehicle or a functioning method of diversification could be significantly impacted if some nations decide to outlaw or restrict it.

Additionally, a declining trust in the stability of the established banking system and an increase in uncertainty characterize the global financial environment. Bitcoin and other cryptocurrencies have become more popular as viable substitutes in this kind of situation. But whether or not investors can take advantage of these new cryptocurrency technologies in addition to traditional investments for maximum return depends largely on the regulatory environment. Since how much investors can profit from these new cryptocurrency technologies in addition to traditional investments for maximum return depends heavily on the state of the regulations. The regulatory risk attached to Bitcoin basically means that investors need to be informed about the legal developments in their respective jurisdictions. The importance of having a diversified investment strategy that considers potential regulatory changes and their implications for the cryptocurrency market is also very important. (Selmi, 2018).

In summary, it is still not clear where exactly Bitcoin fits into investment portfolios as research studies have shown it could have a potential to be used as a safe haven, diversification asset, and hedge during turbulent times. It is attractive to be used as an addition to portfolios due to its lack of correlation with traditional assets and its independence from monetary policies. However, due to its high volatility and speculative nature, Bitcoin's complexity and uncertainty should be considered before using it to mitigate risk. Moreover, researchers found that when compared to more traditional assets like gold or oil Bitcoin can be a valuable hedge and diversification tool that lowers the overall risk of a portfolio, but it all depends on the specific market and situation. It is unique in that it has limited safe-haven qualities, but it isn't always acknowledged as a safe haven in times of economic turmoil. Likewise, investors are reevaluating their portfolio choices and moving toward safe-haven assets as a result of the COVID-19 pandemic. Historically, gold has played this role, but because of its distinct qualities, Bitcoin has become a potential alternative. But research indicates that in a crisis, Bitcoin might not offer the expected hedge against negative risk. Regardless of its security flaws, other factors influencing its role in portfolios are its volatility and regulatory uncertainty.

2. METHODOLOGY FOR EVALUATING THE SAFE HAVE POTENTIAL OF BITCOIN

2.1 Aim and Hypothesis of the research

The purpose of this research is to investigate Bitcoins safe haven capabilities during the COVID-19 pandemic and compare its efficacy as a safe haven tool when compared to other traditional safe havens, primary gold, which for a long time has proven itself as a reliable safe haven asset. In this research we give an overview of how Bitcoin functions in the financial market as it is a new and innovative investment vehicle that its attributes and characteristics are not yet fully understood. In addition, we will construct various portfolios with an allocation to Bitcoin and we will compare their performance to portfolios with an allocation to gold and portfolios with only equities. Doing so will allow us to gauge the efficacy of Bitcoin in reducing volatility and providing stability to these assets especially when compared to the gold allocation which will be the benchmark for our study.

This research hypothesis is: Could Bitcoin, because of its intrinsic qualities like decentralization and limited supply, serve as a dependable safe haven investment like gold? This study attempts to investigate whether the unique characteristics of Bitcoin make it a potential hedge against market volatility, as seen during the COVID-19 pandemic.

For an asset to be considered as a safe haven asset that would be used by investors to protect their wealth, it should maintain its value in the face of unfavorable market conditions and economic volatility and negative market downturns. The assessment of an asset's possession of safe haven attributes has led to the creation of various testing techniques in academic research. Descriptive statistics has always been used as a primary way of estimating the performance of studied assets as these statistics offer an overview of how assets performed during a specific period of time while also showcasing other attributes such as outliers and volatility, while at same time giving insights to their returns and average distribution.

2.2 Selection of the model

Another way of testing an assets potential safe haven attributes is the dynamic conditional correlation modeling, which evaluates the correlation over time between the safe-haven asset and a base or reference asset, it is regarded as one of the most popular and often used techniques. Regression analysis against binary variables is then applied to this correlation in order to explain the occurrences of extreme negative returns in the base asset (Bouri, Molnár et al. 2017)

In addition, another effective way to examine the safe-haven potential of an asset is to apply the ARMAX-GARCH model to the returns of the asset under consideration. In this analytical framework, the inclusion of additional descriptive variables is important, including parameters such as the return on the underlying asset and the occurrence of extreme negative returns within the underlying asset (Baur & Lucey, 2010). These vigorous testing methods enable a detailed examination of assets' safe-haven capabilities. However, one of the main principles in risk assessment and portfolio management is downside risk. When working with assets whose returns follow a normal distribution, professionals and experts often use Value at Risk (VaR), a very significant analytical tool. This method is critical to understanding and calculating the potential losses that a portfolio may incur when considering a predefined confidence level. The Two-Moment Value at Risk (VaR) sheds light on this by using the concept of maximum expected loss over a specified time period.

The Two-Moment VaR formula, is expressed as:

$$\text{VaR}(1 - \alpha) = \mu p - \sigma p z(\alpha).$$

Where VaR in this equation represents value at risk estimated, α represents the confidence interval used, $z(\alpha)$ is the α quantile of the standardized distribution. While μp represents the mean returns of the portfolio and σp represents the standard deviation. Using the two-moment VaR, the downside risk of an investment is a constant multiple of the standard deviation of the investment returns. Therefore, when studying portfolio management and risk assessment, Two-Moment Value at Risk (VaR) has long been considered an important tool for quantifying potential losses within a portfolio. This method is based on the assumption that returns on financial assets follow a normal distribution, which allows the calculation of the maximum expected loss over a given period of time at a given confidence level. However, in practice, returns on financial assets often deviate from this ideal normal distribution, which makes it not appropriate for the two-moment VaR to capture the risk associated with non-normal returns, particularly when faced with extreme events and the possibility of large losses. Bitcoin, is also among those assets with non-normal returns as it is known to be subject to significant price fluctuations and price clustering, and has high skewness and kurtosis values, making it an asset that deviates significantly from normality (Conlon & McGee, 2020)

Given these limitations, researchers have proposed alternative risk measurement methods that can better accommodate the characteristics of assets with non-normal return distributions. One of those approaches suggested by (Favre and Galeano 2002) is the Cornish-Fisher modification, which allows for the adjustment of quantiles within the distribution to account for higher-order moments, such as skewness and kurtosis. This adjustment enables risk managers and investors to assess the

potential downside risk more accurately in situations where extreme events and non-symmetrical return distributions are prevalent. Given that non-normal return distributions are more common in assets like Bitcoin, this research attempts to investigate the downside risk of these assets while acknowledging the limitations of the Two-Moment VaR. A deeper understanding of risk can be possible by employing the Four-Moment VaR, which incorporates higher-order moments into the risk assessment process. This method includes elements like skewness and kurtosis in addition to the mean and the standard deviation of returns which is more significant when working with non-normal distributions.

The Four-Moment VaR differs from the traditional approach, which focuses primarily on the mean and standard deviation of returns. It also includes the skewness and kurtosis of the return distribution, which makes it in this case a more accurate representation of the risk associated with Bitcoin. The Skewness, which quantifies the asymmetry in the distribution of returns, and kurtosis, which measures the fatness of the tails of the distribution, are very important metrics used in assessing the likelihood of extreme events and large losses. Therefore, while in certain cases it is appropriate to use the standard Two-Moment VaR for risk assessment, this method performs poorly when applied to assets like Bitcoin that have non-normal return distributions. With the incorporation of skewness and kurtosis, the Cornish-Fisher modification provides a better method for evaluating downside risk. This study aims to improve our comprehension and understanding of risk in these kinds of situations by applying the Four-Moment VaR, which offers a more reliable and accurate assessment of the possible losses and extreme occurrences that could impact the value of non-normally distributed assets. (Conlon, Corbet, & McGee, 2020).

Four moment VaR is an estimation for the quantile of the distribution, and it is given by:

$$Z(\alpha, S_p, K_p) = z(\alpha) + \frac{1}{6}(z(\alpha)^2 - 1)S_p + \frac{1}{24}(z(\alpha)^3 - 3z(\alpha))K_p - \frac{1}{36}(2z(\alpha)^3 - 5z(\alpha))S_p^2$$

In the above equation K_p and S_p represent kurtosis and skewness of portfolio P, whereas $z(\alpha)$ represents the α quantile of the standard normal distribution. Therefore, Using the Cornish- Fisher expansion the four-moment modified (VaR) is given by:

$$MVaR_p(1 - \alpha) = \mu_p - \sigma_p \hat{Z}(\alpha, S_p, K_p).$$

The modified VaR regulates the two-moment VaR to take into consideration distributional characteristics usually found in financial time series. Moreover, Relative portfolio risk is calculated as a function of the portfolio downside risk with an allocation to gold or Bitcoin relative to a portfolio

holding only the indices examined in this paper. For MVaR, this is given by $MVaR_p/MVaR_{eq}$, where $MVaR_{eq}$ and $MVaR_p$ represent the downside risk of equities only portfolio and portfolios consisting of equities and Bitcoin or equities and gold.

The allocation of Bitcoin or gold to portfolios, as outlined in this research, is influenced by the work of (Conlon, Corbet, & McGee, 2020). Their research suggested a 10% allocation of cryptocurrencies to various portfolios as a method to assess the downside risk of cryptocurrency investments. This allocation serves as a basis for understanding how these alternative assets can contribute to or mitigate portfolio risk. Furthermore, an essential component of our analysis involves determining the downside risk associated with investments in Bitcoin. This aspect is important in determining whether Bitcoin can effectively function as a safe haven during times of economic distress. Therefore, we will compare the downside risk of each individual index with a hypothetical portfolio. This portfolio will allocate 10% of its capital to Bitcoin, with the remaining 90% dedicated to the respective index.

This will enable us to evaluate how a combination of Bitcoin and each index performs in risk mitigation, which will allow us to more understand the effectiveness of Bitcoin as a hedging instrument. We will also conduct a parallel analysis by using Gold and comparing the performance of a portfolio allocating 10% to Gold and 90% to the index. This method will help us assess the relative effectiveness of Bitcoin and Gold as safe-haven assets during times of economic turmoil. (Ghorbel and Jeribi, 2021).

The financial indices used in this research include the S&P 500 which is also known as the Standard and Poor's 500 which is the main indicator of the U.S. stock market, tracking the performance of 500 of the most influential companies listed on American stock exchanges. It is widely known as one of the most closely monitored equity indices, which will be used as a standard for Bitcoin's performance within the U.S. market. Likewise, in this research also we will include the Shanghai Stock Exchange Composite Index (SSE) which represents the Chinese stock market, the SSE Composite Index includes all A-shares and B-shares traded on the Shanghai Stock Exchange which will provide us with insights into how Bitcoin performed when compared to the Chinese market during the COVID-19 pandemic. Moreover, the FTSE 100 representing the U.K. stock market will also be used, which monitors the stocks of the 100 biggest companies listed on the London Stock Exchange. Similarly representing the French market during this time, we will include the CAC 40 index which is the main stock market index for France, tracking the performance of the 40 largest companies listed on Euronext Paris. Lastly representing the German market, we will use the

Deutscher Aktienindex (DAX) which monitors the trading of 30 major German companies on the Frankfurt Stock Exchange. Our chosen proxy for Bitcoin prices is the exchange rate of Bitcoin to U.S. dollars, sourced from CoinMarketCap. CoinMarketCap is a well-known website that maintains comprehensive records of cryptocurrency market cap rankings, price listings, and trade volumes. Using CoinMarketCap allows us to get important information regarding Bitcoin prices and price changes while also allowing us to get more information about Bitcoin's price fluctuations over time since it gathers data from various cryptocurrency exchanges.

The scope of our investigation is the unprecedented COVID-19 pandemic, which the World Health Organization (WHO) initially detected and identified in Wuhan, Hubei province China, in December 2019. This global health crisis forced the WHO to declare a Public Health Emergency of International Concern in January, and by March 11, 2020, it was officially acknowledged as a pandemic. The pandemic had a wide range of effects on the economy since global supply chains were disrupted and there was a significant increase in unemployment while also financial markets saw extreme fluctuations and downturn. This led to a change in investor sentiment and investors' need for safe-haven assets increased as they struggled with the uncertainty that the pandemic caused. Bitcoin, although still a new asset, many professionals and researchers started to speculate on its role during this economic turmoil, some suggested that Bitcoin could play a major role as a safe haven asset similar to gold. In order to evaluate the performance of Bitcoin during this critical time and its ability to serve as a safe haven, we concentrate on data that is available from December 1st, 2019, to May 1st, 2021. This time period includes the early phases of the pandemic and the resulting turmoil in the markets. The selection of this time frame is important to closely examine how Bitcoin reacts to economic hardship and specifically during the COVID-19 pandemic and how it compares to conventional safe-haven assets like gold.

2.3 Limitations of the research

It is important to recognize the limitations of this research since the use of historical data from the COVID-19 crisis, may not be comprehensive of all economic circumstances that could occur in the future, especially when considering that Bitcoin price may be influenced by investor sentiment especially around the halving event what drives investors and speculators alike to have an overall positive sentiment regardless of other circumstances. Moreover, it is important to acknowledge the ever-changing regulatory environment surrounding Bitcoin and how it might impact its usefulness as a safe haven asset in the future beyond the COVID-19 pandemic.

3. EMPIRICAL EVALUATION OF BITCOIN AS AN INVESTMENT AND SAFE HAVEN ASSET

3.1 Assessment of descriptive statistics of various assets during the pandemic

We used historical daily price data from The Wall Street Journal website, WSJ.com, to conduct our comprehensive analysis. Our data set includes a wide range of financial instruments, including gold, Bitcoin, S&P 500, DAX, FTSE 100, CAC 40, and SSE. In order to get a better understanding of the performance of these assets we used the closing prices, to accurately calculate the daily returns for each individual asset. The difference in closing prices from one trading day to the other was calculated. By performing this procedure across our entire data set, we were able to generate a time series of daily returns for gold, Bitcoin, and all included indices in this research.

We also used a variety of statistical metrics to obtain more understanding of the properties of these returns. Skewness, Kurtosis, the Coefficient of Variation, First, Third, and First Quartiles, Interquartile Range, Mean, Median, Standard Deviation, Minimum Return, and Maximum Return were among these metrics. These statistical measures are very important for understanding the risk, variability, and distribution of these financial assets. The results of our data collection and statistical analysis are summarized in Table 1 below.

Table.1. *Descriptive statistics of Bitcoin, Gold and Indices.*

	Gold	BTC	S&P500	DAX	FTSE100	CAC40	SSE
Mean	0.0613	0.7	0.1	0.06	-0.0019	0.035	0.0603
St. Deviation	1.26	4.7	1.89	1.81	1.63	1.77	1.22
Min	-5.61	-26.68	-11.98	-12.24	-10.87	-12.28	-7.72
Q1	-0.629	-1.28	-0.50	-0.54	-0.62	-0.57	-0.54
Median	-0.125	0.34	0.18	0.06	0.06	0.09	0.08
Q3	0.52	2.04	0.84	0.83	0.78	0.82	0.68
Max	5.24	16.92	9.38	10.98	9.05	8.39	5.71
IQR	1.15	3.39	1.342	1.37	1.39	1.39	1.22
Skewness	0.34	-1.03	-0.63	-0.64	-0.83	-0.99	-0.77
Kurtosis	4.06	13.37	10.73	10.83	9.47	10.23	6.33

Note: BTC refers to Bitcoin, St. Deviation is the standard deviation, Min is the minimum return, Max is the maximum return, Q1 is the first quartile, Q3 is the third quartile, IQR is the interquartile range, CV is the coefficient of variation.

The data presented in Table 1 offers a comprehensive view of the performance of various financial assets and indices during the COVID-19 pandemic.

Gold has long been considered a safe haven asset, usually used by investors during economic turmoil since it is regarded as a safe haven and resistant to market fluctuations, it is reliable and has proved itself to consistently protect investors from market downturns. The statistical analysis of gold performance during the COVID-19 pandemic shows that Gold's mean value was 0.0613 suggesting that, on average, it maintains a slightly positive price throughout this time period. However, Gold had a standard deviation of 1.26 which implies a moderate level of price fluctuation, making it a relatively stable investment compared to assets like Bitcoin. The minimum and maximum values of -5.61 and 5.24, respectively, show Gold's change of price since it has experienced both increase and decrease in price, but it does not demonstrate the extreme price movements characteristic of Bitcoin. Additionally, The Q1, Median, Q3 allow for a deeper understanding of Gold's price distribution. The first quartile (Q1) at -0.629 represents the lower 25% of gold prices, while the median stands at -0.125, indicating the midpoint of the dataset. The third quartile (Q3) at 0.52 represents the upper 25% of prices, this suggests a balanced distribution with a slight right-skewed pattern where the tail on the right is longer but not significantly, since the skewness value of 0.34 indicating that there's a greater likelihood of smaller upward price movements compared to equally sized downward movements. The kurtosis of 4.06 showcases that Gold's distribution is leptokurtic, meaning it has heavier tails and a more peaked central distribution than a normal distribution. which suggests that Gold can experience occasional extreme price events, but it also has a more concentrated middle price range.

On the other hand, the above data shows that Bitcoin shows evidence of highly volatile price fluctuations since the mean for Bitcoin is 0.7 which indicates that on average, it experiences significantly more price increase than Gold. However, the standard deviation of 4.7 indicates extreme price volatility. Bitcoin's standard deviation is significantly higher than that of Gold, which shows price sensitivity to market fluctuations and unpredictable changes. The minimum value of -26.68 demonstrates significant downward price movements, and the maximum value of 16.92 shows the potential for significant gains. These extremes show that Bitcoin can experience both rapid increase in price as well as rapid decrease and price crashes.

When observing Bitcoin's quartiles, the first quartile is at -1.28, the median at 0.34, and the third quartile is at 2.04 suggesting that a significant percentage of Bitcoin's prices falls below zero. This indicates a distribution that is significantly skewed to the left, as confirmed by the negative skewness value of -1.03. Moreover, the negative skewness implies that Bitcoin's distribution has a longer tail on the left side, indicating a tendency for extreme downward price movements. The kurtosis value of 13.37 is exceptionally high. This indicates a leptokurtic distribution with extremely heavy tails and a highly central distribution which suggests that Bitcoin is highly susceptible to extreme price events in both directions, making it a speculative asset with a significant potential for both gains and losses.

Meanwhile, The S&P 500 had a mean of 0.1, which suggests steady market performance. However, the standard deviation of 1.89 indicates moderate volatility since the S&P 500 is less volatile than Bitcoin but more volatile than Gold. Moreover, the minimum value of -11.98 and the maximum value of 9.38 demonstrate market movements, with both downside and upside potential. The quartiles for S&P 500, Q1 -0.50, Median 0.18, and Q3 0.84, show a relatively balanced distribution when compared to Bitcoin and Gold. The skewness of -0.63 suggests a slightly left-skewed distribution, meaning a tendency for more frequent downward price movements. The kurtosis value of 10.73 indicates a leptokurtic distribution, which means there is a potential for a relatively higher amount of extreme price events compared to a normal distribution. This shows that the US stock market also experienced occasional extreme fluctuations during the pandemic, even though it is generally more stable than Bitcoin.

When considering the German market represented by the DAX index, we find that the DAX's mean of 0.06 and standard deviation of 1.81 indicates a level of volatility similar to the S&P 500 index. It is more volatile than Gold but still less than Bitcoin. While the minimum value of -12.24 and the maximum value of 10.98 show the market fluctuations during the pandemic and like the S&P 500, the DAX shows both downside and upside potential. The quartiles for the DAX are Q1 -0.54, Median 0.06, and Q3 0.83, indicate a balanced distribution, like the S&P 500. The skewness of -0.64 suggests a slightly left-skewed distribution, demonstrating it is more prone for downward price movements. The kurtosis value of 10.83 shows a leptokurtic distribution, showcasing that the DAX also experienced extreme prices, what is similar to the behavior of many global equity markets during the time period studied in this research.

However, the FTSE 100 had a mean of -0.0019 what is close to zero, suggesting that, on average, it maintains a relatively stable performance. Its standard deviation is 1.63 indicating a

moderate level of volatility, making it less volatile than Bitcoin but more so than Gold. The minimum value of -10.87 and the maximum value of 9.05 indicate potential for both gains and losses. The quartiles for FTSE 100, Q1 -0.62, Median 0.06, and Q3 0.78, suggest a balanced distribution. However, the positive skewness value of 0.83 highlights a slightly right-skewed distribution, meaning a higher likelihood of more frequent upward price movements. The kurtosis value of 9.47 suggests a leptokurtic distribution, indicating that the FTSE also was susceptible for occasional extreme price movements.

However, the CAC 40's mean of 0.035 is similar to the FTSE 100, implying a relatively stable performance. The standard deviation of 1.77 also shows relative volatility however CAC40 shows more volatility than Gold but less than Bitcoin. The minimum value of -12.28 and the maximum value of 8.39 highlights the potential for market movements in both directions during this time period. Moreover, the quartiles for CAC 40, Q1 -0.57, Median 0.09, and Q3 0.82, suggest a stable distribution. However, the negative skewness value of -0.99 indicates a left-skewed distribution, showing a greater likelihood of more frequent downward price movements. The kurtosis value of 10.23 suggests a leptokurtic distribution, demonstrating the potential for extreme price movements.

Lastly the SSE's mean is 0.0603, which is similar to Gold, indicating relatively stable prices. The standard deviation of 1.22 shows less extreme volatility than other market indices used in this research, however it has more volatility than gold still. The minimum value of -7.72 and the maximum value of 5.71 illustrate the potential for market movements in both directions. Also, the quartiles for SSE, Q1 -0.54, Median 0.08, and Q3 0.68, suggest a balanced distribution. The negative skewness value of -0.77 indicates a left-skewed distribution, showing a higher likelihood of more frequent downward price movements. Moreover, the kurtosis value of 6.33 suggests a leptokurtic distribution, indicating the potential for extreme price movements.

Subsequently we analyze and compare the statistical metrics used in this study for a better understanding of the performance of various assets and indices. For many investors and professionals, the mean return is an essential metric because it is a key indicator of an asset's performance. When analyzing the data, we find that Bitcoin is the asset that has the highest mean return among all the other assets since it experienced a significant increase in price. This highlights how attractive Bitcoin is to institutional and individual investors alike as a high-return investment. Although Bitcoin has the potential to yield huge profits, it is important to note that this potential also carries a high risk which is clearly demonstrated by Bitcoin having the highest standard deviation thus having the most extreme price volatility.

By contrast, the S&P 500, which is used in this study to represent U.S. market, show a more stable average return. However, the traditional safe-haven asset, gold shows the lowest mean return. This is consistent with gold's main function as a reliable store of value as opposed to a source of significant returns. The average return on gold shows how resilient it is to fluctuations in the economy, protecting wealth instead of providing rapid growth.

The rest of the assets show mean returns that are in the middle of those of the S&P 500 and Bitcoin, including the FTSE100, DAX, CAC 40, and SSE Index. These variations show how various economic factors during the COVID-19 pandemic affected various markets. Moreover, we analyze risk and volatility of various assets, which are measured by the standard deviation, in order to obtain a more complete prospective of the assets' performance. According to the data, of all the assets analyzed, Bitcoin and the S&P 500 have the highest standard deviations. This suggests that over the course of the observation period, they have seen the biggest price swings. Due to its extreme price volatility, Bitcoin, which has an extraordinarily high standard deviation, presents significant risks in addition to the potential for significant gains.

The S&P 500, on the other hand, also exhibits a high standard deviation. Even with its diversification and inclusion of various US companies, the S&P 500 was susceptible to market volatility during the pandemic, its prices fluctuated significantly indicating how susceptible it was to changes in the world economy and governmental regulations. However, gold's low standard deviation emphasizes how stable an asset it is since Gold is a popular choice among investors because of its ability to steady values even in the face of economic volatility. It represents a safe haven asset, maintaining its worth even in the face of potential losses to other assets. The standard deviation of the German stock market, represented by the DAX index, also indicates a high degree of volatility. Because of this, the DAX saw volatile price fluctuations during the pandemic, which highlighted Germany's susceptibilities to increased market turmoil.

The performance of the assets is further revealed by the minimum and maximum returns, especially when it comes to sharp price swings. Among the assets, Bitcoin has the lowest minimum return, which suggests that it experienced the largest negative price swings. This result is in accordance with Bitcoin's well known volatile price swings. However, Bitcoin also shows the highest maximum return, indicating that it has the potential to make significant gains. Compared to Bitcoin, the S&P 500's minimum return indicates that it experienced comparatively fewer significant price declines. Its high maximum return highlights the possibility of significant gains in the stock market even in the midst of market turbulence.

To better understand the assets' central tendencies, we analyze the median values. Given their relatively stable central tendencies in their price returns, Bitcoin and the S&P 500 have the highest median values. This suggests that they performed somewhat consistently throughout the time that was noted. In contrast, the FTSE100 and DAX show the lowest median values, indicating greater return variability. Particular economic factors in the UK and Germany, respectively, might have had an impact on their performance inconsistency during the Pandemic.

Furthermore, the distribution of returns around the mean can be understood by examining skewness, which quantifies the asymmetry of the return distribution. With the highest positive skewness, Bitcoin's price movements have been more noticeably upward than those of the normal distribution. The high risk, high reward nature of Bitcoin is represented by its positive skewness. Implying that Bitcoin is prone to upward price increases, especially in periods of positive market movements. Gold, on the other hand, has the least skewness, suggesting a more evenly distributed distribution of returns. This is in line with gold's standing as a safe-haven asset that tends to be steadier during volatile market periods.

Moreover, we analyze Kurtosis, a metric used to measure the return of distribution's tails, which provides us with information about the possibility of extreme returns. The DAX index and Bitcoin have the highest kurtosis values, which indicates a higher frequency of extreme returns both positive and negative. Suggesting that during the COVID-19 pandemic, these assets were more vulnerable to outside influences and market shocks. The lowest kurtosis values, on the other hand, are seen in the SSE index and gold, indicating more stable returns and a lower frequency of extreme price fluctuations.

In conclusion when observing all the metrics used to analyze the performance of Bitcoin, S&P 500, Gold, DAX, FTSE 100, CAC 40, and SSE Index during the COVID-19 pandemic, we observe that Bitcoin have the highest mean return which highlights its appeal as an investment with potentially large returns. However, this appeal have its own disadvantages by the considerable risk attached to Bitcoin due to its extreme price volatility. On the other hand, the S&P 500, which represents the U.S. equity market, had a strong mean return, which is evidence of its resilience. When looking for both risk and return, investors find the S&P 500 to be an attractive option. The traditional safe haven asset, gold, has the lowest mean return of all the assets examined, confirming its primary function as a reliable store of value that thrives during uncertain economic times and places a higher priority on preserving wealth than pursuing significant growth potential.

Furthermore, when examining risk and volatility, we find out that the S&P 500 and Bitcoin have the highest standard deviations although Bitcoin has the highest standard deviation by a large margin. Given their inherent risk factors, investors in Bitcoin and the S&P 500 should prepare for significant price fluctuations, as these values indicate how sensitive these assets are to market dynamics. Gold, on the other hand, continues to be regarded as a stable, low volatility asset, which makes it a popular option for risk averse investors or those looking to protect wealth in uncertain times. Also, we analyze the performance of the DAX index, and it shows that its standard deviation indicates a high degree of volatility which could be explained by the ramifications of the global economic shock after the COVID-19 pandemic and the disruptions in global supply chains. Likewise, when taking price extremes into account, Bitcoin's minimum return indicates the most notable negative price fluctuations. But Bitcoin also has the highest maximum return, highlighting the possibility of significant profits and adding to its appeal for investors who like taking risks. On the other hand, the performance of the S&P 500 indicates that it experienced comparatively fewer significant price declines and provided opportunities for significant profits even during market turbulence.

Furthermore, when examining central tendencies, variability, interquartile ranges, skewness, and kurtosis. The central tendencies of both the S&P 500 and Bitcoin are comparatively stable, with high median values signifying consistency in performance over the observed period. By comparison, the median values of the DAX and FTSE 100 are lower, indicating higher volatility in returns. While Gold's stable interquartile range solidifies its reputation as a dependable store of value, especially during periods of economic turmoil, Bitcoin's significant price volatility is highlighted by the interquartile range, Kurtosis and skewness. Bitcoin has the highest positive skewness, which suggests that it is more likely to experience sharp price increases. This aligns with its nature of high risk and high reward, primarily seen during periods of positive market conditions. In contrast, gold demonstrates low skewness, indicating a more evenly spread distribution of returns, showcasing its stability in turbulent markets.

Extreme return possibilities can be better understood from analyzing kurtosis, which is a measure of the tails of the return distribution. With the highest kurtosis values, the DAX index and Bitcoin indicate a higher frequency of extreme returns, both positive and negative. It is important for investors in DAX and Bitcoin to be prepared for sudden fluctuations in price, as this implies that these assets were more susceptible to outside influences and market shocks during the observed period. Additionally, lower kurtosis values for the SSE index and gold indicate more consistent returns and fewer instances of sharp price swings, making them more reliable investments during the

pandemic which is especially interesting when considering that the COVID-19 pandemic was initially started in China, yet the Chinese market showed more resilience and overall stability in the face of the market downturn experienced throughout the world and experienced substantially less price fluctuations during this time when compared to other indices in Europe and North America.

3.2 Analysis of various assets performance during the pandemic

The figures below demonstrate a comprehensive look at the returns of seven important indices, including Gold, Bitcoin, the S&P 500, the DAX, the FTSE 100, the CAC 40, and the SSE, which would help us have a better understanding about their performance during the COVID-19 pandemic.

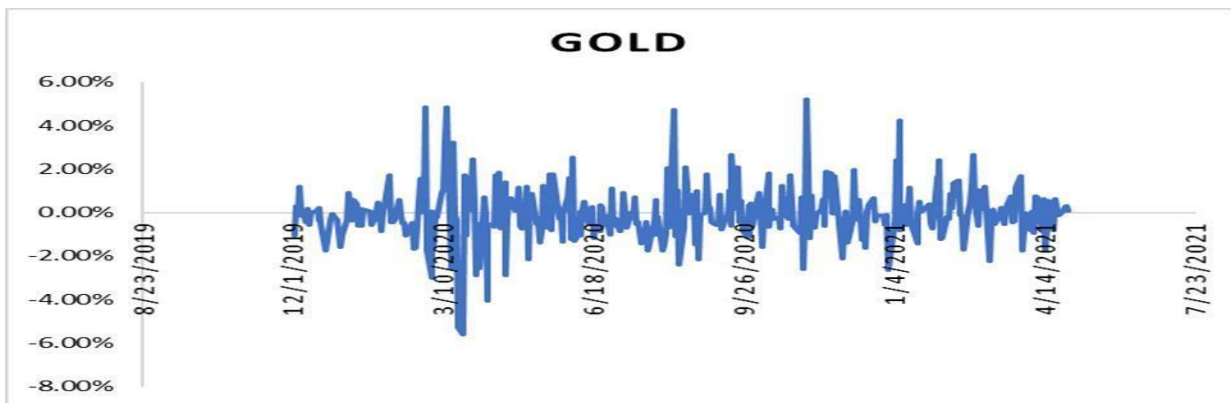


Fig.1. Returns from Gold.

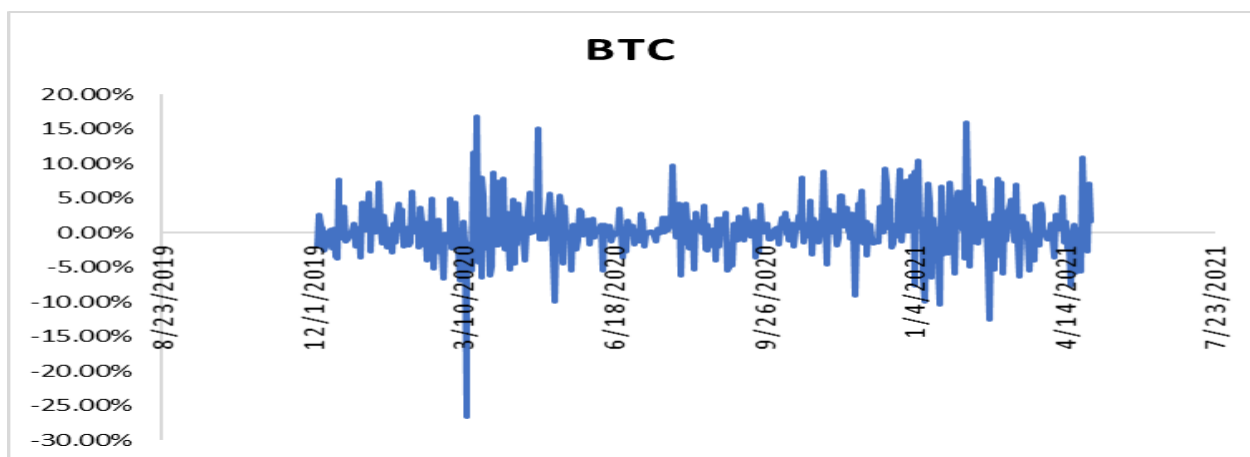


Fig.2. Returns from Bitcoin.

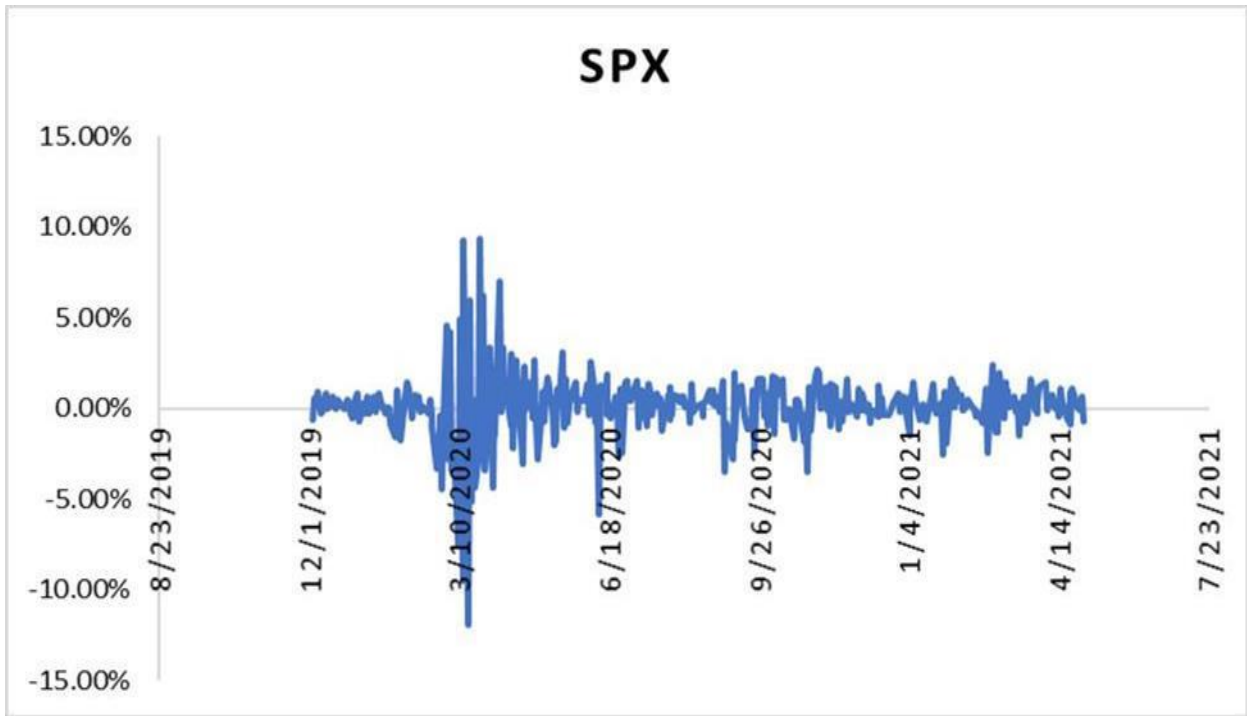


Fig.3. Returns from the Standard & Poor's 500 Index (S&P 500)

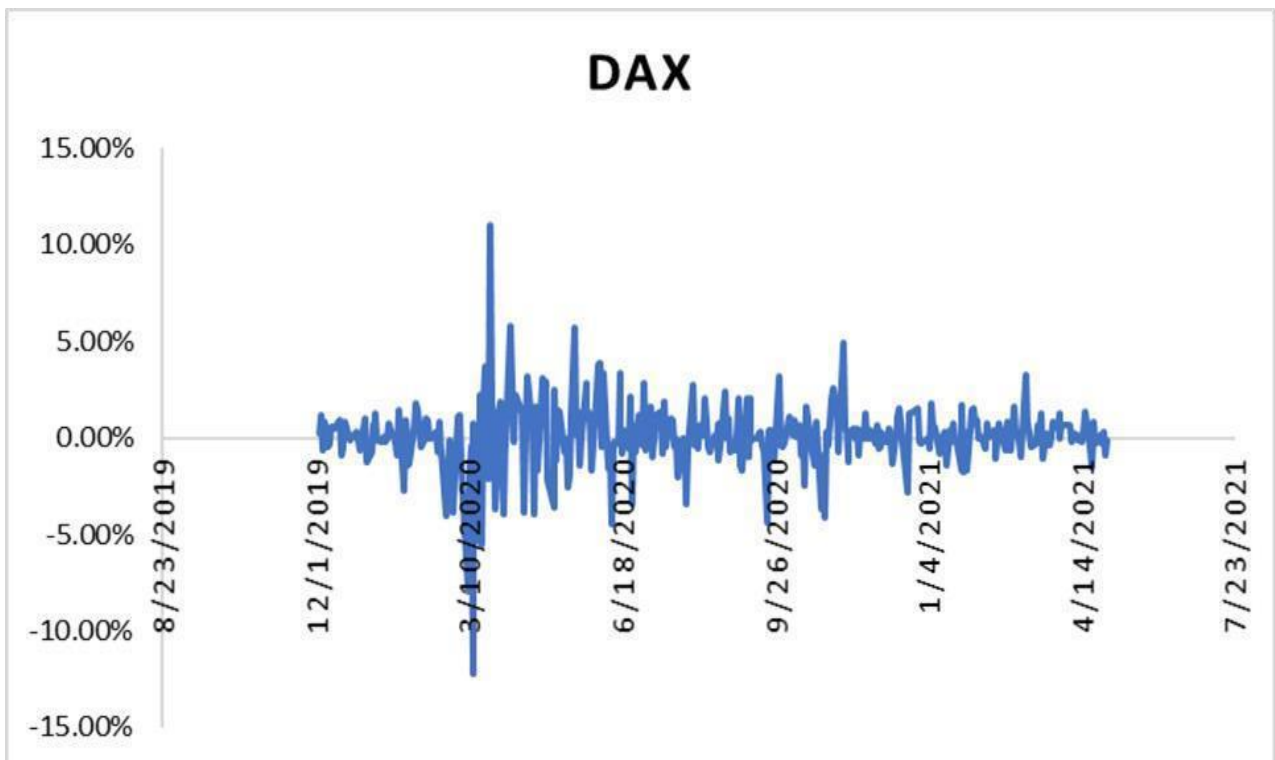


Fig.4. Returns from Deutscher Aktienindex Index (DAX)

When observing the above figures, we can infer that the primary cause of the significant fluctuations and declines observed in March and April of 2020 is the World Health Organization's declaration of COVID-19 as a pandemic. This announcement came at a critical moment, causing considerable market volatility as investors attempted to process the unexpected beginning of a global health emergency. The European indices showed the most volatility and had the biggest downturns during this time, including the FTSE 100, DAX, and CAC 40. Due to the fact that these indices covered a wide range of industries and regions, they were especially susceptible to changes in the global economy, and the uncertainty surrounding the pandemic price fluctuations.

During this time, also the S&P 500 saw significant volatility, which also suggests that the US market was also susceptible to the economic shock the pandemic has caused. It is also worth noting that these indices showed some interval with lower volatility from May 1st, 2021, to around June 2020, in contrast to the preceding months of March and April 2020. During which the economy started to recover from the pandemic, which helped the S&P 500 rise again.

On the other hand, the SSE index, which is a representation of the Chinese market, showed similar characteristics and price movements. In January and February of 2020, the SSE index showed increased volatility during the early phases of the COVID-19 pandemic. The market's reaction to the outbreak in Wuhan, Hubei province, China, is what is responsible for the recent spike in volatility. Which caused uncertainty and possible economic consequences of the new coronavirus as the situation developed and the pandemics worldwide impact became more evident, which led to volatile price movements.

Often seen as safe havens or alternative investments, gold and bitcoin also showed significant volatility in March and April of 2020, reflecting the turbulence in the global markets as a result of the pandemic. During this time, investors rushed to gold as a hedge against economic instability and as a store of value. Even though gold's returns were relatively low when compared to other assets, its value as a haven asset became especially apparent during this time.

However, when analyzing Bitcoin, the unique event that occurred in January 2020 which is known as the Bitcoin Halving, continued to impact Bitcoin's characteristic volatility, in addition to pandemic related factors. A major influence on Bitcoin's price in January, February, and March of 2021 was the Halving event coupled with the ramifications of the COVID-19 pandemic. This event caused a significant increase in Bitcoin price since essentially the number of Bitcoins that could be created by miners decreased radically. The scarcity of Bitcoin and the expectation of future price spikes was appealing to investors, which in turn led to increased volatility and higher returns.

3.3 Analysis of the descriptive statistics of various portfolios

Table.2. *Descriptive statistics of different portfolios.*

	(90% S&P) (10%BTC)	(90% DAX) (10%BTC)	(90%) FTSE100 (10% BTC)	(90%)CAC40 (10% BTC)	(90%)SSE (10%BTC)
Mean	0.16	0.12	0.068	0.099	0.119
St.Dev	1.92	1.83	1.547	1.70	1.23
Skewness	-1.057	-1.387	-0.86	-0.85	-1.01
Kurtosis	12.48	15.87	8.93	12.25	6.80

	(90% S&P) (10%Gold)	(90% DAX) (10%Gold)	(90%) FTSE100 (10% Gold)	(90%)CAC40 (10% Gold)	(90%)SSE (10%Gold)
Mean	0.098	0.064	0.008	0.037	0.058
St.Dev	1.72	1.65	1.44	1.61	1.08
Skewness	-0.64	-0.61	-0.85	-0.97	-0.82
Kurtosis	10.95	11.7	9.24	10.3	6.47

The above table details summary statistics of portfolios with a mix of equities and alternative assets, such as gold and Bitcoin which provides us with important information about the risk and performance consisting of an allocation of 90% to equities and 10% to Bitcoin, and portfolios consisting of an allocation of 90% to equities and 10% to gold, all Data includes periods from December ,2019, to May, 2021 We can learn more about the effects of asset allocation decisions on risk and return by observing and comparing important statistical metrics like mean returns, standard deviation, skewness, and kurtosis for various portfolio mixes.

First, we start by analyzing the Portfolios with 90% Equities and 10% Bitcoin, the S&P 500 with Bitcoin allocation portfolio show a mean return of 0.16. This indicates that, on average, investors in this portfolio experienced a positive return, although it's relatively low. Additionally, the standard deviation for this portfolio is 1.92, suggesting that it has an overall average volatility. Skewness on the other hand was -1.057, reflecting a significant left-skew in the distribution, this means that the portfolio has an inclination for extreme downward price movements, indicating higher risk. While The kurtosis value of this portfolio was 12.48 which is relatively high, indicating a susceptibility to

extreme price events in both directions, making it a risky investment with significant potential for both gains and losses.

Likewise, when analyzing the DAX and Bitcoin portfolio consisting of 90% allocation to DAX and 10 % allocation to Bitcoin, we observe a mean return of 0.12. which is also low, indicating a low average return. While the standard deviation for this portfolio is 1.83, which means that it had moderate volatility. The skewness of -1.387 is even more evident, reflecting a strong left-skew in the distribution, indicating a higher likelihood of significant price drops, also the kurtosis value of 15.87 is very high, suggesting a high exposure to extreme price changes, both positive and negative. It implies a speculative nature with potential for significant price swings.

Moreover, the portfolio consisting of FTSE 100 and Bitcoin shows a mean return of 0.068, which is relatively low, indicating very low average returns as the mean return is close to zero . While the standard deviation of 1.547 suggests moderate volatility, with notable price fluctuations. Skewness on the other hand is -0.86 implying that the portfolio has a left skew in the distribution, and a tendency for downward price movements, although less pronounced than Bitcoin or DAX. Also, the kurtosis value of 8.93 is quite high, indicating a susceptibility to extreme price events in both directions positive and negative.

The Portfolio comprising of CAC40 with Bitcoin allocation was also analyzed, and the mean return was 0.099 which is slightly higher than some other portfolios, indicating that the returns were relatively higher. The standard deviation, on the other hand, is 1.7, which denotes significant price fluctuations and high volatility. A distribution that is left-skewed and has a propensity for downward price movements is indicated by the skewness of -0.85. Furthermore, this investment has a large potential for both gains and losses due to the high kurtosis value of 12.25, which indicates susceptibility to extreme price events in both directions.

On the other hand, the portfolio consisting of SSE and Bitcoin had a mean return of 0.119, indicating a relatively higher return compared to some other portfolios, and with a standard deviation of 1.23 showing relatively moderate volatility. The skewness of -1.01 of this portfolio indicates a left-skewed distribution with a tendency for extreme downward price movements, although less pronounced than in DAX with Bitcoin allocation. While a kurtosis value of 6.8 is suggesting that this portfolio has the potential to have extreme price swings although significantly less pronounced when compared to other portfolios studied in this research.

Next, we analyze the same metrics for the Portfolios with 90% Equities and 10% Gold allocation and starting with the S&P500 and gold portfolio we find that mean return is 0.098. This

suggests that, on average, investors in this portfolio experienced positive returns, though relatively slight returns. The standard deviation of this portfolio is 1.72, indicating notable price fluctuations. While a skewness of -0.64 indicates a relatively mild left-skew in the distribution, suggesting a minor tendency for downward price movements. Kurtosis on the other hand is 10.95 which is reasonably high, implying susceptibility to extreme price events.

Secondly, we observe the DAX portfolio with gold allocation, which had a mean return of 0.064, which is lower than the other portfolios, implying relatively lower returns. Moreover, the standard deviation is 1.65, indicates an overall relatively moderate volatility with moderate price fluctuations. The skewness of -0.61 indicates a comparatively mild left-skew, reflecting a minor tendency for downward price movements. While a very high kurtosis value of 11.7 shows extreme volatility and price instability.

The mean return of the portfolio consisting of FTSE100, and gold allocation is 0.008, the lowest among the portfolios, indicating very low average returns almost negligible. Although the standard deviation is 1.44, suggest moderate volatility for this portfolio. The skewness of -0.86 indicates a minor left-skew in the distribution, suggesting a tendency for downward price movements. While The kurtosis value of 9.24 is relatively high, indicating susceptibility to extreme price fluctuations.

An analysis of a portfolio that is 90% allocated to the CAC 40 and 10% to gold reveals a mean return of 0.037, indicating low average returns. Although not particularly high volatility or price swings are indicated by a standard deviation of 1.61. The skewness of -0.97 indicates a left-skewed distribution with more probability for downward price movements. Although the 10.3 kurtosis value this portfolio exhibits is comparatively high, which it indicates that it may be more vulnerable to extreme price events.

The last Portfolio in this data set consists of SSE and gold and this portfolio has a mean Return of 0.058, indicating moderate average returns and the standard deviation is 1.08, suggesting moderate volatility. Moreover, the skewness of -0.82 suggests a slight left skew in the distribution, indicating an inclination for downward price movements. While The kurtosis value of 6.47 is more moderate demonstrating less susceptibility to extreme price fluctuations.

Subsequently we compare the above data for different portfolios with various asset allocations to have a deeper understanding of the effect of adding Bitcoin and Gold to such assets. First, we analyze the mean returns since it is a key performance indicator. Portfolios that included Bitcoin allocations showed higher mean returns than portfolios that only included stocks, according to the

analysis the S&P 500 and the DAX index showed the highest mean returns among the portfolios allocated to Bitcoin, while the FTSE100 showed the lowest mean return. This suggests that the average returns of a portfolio were positively impacted by including Bitcoin.

Due to its high potential for substantial gains, Bitcoin improved returns and improved the performance of the portfolio as a whole. In comparison, the mean returns of portfolios that included gold allocations varied. The portfolios with the highest mean returns were the S&P 500 and the DAX index, while the portfolio with the lowest mean return was the FTSE100. These portfolios gold addition did not always result in higher mean returns. Which is understandable since Gold is valued not so much for its potential to yield large returns as it is for its ability to protect wealth in uncertain economic times. Gold has long been seen as a safe-haven asset which could reveal why the returns were not as high as other portfolios with Bitcoin allocation.

Also, we analyze and compare the standard deviation of the portfolios with Bitcoin and Gold allocations respectively. According to the analysis, portfolios that included Bitcoin allocations typically had higher standard deviations than portfolios that only included stocks. The European indices, DAX and CAC40, and the S&P 500 had the highest standard deviations among the portfolios allocated to Bitcoin. The SSE index, on the other hand, had the lowest standard deviation. This suggests that there was an increase in risk and volatility when Bitcoin was added to these portfolios. The extreme price volatility of bitcoin raised the risk of the portfolios even though it may have improved returns and allowed for additional profits.

On the other hand, Gold allocated portfolios displayed different risk characteristics. The standard deviation of the portfolios decreased in most cases when gold was added. Among these portfolios, the S&P 500 had the highest standard deviation and the SSE index the lowest. This implies that the safe haven quality of gold helped to lower portfolio risk overall.

When observing the skewness of the portfolios used in this research, we find that the portfolios that had allocated funds to Bitcoin showed the highest positive skewness in the DAX index. This suggests that there is a inclination for the prices to increase higher than normal. By comparison, the FTSE100 and CAC40 indices showed more balanced return distributions, with the lowest skewness values. This suggests that the allocation of Bitcoins increased skewed returns in the portfolios, with a higher probability of increasing price spikes.

However, when considering portfolios with gold allocation, the CAC40 had the highest skewness with the most positively skewed return distribution, whereas the DAX index showed the

lowest skewness value. Depending on the index, the inclusion of gold in these portfolios changed the skewness. However not all portfolios had the same degree of change in skewness.

Furthermore, when analyzing kurtosis the DAX index showed the highest kurtosis values among portfolios with Bitcoin allocation, suggesting a higher frequency of extreme returns. There were also comparatively high kurtosis values in the S&P 500. The SSE index, on the other hand, had the lowest kurtosis value, indicating more consistent returns and fewer extreme price spikes. Therefore, adding Bitcoin to these portfolios resulted in the possibility of more frequent extreme price movements, implying increased market sensitivity. Likewise, kurtosis values of portfolios that included gold allocations typically increased although not as great of an increase as when Bitcoin was added. The DAX index showed the highest kurtosis, while the SSE index showed the lowest kurtosis value, indicating lower frequency of extreme price movements and more stable returns.

When comparing the portfolios with Bitcoin or Gold allocation to portfolios consisting of only equities certain patterns become more apparent. The portfolio comprising only of S&P 500 showed lower mean returns than the S&P 500 with a 10 percent allocation to Bitcoin. However, this portfolio also showed higher values of skewness, kurtosis, and standard deviation, indicating higher risk and potential for extreme returns. The DAX index with a Bitcoin allocation also displayed a similar pattern. Yet, the FTSE100 with a Bitcoin allocation showed reduced risk as evidenced by a lower standard deviation and a lower mean return when compared to the equities only portfolio.

Moreover, Standard deviations of gold allocated portfolios were generally lower than those of equity only portfolios, suggesting a lower level of risk. These portfolios' mean returns differed since the FTSE100 and SSE had lower mean returns, while the S&P 500 and DAX indices showed higher returns. In general, the values of skewness and kurtosis increased, suggesting a higher probability of extreme returns. This implies that while adding gold to portfolios reduced risk, it also increased the possibility of more inconsistent returns.

Upon comparing the effects of gold and bitcoin allocations on portfolios, we observe that in general, portfolios that included Bitcoin allocations had higher mean returns, skewness, and kurtosis values than portfolios that included gold allocations, this suggests that adding Bitcoin to these portfolios increased returns and price fluctuations. Standard deviations, also increased from Bitcoin allocations, indicating a higher level of risk. However, when it came to mean returns, skewness, and kurtosis, portfolios that included gold allocations produced inconsistent results. Allocations to gold lowered standard deviations and also reduced risk. It can be assumed from this that although gold did not always result in higher mean returns, it did contribute to lower overall portfolio risk.

3.4 Assessment of Downside Risk of Various portfolios

Table.3 *Downside risk analysis*

1% Confidence Level (MVaR)					
	S&P500	DAX	FTSE100	CAC40	SSE
Equity only	9.63	9.31	7.97	8.95	5.00
10% Bitcoin 90% Equity	10.60	11.49	7.31	9.35	5.16
10% Gold 90% Equity	8.86	8.83	6.97	8.07	4.48
5% Confidence Level (MVaR)					
	S&P500	DAX	FTSE100	CAC40	SSE
Equity only	2.92	2.84	2.73	2.97	2.04
10% Bitcoin 90% Equity	3.05	2.96	2.55	2.73	2.07
10% Gold 90% Equity	2.65	2.55	2.43	2.70	1.82

The examination of downside risk in portfolios comprising gold, Bitcoin, and equity indexes between December 2019 and May 2021 allows us to get a better understanding of how well these assets performed in terms of mitigating risk. The Modified Value at Risk (MVaR) metric, which can be computed with 5 percent and 1 percent confidence levels using the Cornish-Fisher expansion, is used in this research. The findings provide empirical support for the usefulness of gold and Bitcoin as safe haven investments, especially on how they affect portfolio risk.

At a 1% confidence level, the MVaR values for equity-only portfolios shows that S&P 500 had MVaR of 9.63 which indicates that there is a 1% probability that losses in the S&P 500 portfolio will exceed 9.63%. Likewise, the DAX portfolio has a similar risk profile to the S&P 500, with a 99% probability of losses not exceeding 9.31%. Both indices display comparable downside risk levels. However, the FTSE100 has a slightly lower MVaR of 7.97, implying that there is a 1% probability of losses surpassing 7.97%. This indicates a relatively lower level of downside risk compared to the S&P 500 and DAX. The CAC40 on the other hand has a MVaR of 8.95 showcasing a risk profile similar to the DAX, with a 1% probability of losses exceeding 8.95%. Moreover, the SSE portfolio has the lowest MVaR of 5, suggesting a 99% probability that losses will not exceed 5.00%. This signifies a relatively low level of downside risk compared to the other equity indices.

The addition of Bitcoin to the portfolios consisting of only equities increased their downside risk, as shown by the MVaR values at a 1% confidence level since the S&P500 and Bitcoin portfolio has MVaR of 10.6 reflecting a 1% probability of losses being more than 10.6 % which highlights that a 10 % Bitcoin allocation led to an increase of downside risk for the S&P500 portfolio.

The DAX portfolio with a 10% Bitcoin allocation has a higher MVaR value of 11.49, indicating a 1% probability of losses exceeding 11.49%. This shows a relatively higher level of downside risk. While The FTSE 100 portfolio with Bitcoin allocation has an MVaR of 7.31, showing a decrease in downside risk compared to the equity only portfolio. Likewise, The CAC40 portfolio, when combined with Bitcoin, exhibits a 1% probability of losses exceeding 9.35%, representing amplified downside risk, same as The SSE portfolio with Bitcoin which has an MVaR of 5.16, indicating higher downside risk compared to the equity only SSE portfolio.

The addition of Gold to the portfolios also affects downside risk at a 1% confidence level since S&P500 and Gold portfolio displays a 99% probability of losses not exceeding 8.86%, demonstrating a lower level of downside risk compared to the equity only S&P 500 portfolio. Likewise, a 10 % allocation to the Dax portfolio led to an MVaR value of 8.83 suggesting a decrease of downside risk. However, when 10% gold was allocated to the FTSE 100 portfolio the MVaR was 6.97 suggesting a 1% chance of losses surpassing 6.97 % which is relatively lower downside risk compared to the S&P 500 and DAX with Gold. The CAC40 portfolio with Gold has an MVaR of 8.01, showing a 1% probability of losses exceeding this threshold, Meanwhile the SSE and gold portfolio had MVaR value of 4.48 showcasing a 1% probability of losses exceeding 4.48%. The addition of Bitcoin or Gold to the portfolios impacts downside risk differently. Bitcoin introduces higher downside risk compared to Gold, with Bitcoin portfolios generally having higher MVaR values at a 1% confidence level. Moreover, when analyzing the MVaR values at a 5% confidence level, the MVaR values for equity only portfolios indicate a higher level of risk tolerance. The S&P 500 MVaR of 2.92 reflects a 5% probability of losses exceeding this percentage. While The DAX portfolio has a similar risk profile to the S&P 500, with a 5% probability of losses exceeding 2.84%. Both indices display comparable downside risk levels. However, the FTSE100 has a relatively lower MVaR at 2.73, indicating a relatively lower downside risk compared to the S&P 500 and DAX at this confidence level. The CAC40 exhibits a risk profile similar to the DAX, with a 5% probability of losses exceeding 2.97%. While the SSE portfolio has the lowest MVaR value of 2.04 at this confidence level, indicating a relatively lower downside risk compared to the other equity indices.

When analyzing the MVaR values for portfolios with 10% Bitcoin allocation to the equity portfolios at a 5% confidence level we find that the S&P500 and Bitcoin had MVaR value of 3.05 signifying a 5% probability of losses exceeding 3.05 %, demonstrating that a 10% Bitcoin allocation increases the downside risk for the S&P 500 portfolio at this confidence level. Likewise, the DAX portfolio with a 10% Bitcoin allocation has a higher MVaR, indicating a 5% probability of losses exceeding 2.96%. Moreover, The FTSE 100 portfolio with Bitcoin has an MVaR of 2.55, showing a decrease in downside risk compared to the equity only portfolio. The CAC40 portfolio with Bitcoin exhibits a 5% probability of losses exceeding 2.73% with MVaR of 2.73 while the SSE portfolio with Bitcoin has an MVaR of 2.07, signifying increased downside risk when compared to the equity only SSE portfolio,

The inclusion of Gold in the portfolios also impacts downside risk at a 5% confidence level as shown by the S&P 500 and Gold portfolio which has MVaR of 2.65 demonstrating a 5% probability of losses exceeding 2.65. Similarly the DAX and Gold allocation portfolio had MVaR of 2.55, suggesting a 95% probability of losses not exceeding 2.55%. When observing the FTSE 100 portfolio with Gold we find a 5% probability of losses surpassing 2.43, indicating relatively lower downside risk compared to the S&P 500 and DAX with Gold. The CAC40 portfolio with 10 % Gold allocation has an MVaR of 2.7, showing a 5% probability of losses exceeding this level. On the other hand, the SSE portfolio with a 10% Gold allocation has the lowest MVaR, indicating a 5% probability of losses exceeding 1.82.

In assessing the downside risk of portfolios with Bitcoin allocations, the study reveals mixed results depending on the equity index and the chosen confidence level. At a 1% confidence level, Bitcoin allocation to the S&P 500 increases the MVaR by 9.15%, indicating increased risk in the portfolio. Similar results are also found with other indices, with Bitcoin increasing MVaR by 18.97% for the DAX, 4.28% for CAC 40, and 3.1% for SSE. However, the FTSE100 portfolio experiences a decrease in MVaR by 8.28%, suggesting that Bitcoin allocation might reduce downside risk for this specific index. When considering a 5% confidence level, Bitcoin's impact on downside risk is less evident but still significant. It increases MVaR by 4.45% for the S&P 500, 4.05% for the DAX, and 1.44% for SSE. However, Bitcoin allocation results in a decrease in MVaR for the FTSE100 by 6.59% and for the CAC40 by 8.08%.

Contrasting with Bitcoin, gold allocation generally reduces downside risk across various equity indices. At a 1% confidence level, gold allocation results in a decrease in MVaR for the S&P 500 by 7.99%, the DAX by 5.15%, CAC 40 by 9.83%, SSE by 10.7%, and FTSE100 by 12.54%.

This suggests that gold acts as a reliable safe haven asset, effectively reducing the risk exposure of portfolios during the COVID-19 pandemic. These results are consistent when considering a 5% confidence level, with gold allocation leading to a decrease in MVaR for the S&P 500 by 9.24%, the DAX by 10.2%, CAC 40 by 9.09%, SSE by 10.4%, and FTSE100 by 10.98%. The impact of gold allocation on downside risk was consistent in risk mitigating across different confidence levels and portfolios.

The data results suggest that Bitcoin does not reliably perform as a safe haven asset for most of the examined indices during the COVID-19 pandemic. The increase in MVaR and downside risk associated with Bitcoin allocations contradicts the hypothesis that Bitcoin can be used as a safe haven asset. The results signify that a 10% allocation of Bitcoin to portfolios containing the DAX, S&P 500, CAC40, and SSE led to an increase in MVaR and downside risk at a 1% confidence level, as well as an increase in MVaR for the DAX, S&P 500, and SSE at a 5% confidence level. However, it is worth noting that Bitcoin did in fact result in a decrease of MVaR and downside risk for the FTSE 100 at both 1% and 5% confidence levels.

In contrast to Bitcoin, gold's performance during the same period when allocated to various portfolios further supports its status as a safe haven asset. The consistent reduction in MVaR and downside risk for all indices and confidence levels highlights gold's reliability in reducing portfolio risk during times of economic uncertainty. The results indicate that a 10% allocation of gold to portfolios containing the DAX, S&P 500, CAC40, SSE, and FTSE100 resulted in a decrease in MVaR and downside risk at both 1% and 5% confidence levels. This consistent reduction in downside risk demonstrates that gold has a stabilizing effect on portfolios and serves as a reliable safe haven during turbulent times.

Conclusion

The COVID-19 pandemic in 2020 caused significant economic unrest and uncertainty around the world. Investors searched for stability and resilience in their portfolios because of the unprecedented volatility experienced in the financial markets. Many speculated that Bitcoin could possibly be used as a hedge against market volatility and a safe haven asset especially during this pandemic that had a significant effect on world economies. Severe economic distress was caused by lockdowns, supply chain disruptions, and business closures also the financial markets had significant drops. Therefore, assets that were historically thought to be safe havens, like gold, provided stability to investors during this crisis. Meanwhile many people began to pay attention to Bitcoin, Supporters of this digital currency emphasized its distinct features, such as its independence from traditional financial systems, decentralization, and limited supply. These characteristics encouraged some investors to regard Bitcoin as a potential safe haven asset, protecting them from unpredictable market movements and uncertain economic conditions.

Advocates argued that Bitcoin's decentralized structure and limited supply, which is limited to 21 million Bitcoins, made it a desirable hedge against market turmoil. Some considered it to be able to store value and be the digital equivalent of gold. Nevertheless, Opponents argued that Bitcoin's high volatility and vulnerability to fraudulent activities would be a major obstacle to its ability to function as a trustworthy safe haven investment. Significant price fluctuations, which are one of Bitcoins main characteristics, also raised questions about its stability and capacity to offer reliable protection during market downturns. Despite this some investors considered adding Bitcoin to their portfolios for diversification during the pandemic, viewing Bitcoin and other cryptocurrencies as alternative investments that could supplement their investment strategies.

During this time, Bitcoin demonstrated a higher average return compared to major indices like the FTSE100, S&P500, CAC40, SSE, DAX, and even gold. This surge in Bitcoin's value, especially around the January 2021 period, matched the Bitcoin halving event. This event reduced the number of new Bitcoins generated through mining, possibly contributing to the exponential increase in Bitcoin's price during that timeframe.

But, in contrast to the previously mentioned indices, Bitcoin also showed noticeably higher volatility and standard deviation despite its significant returns. In comparison to conventional stocks or gold, this higher volatility suggests that the value of Bitcoin will fluctuate more and be unpredictable. It was found that, in comparison to holding the equity index alone, adding Bitcoin to a diversified index portfolio increased the portfolio's standard deviation, kurtosis, and skewness. The

addition of Bitcoin to a portfolio basically raised the risk profile overall, with higher volatility and the possibility of extreme values. Nevertheless, the standard deviation of these index portfolios typically decreased as a result of the addition of gold. Gold served as a stabilizing element and reduced overall risk in these investment portfolios because of its historical use as a hedge against market volatility and economic uncertainty. As a result of its increased volatility and unpredictability, Bitcoin, even though it showed higher average returns than traditional indices and gold during this time, increased the overall risk profile of investment portfolios to which it was added. As an alternative, adding gold to the portfolios tended to lower the standard deviation and increase stability.

Likewise the examination of downside risk using the Cornish- Fisher expansion four-moment modified (VaR) The findings indicated that a 10% allocation of Bitcoin to portfolios containing the DAX, S&P 500, CAC40, and SSE indices led to a substantial increase in MVaR and downside risk at both 1% and 5% confidence levels with the only exception being the FTSE 100 and CAC 40, where allocating 10% to Bitcoin resulted in a decrease of downside risk in FTSE 100 at both 1% and 5 % confidence levels and a decrease of downside risk in CAC40 at 5% confidence level. In contrast to the uncertain performance of Bitcoin, gold showed more stability, constantly highlighting its historical status as a reliable safe haven asset. The data revealed a reduction in MVaR and downside risk for all examined indices and confidence levels, showcasing gold's reliability in reducing portfolio risk during times of economic uncertainty.

In conclusion this research has analyzed various metrics what are usually used to determine the risk factors for traditional assets while also the Cornish- Fisher expansion four-moment modified (VaR) allows for a deeper understanding of the risk factors associated with investing in various portfolios. The examination of Bitcoin's role as a safe haven asset during the COVID-19 pandemic showed that although some might consider Bitcoin a good investment with the potential to yield significant returns, the analysis done during this research answered our hypothesis question and revealed that in fact Bitcoin did not consistently perform as a reliable safe haven for most of the examined indices during the COVID-19 pandemic. The apparent and significant increase in Marginal Value at Risk (MVaR) and downside risk associated with Bitcoin allocations coupled with the increase of standard deviation, skewness and kurtosis revealed that Bitcoin can't serve as a safe haven for investment portfolios during times of economic turmoil.

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BITCOIN'S ROLE IN A NEW FINANCIAL SYSTEM

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SUMMARY

Bitcoin dažnai minimas kaip potencialus saugaus prieglobsčio turtas. Norėdami išnagrinėti Bitcoin saugaus prieglobsčio savybes, palyginome galimą riziką, kad Bitcoin bus paskirstyta įvairioms tarptautinėms akcijoms, su aukso paskirstymu toms pačioms akcijoms. Šiame moksliniame darbe nagrinėjamas laikotarpis yra nuo COVID-19 pandemijos pradžios nuo 2019 m. gruodžio iki 2021 m. gegužės mėn., dėl kurios kilo neprognozuojamas ekonomikos krizė. Rezultatai patvirtino Safe Haven savybes Gold, kur aukso paskirstymas akcijų portfeliams sumažino galimą neigiamos rizikos sumažėjimą. Bitcoin paskirstymas sukėlė portfelio rizikos padidėjimą, diskredituojant hipotezę, kad Bitcoin gali būti naudojamas kaip saugaus prieglobsčio turtas.

Bitcoin is often mentioned as a potential safe haven asset. In order to examine the safe haven properties of Bitcoin we compared the possible downside risk of allocating Bitcoin to various international equities to that of allocating gold to the same equities. The period studied in this research paper is from the start of the COVID-19 pandemic from December 2019 to May 2021, which resulted in an unprecedented economic crisis. The results confirmed the safe haven properties of Gold where allocating gold to equities portfolios resulted in a decrease of the potential downside risk. However, Bitcoin allocation caused an increase in portfolio risk, discrediting the hypothesis that Bitcoin can be used as a safe haven asset.