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Analysis of the behavior of the cryptocurrencies "Bitcoin" and "Ethereum" during the COVID-19 pandemic in the period 2019-2021 and their role as a safe haven asset

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Abstract

This paper analyzes the behavior of the Bitcoin and Ethereum cryptocurrencies during the COVID-19 pandemic, in 2019-2021, and if they were effective as a safe haven. It's specified the characteristics of cryptocurrencies, and their volatility, in front of the most important events, during the COVID-19 pandemic. Through the systematic review, of studies carried out by peers, determinates if Bitcoin and Ethereum had characteristics of safe haven, for the different international markets. It is concluded that, the volatility during this period of time, could help investors to increase their capital and protect it, depending on the period of time which it was invested. They worked as a safe haven, only against markets with which they had negative correlation; however, this characteristic depends on the period of time that was taken as a reference. So, cryptocurrencies worked as a safe haven only in specific markets and periods. They were classified as a weak safe haven.

Key words

- Cryptocurrency, Bitcoin, Ethereum, COVID-19, Safe haven.

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1. Introduction

On December 31, 2019, the World Health Organization received a report about the first contagion of an unknown virus, with characteristics of pneumonia, in the city of Wuhan in China. Later, the Chinese Center for Disease Control and Prevention identified it as the new coronavirus, known as COVID-19. On January 30, 2020, the World Health Organization alerted an international public health emergency, due to the imminent increase in infections around the world (WHO, 2020a) . The policies applied by the countries, to face the virus and prevent its expansion, such as the confinement that occurred during the year 2020 directly affected large companies, SMEs and MSMEs, as well as foreign trade. As a consequence, there were serious problems in the world economy, leading to the fall of several markets and a global recession (The World Bank, 2020) . This gave uncertainty to people and investors who wanted to keep their savings.

Since its appearance, the crypto-economy has made its way faster in the world, due to the current global connection, which has occurred as a result of the internet, and to the characteristics that they present as decentralized currencies. Bitcoin has grown more than 101735.94% since its first registration in 2010, since its historical minimum registered value was US$67.81 in July 2013 and the maximum of US$69,044.77 in November 2021 (Coingecko, 2022a). Ethereum has grown by 1126573.58%, since, its first registered value was US$0.432979 in October 2015 and its historical maximum of US$4878.26. However, they are also very unstable currencies, showing price drop to 45% of their value (Coingecko, 2022b) . The importance of analyzing cryptocurrencies is that, due to, the popularization that has occurred as a result of their volatility, investors have bet on them, receiving large profits and losses. The best way to enhance investments safely is by knowing the characteristics of these assets.

The present study analyzes, the effect of the COVID-19 crisis, on the volatility of the cryptocurrencies "Bitcoin" and "Ethereum". And, through the different authors, it is determined if they had the capacity to function as a safe haven during the pandemic, against the different international markets. This contributes to the knowledge of the characteristics of these digital assets, how they can benefit or harm the economy of investors and individuals who hope to diversify their income and provide a clearer perspective on the crypto economy.

1.1 Objectives

The present study seeks to analyze the behavior on the price of the Bitcoin and Ethereum cryptocurrencies, during the period of time 2019-2021, in the COVID-19 crisis, and analyze their effectiveness as a safe haven. For this it is necessary to: determine what the general characteristics of cryptocurrencies are, and mention the specific characteristics of the two main ones: Bitcoin and Ethereum; Also, analyze the price fluctuations of these cryptocurrencies during the years 2019-2021, in the most important events related to the COVID-19 pandemic. Finally, through the review of different authors, conclude if the currencies fulfilled the role of refuge asset, compared to different international markets. In this way, it is expected to determine the sensitivity of the Bitcoin and Ethereum cryptocurrencies in the global crisis and if they were effective in protecting the capital of their investors.

1.2 Theoretical framework

1.2.1 Cryptocurrencies

The Royal Spanish Academy (2022) defines cryptocurrency as: "virtual currency managed by a network of decentralized computers that has an encryption system to secure transactions between users". On the other hand, Cambridge Dictionary (2022) explains that it is: "a digital currency produced by a public

network, rather than any government, that uses cryptography to ensure that payments are sent and received securely." This means that they are public digital currencies without regulation by governments, that work under cryptography. The first idea of digital currency that did not require a trusted authority was presented by Chaum (1998) in an untraceable email, where the pseudonyms and return addresses are based on public key cryptography. However, previously Law et al (1996) presented an electronic cash project also based on public key cryptography, but it was intended to be used only by banks. Later, arises the term "cryptocurrency" or "b-money", which was mentioned for the first time, by the computer engineer Dai (1998) , in an email list named "cypherpunks". He proposed an alternative to fiduciary money, to carry out transactions without intermediaries such as financial entities, governments and companies.

Dai (1998) in his cryptographic library "Crypto ++" presented the theoretical concept for the subsequent creation of cryptocurrencies. He raises the term "cryptographic currency" and briefly explain it as a community system with the objective of cooperation, where a physical medium of exchange such as fiduciary money is not necessary, nor a government entity that controls the fulfillment of transfers and contracts. This protocol is provided by an untraceable network, it means cryptographic control. It is possible to create assets by solving a computer problem, and the number of monetary units received is proportional to the effort made in this process. To make transfers, receivers and senders are identified by public keys or pseudonyms, each one must be encrypted by the receiver and signed by the sender.

This concept was applied for the first time in 2008 by the anonymous entity Satoshi Nakamoto in a document called "The White Book of Bitcoin" where the author defines digital currencies as a chain of signatures, giving rise to the term "cryptocurrency". They have the main function of being an electronic version of money, in which there is no need for the intermediation of a financial institution, company or government. In this way, the double expense involved in mediation in capital exchanges is avoided. They are managed through "Blockchain" technology (Bitcoin.org, 2022) . According to the largest crypto asset exchange Coinbase (2022) and the first cryptographic database Coinmarketcap.com (2022) there are currently more than 1,600 cryptocurrencies in total, and their market capitalization until the year 2021 were 2.4 billions of dollars approximately, of which "Bitcoin" and "Ethereum" have higher numbers in price and market capitalization.

Bitcoin and Ethereum are decentralized cryptocurrencies, since their control is distributed globally among users, who voluntarily dedicate themselves to generating them, through the mining process, which consists of verifying transactions and guaranteeing security, receiving a reward for it. It is mandatory that all people accept the conditions of the system, which makes the protocol durable and highly resistant to corruption. This system is built on mathematical properties, and its price fluctuates according to the law of supply and demand. Cryptocurrencies have value, thanks to the decision of the people who operate with them, who express their interest, and give them value. People see them as useful, since they have similar characteristics to assets such as gold and fiduciary money (Bitcoin.org, 2022) .

Gold has the characteristics of divisibility, durability, and rarity; Each unit of Bitcoin and Ethereum can be divided into one hundred million parts. They are durable, since they work through the "Blockchain" network that operates by computers, that are distributed among its users, and track operations, so the loss of an unit is impossible (Bitcoin.org, 2022). Also, Bitcoin is capped at 21 million and Ethereum is capped at 18 million (Coinmarketcap.com, 2022) . They are similar to fiduciary money in Portability: it is easy to possess and exchange through digital wallets; Divisibility: since they can be divided into unit fractions; Recognizability: because users recognize its value; and Durability, because since there are people who are constantly receiving transactions, assets maintain value over time. Also, the number of users who attribute value to them, grows exponentially (Bitcoin.org, 2022) .

1.2.2 Obtaining and exchanging cryptocurrencies

Binance.com (2022) explains that cryptocurrencies can be obtained through their commercialization in an exchange house, payment for a good or service and through mining. Their commercialization in exchange houses is done by registering in exchange platforms such as: Coingecko, BraveNewCoin, Binance, Coinbase and Coinmarketcap that present greater commercial activity. To obtain a cryptocurrency wallet, it is necessary to register personal information on one of these platforms, deposit funds in fiduciary currency and proceed to the identity verification (Vidal, 2022) . The obtaining of crypto assets also happens through the payment for a good or service, which are made in the virtual wallet applications inserting the address of the recipient, this process takes an average of ten minutes in which the information is verified. Mining is the last option to obtain cryptocurrencies, this consists of processing each

transaction through mathematical procedures and verifying its validity with computational hardware, in exchange for this service the miners receive a fraction of the cryptocurrency (Binance.com, 2022) .

1.2.3 Regulation of cryptocurrencies

There is a danger that these assets may be used for illicit activities, such as, money laundering and the acquisition of illegal goods, due to their decentralized nature, so, many people arguments about the possibility of regulating them (Chawki, 2022) . However, the cryptocurrency system cannot be modified, since the intervention of all users would be necessary, so, altering or giving power to an authority or government is not possible. It can be invested to mine large amounts of coins, with the aim of blocking transactions but it requires a computational investment greater than that of all global miners, because when they detect an unusual movement, each hardware will reject this action. This means, that the only regulation that can be used is the legislative one, since each country can regulate the trade and the payment methods allowed (Bitcoin.org, 2022) . As an example, we can take El Salvador, since it is the first country to implement Bitcoin as legal tender (Alves et al., 2021) . On the other hand, countries such as Australia, Japan and the United Kingdom consider them as legal property, but not as legal tender (Chawki, 2022) .

1.2.4 Market capitalization

Market capitalization refers to the value in the US dollar currency, of the financial actions of an organization, company or cryptocurrency. It is calculated by multiplying the unit price by the total number of coins in circulation. It helps to identify the stability of an asset, since, if they have a larger capitalization, they tend to have a more stable price. On the contrary, new currencies with smaller capitalization, tend to be more susceptible to fluctuations, generating large profits or losses. So, this metric helps to identify the growth potential and security of each cryptocurrency. Three types of coins are presented according to their capitalization: with high capitalization they have a value greater than 10,000 million dollars, they are low-risk investments, since their liquidity is high, therefore, their growth is demonstrated, here are Bitcoin and Ethereum ; mid-capitalization between $1 billion and $10 billion, have higher risk; and, low capitalization, with a value of less than 1,000 million, which are susceptible to drastic changes (Coinbase.com, 2022) .

1.2.5 Blockchain

“Blockchain” is the technological system on which cryptocurrencies are built. It had its start on January 3, 2009 and was founded by the anonymous entity Satoshi Nakamoto on January 9, 2009 (Bitcoin.org, 2022) . It consists of a chained data structure that joins blocks of information, which are recorded chronologically, using encryption to guarantee their secure transmission. These are transactions that cannot be falsified or manipulated, independent and decentralized. Since the nodes (specialized hardware) that make them up, are linked by "peer-to-peer" (P2P) (Lu, 2019) ; This means that it is a system in which any individual with specialized hardware can help maintaining and creating this data, while profiting. So "Blockchain" is maintained thanks to the same users, also called miners (Bauwens et al., 2019) . Bitcoin began its rise and popularity as the first implementation of this system (Bitcoin.org, 2022) .

The article published in 2009 by Satoshi Nakamoto: “Bitcoin: A User-to-User Electronic Cash System” is the technical basis of “Blockchain”. Its objective was to avoid the problem of double spending in online payments, that is, that they are made directly from one user to another without the participation or mediation of financial entities, companies or governments. These do not allow non-reversible transactions, since a high level of trust between the parties would be necessary, due to the potential possibility of fraud, therefore, the institutions must always mediate the procedures. In this way, costs increase and consequently the possibility of carrying out small transactions is limited. It is expected to solve this problem through the application of the user-user network (P2P), which is not based on trust and is based on cryptographic evidence (Nakamoto, 2009) .

The cooperative network "Blockchain" secures transactions by verifying the first time the sender receives the payment and confirming the amount to the receiver, making them irreversible. All transactions are recorded in a public record called "time stamp" and are verified by all the nodes that are part of the block chain system, thus preventing fraud and increasing reliability. To verify the effectiveness of the transactions, the "Proof of Work" (PoW) system was implemented, which attributes a random number to each transaction, is attached to a mathematical calculation and must be solved to be sent and verified. As more transactions are made, they accumulate. Users who engage in this process, better known as mining, in compensation for the creation of new blocks, receive the corresponding cryptocurrency. In this way, people keep the network running and retain its decentralized feature. The "Blockchain" system protects the

privacy of the participants, since although the public can verify the transactions, only the address of the block chain is registered, so personal and private information is not involved (Nakamoto, 2009) .

Blockchain technology is a tool that provide a wide variety of services and products, because it integrates technology and devices. This system have a great potential for the industry. For this reason, it is evident that it has evolved in its use. "Blockchain" has had two stages in its development: the first, being the block chain for cryptocurrencies, in which the Bitcoin system stands out as a pioneer and basis for the creation of all other crypto assets; and the second phase where smart contracts and achievable commands adhere to the blockchain, Ethereum is part of this stage (Lu, 2019) .

1.2.6 Bitcoin

Bitcoin was created by Satoshi Nakamoto, being the first implementation of the concept of cryptographic currency and the "Blockchain" system, its foundations were based on his article "Bitcoin: A User-to-User Electronic Cash System" published in 2009 (Bitcoin. org, 2022) . The Bitcoin protocol is public, so modified versions of it, can be created, thus laying the foundations for other cryptocurrencies, which are known as "Altcoins", since they are alternatives to it. It works with the block system or "Blockchain", which consists of "proof of work" (PoW) mining, which through computer nodes is responsible for solving mathematical algorithms. When a transaction is completed, this information is publicly stored in a memory pool, and the miners receive Bitcoins as a reward (Nakamoto, 2009) . Bitcoin has a creation limit of 21 million BTC. However, they can be divided into subunits of up to 8 decimal places (0.000,000 01 BTC), with Satoshi being the name of the smallest fraction. It represents 35% of the entire cryptocurrency market, with a current market capitalization of 404.8 thousand ThUS$. So far, 19.1 M BTC have been mined, that is, 91% of the total supply and its historical maximum in terms of price is US$ 68,789.63 (Coingecko, 2022a) .

1.2.7 Ethereum

The introductory article to the Ethereum “Blockchain” “A next generation smart contract and decentralized application platform” was published by its founder Vitalik Buterin in 2013. This cryptocurrency is the second most used worldwide. The creation of Bitcoin and its "Blockchain" system are the basis for a large part of the digital assets that exist today, among these is Ethereum. Which, despite being based on the same Bitcoin system, adds the characteristic of being a block system that is based on an integrated Turing complete language, this means that it allows a node to be programmed to perform any type of operation. Thus, users, apart from mining and trading cryptocurrency, can create digital assets such as: non-fungible assets or NFTs, financial instruments and decentralized applications. The fundamental aspect that differentiates Ethereum is the possibility of implementing smart contracts, which are used to read and write data in the block chain and have the objective of enforcing the terms of an agreement, executing automatically (Ethereum.org, 2022) .

At the time of block mining, the "Proof of Work" system is implemented in which users, through nodes, solve the mathematical puzzles that are assigned and as a reward receive the Ethereum currency or also known as "Ether" (Buterin , 2013) . It has an annual creation limit of 18 million ETH. However, they can be divided into subunits of up to 8 decimal places (0.000 000 01 ETH), with Wei being the name of the smallest fraction (Ethereum.org, 2022) . It represents 13% of the entire cryptocurrency market, with a current market capitalization of 147.4 thousand ThUS$. So far, 121.3 M ETH have been mined and its historical maximum in terms of price is US$ 4,891.70 (Coingecko, 2022b) .

2. Literature review

Investors hope to reduce losses in times of market turbulence, seeking capital stability, so Baur & Lucey (2010) proposed three types of assets: hedging, diversifying, and the basis for this study, safe haven. Hedging is defined when the price of an asset is not correlated with another type of asset in normal market times, and may have a positive correlation in times of turbulence; A diversifying asset is positively correlated with another, regardless of whether the market is deflating or rising, so it does not reduce the risk of losses; The safe haven is a type of asset that is negatively related to other assets during times of market turmoil; however, during bullish periods the correlation can be positive or negative, so this option is ideal to ensure capital stability. As an example of a safe-haven asset in the short term, facing the stock market recession, he mentions gold.

Sandoval & Franca (2012) in their research carried out an analysis of the different financial markets in times of crisis, taking as reference key dates of economic recession such as: Black Monday, 911, the dotcom bubble, the financial crisis of 2008 and the Russian crisis. He concluded that markets have a tendency to behave in a similar way during times of crisis, so he agreed that assets that do not have this correlation are a safe haven. However, Kindleberger et al. (2005) explained that, in times of crisis, investors tend to abandon risky values, that is, less liquid, and seek safer or more liquid assets, since the possibility of selling and buying is necessary. Therefore, in addition to the return correlation, it is necessary to take into account volatility and liquidity.

Several analyzes of cryptocurrencies as a safe haven asset prior to the COVID-19 pandemic were carried out, as being relatively new and having features such as anonymity and decentralization, they attract the attention of investors. The authors who found a negative response to using the cryptocurrencies Bitcoin and Ethereum as safe haven assets are: Smales (2018) , who presented an analysis of Bitcoin in the period 2011-2018, arguing about the high volatility during normal times market, and low liquidity, so he speculated that these characteristics do not vary in times of crisis. Bouri et al. (2016) on the other hand, proposed Bitcoin as a refuge against the main world stock indices, the US dollar, the commodity market and oil, in the period from 2011 to 2015, however, only against the stock market Asian exhibits safe haven characteristics. Klein et al. (2018) made a volatility comparison between gold and Bitcoin as safe-haven assets, where they found that these assets behave differently in turbulent situations.

Different analyzes are in favor of this position. Urquhart & Zhang (2019) stated that Bitcoin, in the 2014-2017 period, presented safe haven properties against the volatility of the Canadian dollar, the British pound and the Swiss franc, as there was no correlation with these markets. However, not against other currencies such as the US dollar, the Japanese yen and the euro. Bouri et al.(2019) analyzed 8 cryptocurrencies in the period 2015-2018, against the volatility of the US stock market S&P 500 index, focusing on its 10 indicators: basic consumption, health, finance, technology, basic products, industry, basic materials, telecommunications, public services and energy, and concluded that Bitcoin is a refuge for all indicators, however, Ethereum only for public services and telecommunications. Meshcheryakov (2020) studied Ethereum in contrast to the dollar, the S&P 500 stock market, and gold, finding that it serves as a haven only for gold.

During the COVID-19 pandemic in the 2019-2021 period, several authors analyzed if the cryptocurrencies Bitcoin and Ethereum were carried out as a refuge asset. Some argued against, such as: Conlon et al. (2020) that compared six world stock indices against the volatility of Bitcoin and Ethereum, concluding that Bitcoin only works as a refuge against the Chinese market, and Ethereum does not meet this characteristic with most markets. Melki & Nefzi (2021) mentioned that the refuge properties vary depending on the market with which it is related, and Ethereum only has refuge capacity against basic products. Mokni et al. (2022) focused the economic policy (EPU) against cryptocurrencies, with positive results pre-covid, but during the pandemic they show weak safe haven capacity. Raheem (2021) described in turn that Bitcoin does not have the characteristics of a safe haven against the measure of uncertainty: Oil Stock. Będowska & Kliber (2021) completed an analysis of the two cryptocurrencies against 4 stock indices, concluding that Bitcoin is a weak haven with DAX and FTSE250, while Ethereum is not a safe haven for either.

The authors who present results in favor of the use of Bitcoin and Ethereum as safe haven assets are: Dwita et al. (2020) , who carried out a comparative analysis between crypto-assets and the S&P500 stock market in the United States together with gold, concluding that they are safe haven assets in the short term and Ethereum stands out against Bitcoin. Coco et al. (2022) hypothesized against: global financial market, gold, commodity, US dollar, stock, oil, the Gold Aug 20, the S&P GSCI Index, the Brent Crude Oil Last Day Finance Index, the VANGUARD BD IDX FD; MSCI Indices: the MSCI World Index Futures, the iShares MSCI Europe Financials ETF and the iShares Trust. They concluded that Bitcoin functioned as a safe haven in specific periods. Maganini et al. (2021) compared Bitcoin to the dollar, gold, and the MSCI investment fund, concluding that Bitcoin is efficient as a safe haven.

3. Methods

The methodology to be used for the study is the systematic review, which was developed qualitatively and quantitatively: qualitatively to specify the characteristics of the crypto-economy and of the Bitcoin and Ethereum currencies; and quantitatively to answer the research question.
The systematic review model used the Bárbara Kitchenham one, which is divided into: planning the review, conducting the review and documenting the review.

1. **Review Planning:** The research question was posed: “What was the behavior of the Bitcoin and Ethereum cryptocurrencies during the COVID-19 pandemic?” And what has been the role of cryptocurrencies as a safe haven asset in the context of the pandemic? Keywords were taken into account for the extraction of information such as: "Cryptocurrency" "Bitcoin" "Ethereum" "Covid-19" and "Safe Haven". Subsequently, the review protocol was developed and validated.

2. **Conduct the review:** The identification of relevant sources for the study focused worldwide was carried out, which were extracted from verified official crypto economy pages such as: Bitcoin.org, Ethereum.org, Coinbase, Coinmarketcap and Coingeko, also official information on the coronavirus from official sources such as the World Health Organization and the World Bank and, virtual libraries like Science Direct and Scopus. These contain: conceptual books and official information, to specify the basic concepts related to the research question and numerical data to perform the analysis. Also, peer-reviewed scientific articles, which are focused on answering the research questions, similar studies were taken into account as a reference; the articles are focused on the years 2019-2021, since the rise of COVID-19 occurred in this period of time.

3. **Document the review:** We proceeded to analyze the relevant information that was previously extracted from the bibliography. Analyze the numerical data about the price fluctuations of the Bitcoin and Ethereum cryptocurrencies, during the years 2019-2020, and the chronology of the COVID-19 pandemic. Next, with the information taken from articles, analyze the role of them as a refuge asset in the context of the pandemic. Thus, it was possible to answer the research questions and concluded by validating the review report.

4. Results

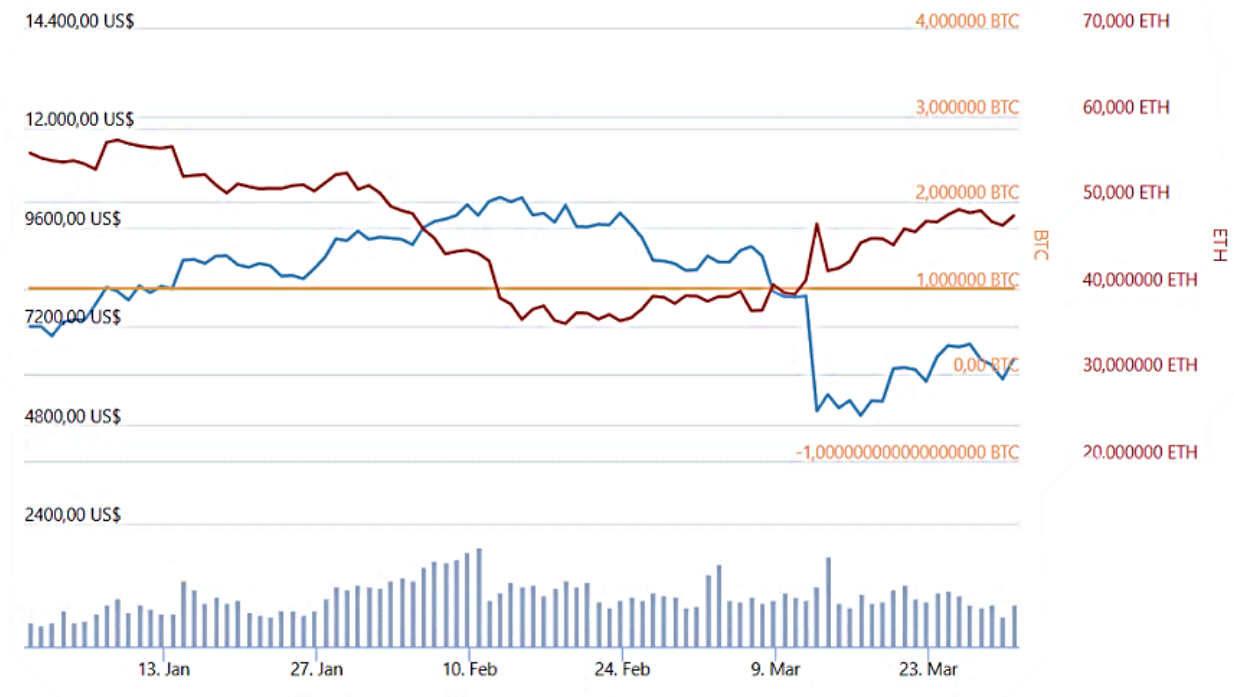
To analyze the behavior of Bitcoin and Ethereum cryptocurrencies during the Coronavirus pandemic, the main world events that occurred in the 2019-2021 period, related to the spread of COVID-19, are taken into account. Based on monthly information issued by the WHO and data that contrast with the variation in the price of Bitcoin and Ethereum assets, on a quarterly basis.

The first report on the appearance of the virus was made by the Wuhan Municipal Health Commission in China, on December 31, 2019, as an unidentified pneumonia on twenty-seven people, the first infected reported symptoms, since December 8, 2019. On January 7, 2020, the Chinese government identified it as a new virus named COVID-19 or coronavirus. The World Health Organization published a report on January 30, 2020, where it mentions the spread of the virus as a public health emergency at the international level; Thus, cases were confirmed in the United States, the Philippines, Finland and India, with a total of 7,818 infections worldwide. Also, they began to apply programs to guarantee the availability of tests for its detection of PCR 2019-nCoV (WHO, 2020a) .

For the month of March, the exponential increase in cases of COVID-19 around the world was observed; therefore, several countries began to implement measures to prevent the increase in infections, including the confinement applied on March 23 and 17 in the United States and France, respectively (WHO, 2020b) . Until the 3rd of March, 188,949 cases with 3,561 deaths were confirmed worldwide. Europe was the epicenter of the pandemic (WHO, 2022b) . Economic consequences began to be seen, such as the drop in oil prices (World Bank, 2020b) .

Figure 1

Bitcoin and Ethereum price from December 31, 2019 to March 30, 2020



Note: The following graph shows the price data for Bitcoin and Ethereum in the time period from December 31, 2019 to March 30, 2020, with prices measured in US dollars. Where the red values represent the price of Ethereum and the blue values the price of Bitcoin.

Source: Adapted from Bitcoin and Ethereum Price Chart, by Coinbase.com, 2022, https://www.coingecko.com/en.

During the last month of 2019, the price of Bitcoin fluctuated between $6,635.84 and $7,517.58, during the first report of the virus it had a value of $7,189.94. Ethereum had values between $121.5 to $151.74 and during that day its value was $129.02. During the month of January, it is evident that Bitcoin trended higher reaching a price of $9342.23 on the 31st, Ethereum followed the same pattern reaching a peak of $185.97 on this day. During this time, Bitcoin reached a price of $8,549.38 on February 29 and dropped to $6,423.6 by March 31. On the other hand, Ethereum reached $218.27 in February and dropped to $136.07 through March (Coingecko, 2022b, 2022a) . The drop in the price of Bitcoin is evident. On the other hand, Ethereum had high volatility, managing to recover at the end of this period of time.

In the months of April, May and June 2020, the World Health Organization reported the increase of cases to 1,179,620 with 66,608 deaths as of April 27; this number increased to 2,454,452 with 143,739 as of May 25, 2020; and to 5,136,705 with 247,129 deaths as of June 29, 2020 (WHO, 2022b) . The measures to suspend activities and confinement that were applied in several countries caused the contraction of the world economy (World Bank, 2020a) .

Figure 2

Bitcoin and Ethereum price from March 31, 2019 to June 30, 2020

Note: The following graph shows the price data for Bitcoin and Ethereum in the time period from March 31, 2019 to June 30, 2020 , with prices measured in US dollars.

Source: Adapted from Bitcoin and Ethereum Price Chart, by Coinbase.com, 2022, https://www.coingecko.com/en.

The price of Bitcoin during these dates was: $7,760.32 until April 27, $8,844.50 on May 25, 2020 and $9,136.47 on June 29, 2020; Ethereum had figures of: $196.88; $201.04; and $225.49, respectively (Coingecko, 2022b, 2022a) . Both currencies showed a drop at the beginning of the period, however, they managed to rebound in the month of May, subsequently showing relative stability, despite the global recession and the drop in other markets such as oil (World Bank, 2020b) .

During July, August and September, the application of a vaccine began to be considered worldwide and different types appeared, such as Sputnik V, developed in Russia, and the vaccine from a Chinese biopharmaceutical company, Sinovac Biotech Ltd. (WHO, 2022a) . During these months the cases were 8,728,962 with 339,651 deaths until June 27, 13,356,411 with 467,149 deaths on August 31; and 16,434,186 with 551,313 as of September 28 (WHO, 2022b) .

Figure 3

Bitcoin and Ethereum price from June 30, 2019 to September 30, 2020

Note: The following graph shows the price data for Bitcoin and Ethereum in the time period from June 30, 2019 to September 30, 2020, with prices measured in US dollars.

Source: Adapted from Bitcoin and Ethereum Price Chart, by Coinbase.com, 2022, https://www.coingecko.com/en.

As for the price of Bitcoin, it presented the values of: $10,933.26 on July 27; $11,926.68 as of August 31; and, $10,779.42 on September 28. On the other hand, Ethereum values were: $434.14; $475.99; and, $353.92 respectively (Coingecko, 2022b, 2022a) . Bitcoin had growth at the end of July, however, it fell for the month of August, on the other hand, Ethereum maintained a small downward trend. Using the initial prices for the month of June, it can be concluded that the price of the two cryptocurrencies is negatively correlated, since their values and trends do not coincide most of the time.

During the last months of the year, October, November and December, drugs such as "remdesivir" and "interferon" began to be implemented. On December 1, the variant of the COVID-19 virus called SARS-CoV-2 VOC (WHO, 2020c) appears . On the other hand, the BNT162b2 Pfizer-BioNTech vaccine was approved by the Medicines and Health Products Regulatory Agency on December 31, 2020 (WHO, 2022a) . Also, due to the large increase in infections, Italy applied complete confinement for its citizens (WHO, 2020b) . The number of infections during the month of October was 3,533,901 with 47,973 deaths; During November, 4,206,350 cases with 78,099 deaths; In December 4,249,784 with 84,977 deaths (WHO, 2022b) .

Figure 4

Bitcoin and Ethereum price from September 30, 2020 to December 31, 2020

Note: The following graph shows the price data for Bitcoin and Ethereum in the time period from September 30, 2020 to December 31, 2020, with prices measured in US dollars.

Source: Adapted from Bitcoin and Ethereum Price Chart, by Coinbase.com, 2022, https://www.coingecko.com/en.

Bitcoin and Ethereum prices continued to rise; on October 26, with prices of $13,646.02 and $403.74; on November 30, with, $18,792.03 and $586.23; and, on December 21, with $23,823.32 and $637.23, respectively (Coingecko, 2022b, 2022a) . Both cryptocurrencies showed a rebound in their prices at the end of December.

The WHO examined the origins of the virus and its origin in Wuhan-China is confirmed. There was also the problem of the lack of an equitable distribution of vaccines between countries and the Oxford and AstraZeneca vaccine was approved (WHO, 2022a) . Worldwide, 2,000,000 million deaths were exceeded. In the month of January, 3,753,390 cases and 99,919 deaths were recorded; In February 2,657,743 cases and 63,653 deaths (La, 2021); During March, there were 4,069,391 cases and 75,162 deaths (WHO, 2022b) .

Figure 5

Bitcoin and Ethereum price from December 31, 2020 to March 31, 2021

Note: The following graph shows the price data for Bitcoin and Ethereum in the time period from December 31, 2020 to March 31, 2021, with prices measured in US dollars.

Source: Adapted from Bitcoin and Ethereum Price Chart, by Coinbase.com, 2022, https://www.coingecko.com/en.

The price of Bitcoin on January 25 was $32,516.52 on February 22, $48,898.70; and on March 23, $52,303.02. Ethereum had prices of $1368.22; $1,578.19; and $1583.24 respectively (Coingecko, 2022b, 2022a) . It is shown that both cryptocurrencies since the end of 2020 presented high volatility with an upward trend, however, at the end of January the prices fell, to show constant growth in February.

5. Discussion

The safe haven asset capacity of Bitcoin and Ethereum is determined by: The data found regarding the dollar price of Bitcoin and Ethereum during the COVID-19 pandemic, compared to the different events of this period, and the different authors who analyzed cryptocurrencies against different international markets.

The Bitcoin and Ethereum cryptocurrencies presented prices of $7,189.94 and $129.02 (Coingecko, 2022b, 2022a), when the first report of COVID-19 appeared in Wuhan, China, on December 31, 2019 (WHO, 2020a) . During the first month of 2020 these values rose, however, then they presented a downward trend. During the second quarter, confinement began to be applied in several countries, causing a global contraction of the economy, as well as a drop in the price of oil worldwide (World Bank, 2020b) . However, during this period of time, the cryptocurrencies fell only in mid-April, to then maintain the trend of growth and stability, despite the fact that the two cryptocurrencies have similar trends at various times, at the beginning of July, Bitcoin showed a significant rise while Ethereum had more stability. At the end of 2020, the WHO reported on the first variant of COVID-19 (WHO, 2020c) , the price of both cryptocurrencies maintained a constant increase in the last three months. At the beginning of 2021, together with the appearance of two new variants and the application of vaccines (WHO, 2020c, 2022a) , prices fell for a period to then maintain a constant rise, with the first quarter of 2021 being the period with the highest volatility.

The trend to rise during the 2019-2021 period is clear, since the first record taken from 2019 at the start of the pandemic in Bitcoin was $7,189.94 and the last record made on March 23, 2021 was $52,303. $02. Which is a percentage increase of 627.45%. On the other hand, the first value of Ethereum was $129.02, while the last record was $1,583.24, with a percentage increase of 1,127.13% (Coingecko, 2022b, 2022a). Despite not finding a correlation between the prices of Bitcoin and Ethereum, and the events of

COVID-19 during 2019-2021, both maintained a lot of volatility. And, despite relevant periods such as the fall in oil, the prices of these assets were not greatly influenced by these events and their prices varied constantly. Even both cryptocurrencies trended higher during this period, so a case could be made for their use as a safe haven asset during COVID-19. However, it must be taken into account, which is the stock market or asset, in which the investor has his capital, and if, the two cryptocurrencies work as a refuge against them individually, since each asset maintains a different behavior in this period. Kindleberger et al. (2005) mentioned that, for an asset to be considered a safe haven, it is important to take into account volatility, return correlation and liquidity. Therefore, the last characteristic is suggested as a new line of research, in cryptocurrencies, during the period of crisis by COVID-19.

Different authors compared the Bitcoin and Ethereum volatility during this period of time against the price of various financial markets around the world.

In order for cryptocurrencies to be considered safe-haven assets, their correlation with the price of gold must be positive, that is, both trends remain positive or negative together, gold is taken as a safe-haven asset reference because it has a higher level stability than others. Dwita et al. (2020) found that Bitcoin has a positive correlation with gold in the time period of July 1, 2019 and April 6, 2020, being evident that it maintained this characteristic before and during COVID.19. However, Maganini et al. (2021) despite agreeing that gold has solid properties as a refuge asset, they mentioned that it is important to take into account that this may depend on the period of time being analyzed, they conclude that gold functioned as a refuge more solidly secured during the first four months of the pandemic. So, the correlation of Bitcoin and Ethereum with gold, no longer defines with certainty the qualities of these cryptocurrencies as a safe haven asset. Melki & Nefzi (2021) through an analysis carried out until September 4, 2020 against the Gold Bullion LBM gold market (The London Bullion Market), analyzed whether Bitcoin and Ethereum functioned as a refuge against the volatility of gold, and reached the conclusion that none of the cryptocurrencies fulfilled this role; because, as already mentioned, gold presented less volatility than cryptocurrencies. Klein et al. (2018) reached the same result with an analysis prior to the COVID-19 crisis.

There are several studies that take into account the world's stock markets. Regarding the S&P500 (US stock market index), Dwita et al. (2020) analyzed its correlation with the two cryptocurrencies, in the period of July 1, 2019 and April 6, 2020, and found a low correlation with both cryptocurrencies, however, Ethereum had lower percentage than Bitcoin, which means that has better capacity as a refuge asset. For an asset to be considered a safe haven during the pandemic, its correlation with the stock market must have negative trends, since the prices of the stock market are dependent on the behavior of the world economy, since, if a market falls, your stock goes down. It concludes that Bitcoin and Ethereum did function as safe haven assets against the S&P500. However, Conlon et al. (2020) mentioned that no cryptocurrency, in the time period from April 11, 2019 to April 9, 2020, complied as a refuge in this case, because they presented high levels of volatility, which translates into instability. Będowska & Kliber (2021) noted that due to volatility they functioned as a refuge, against the S&P500, only occasionally.

Regarding the MSCI World (financial markets of the world and the economy) Melki & Nefzi (2021) made an analysis comparing its efficiency against Bitcoin and Ethereum in the period from March 11, 2020 to July 10, 2020, they found that cryptocurrencies are more efficient as a refuge, since the prices of this index were directly affected by the financial crisis caused by covid-19; However, this does not mean that both Bitcoin and Ethereum work as a refuge against the fall of this stock index. Therefore, Conlon et al. (2020) analyzed the safe-haven property of these crypto assets against MSCI World during the years 2019 and 2020, concluding that they do not meet this property. However, Maganini et al. (2021) mentioned that only Bitcoin can fulfill this characteristic in some periods of time, where its price is not correlated as the financial market index.

Conlon et al. (2020) analyzed the international stock market indices: FTSE 100 from the United Kingdom, IBEX from Spain and FTSE MIB from Italy, concluding that both Bitcoin and Ethereum do not work as safe haven assets against them during the COVID-19 pandemic. However, compared to the Chinese CSI 300 index, it calculates that the risk to loss can be reduced, with the cryptocurrencies Bitcoin and Ethereum if an investment of 14% or 16% of the capital invested in this index is made. It is important to take into account the percentage that is invested to find balance in the benefits provided by the refuge asset, reducing volatility and maximizing returns, this strategy is called diversification. In case of investing 100% of the capital in a crypto asset, there is a risk of loss due to the strong volatility they have compared to other types of assets. Będowska & Kliber (2021) included DAX (German stock index) and found that Bitcoin is a safe haven limited to certain times, but tends to be negatively correlated against DAX mostly.

Different international markets not related to stocks are taken into account: Melki & Nefzi (2021) carried out the analysis against the market for raw materials and basic products in the period from August 2011 to September 2020. They mentioned that prior to the crisis due to covid-19 Bitcoin does not present safe haven characteristics, however, Ethereum proved to be a strong refuge for this market, agreeing with Bouri et al. (2016) who carried out the same study prior to COVID-19. However, during the pandemic they maintained these characteristics, where Ethereum shows negative correlation compared to the commodity market and Bitcoin positive at various times. Mokni et al. (2022) took into account the EPU (Economic Policy Uncertainty Index) from January 1, 2018 to June 6, 2020, and found that the two cryptocurrencies did not function as a refuge against this index before and during the pandemic, without However, Ethereum had slight features in its favor, so it can be used as a safe haven in extreme market conditions. Compared to Oil Stock (oil market), Raheem (2021) concluded that Bitcoin functioned as a weak safe haven. Finally, regarding the foreign exchange market, Melki & Nefzi (2021) and Maganini et al. (2021) agreed that Bitcoin served as a safe haven against the US dollar in times of pandemic; however, Urquhart & Zhang (2019) and Meshcheryakov (2020) reached the same result before the pandemic, showing that the properties of Bitcoin and Ethereum respectively against the dollar were not affected by the COVID-19 crisis.

Mokni et al. (2022) and Dwita et al. (2020) S&P500 Melki & Nefzi (2021) mentioned that Ethereum has greater characteristics as a safe haven in the EPU index, S&P500 and in various financial indices during COVID-19. Melki & Nefzi (2021) , explains that this phenomenon occurs because Bitcoin gradually loses supremacy against new cryptocurrencies or "Altcoins". This is visualized in the characteristics of Ethereum, since it not only serves as a currency, but is also a system that allows the application of smart contracts that benefit and facilitate transactions for users (Buterin, 2013) . On the other hand, despite the fact that Ethereum works with the same technology as Bitcoin, its price is totally independent of the other cryptocurrency, and is governed by the demand of its users together with the miners that manage its “Blockchain”.

6. Conclusion

Cryptocurrencies are a type of digital asset that works by "Blockchain" technology, a network that is managed by its own users, who through mathematical algorithms carry out transactions, verify them and receive a reward for this process. Which means that the users of this network control its security, all payments are stored in a block chain that is public and impossible to alter. The objective of this system is to avoid the double cost that implies the intermediation of third parties, such as government entities, banks or companies, when executing economic transactions. The price of these currencies is governed by the law of supply and demand and has value, since it shares characteristics with assets such as gold and fiduciary money, also because people make the decision to give it value. The two best known cryptocurrencies are: Bitcoin and Ethereum because they have the largest market capitalization.

Cryptocurrencies have the characteristic of having high volatility, since, they don’t have the control of any state entity, it is governed solely by the market and the constant operation of its "Blockchain". Therefore, due to these characteristics, they have been seen as an opportunity for investors who want to protect their capital from market turmoil and bet on safe-haven assets. During the COVID-19 pandemic, Bitcoin and Ethereum presented high volatility in their price, with multiple variations, mostly with an upward trend, showing a percentage increase from the first record in December 2019 to March 2021, implying that their Price was not influenced and did not correlate with the different events that occurred during the 2019-2021 time period. It could be considered a refuge asset at certain times, however, considering that it is impossible to speculate on its price and it has extreme fluctuations in the short and long term, there was a risk of losing the capital invested.

Taking into account the different international markets such as gold, oil, raw materials, currencies, economic policy and stock markets, it was concluded that: gold is considered the best refuge asset, so cryptocurrencies must have a positive correlation with it. Therefore, it is concluded by mentioning that they do not function as a refuge asset against gold, since their volatility is high compared to gold, despite the fact that there are times when it shows a positive correlation. With respect to the stock markets, there should be a negative correlation, because these tend to fall in times of recession, Bitcoin worked as a refuge asset with MSCI World and DAX only at some moments, however, with FTSE 100, IBEX and FTSE MIB, they didn’t work as a refuge, but in the CSI 300 index they worked with an investment of 14% for Bitcoin or 16% for Ethereum to protect the capital invested in this index. Finally, with non-stock indices, it is shown

that for: Commodities and EPU, Ethereum did have safe haven characteristics for adverse conditions at certain times, while Bitcoin did not bring any benefit.

Bitcoin and Ethereum cryptocurrencies had constant high volatility even during the 2019-2021 period, in which several important events took place regarding the COVID-19 pandemic, despite the fact that a trend towards increase. It is relevant to take into account that there are drastic rises and drops in the price of both currencies on a daily basis and, together with their decentralized characteristics, it is impossible to determine their price in the short and long term. Therefore, despite the fact that they showed profits for the investments made, from the end of 2019 to March 2021. Also, there were large losses, depending on the months in which the coins were acquired, if the asset was left in a period lower, or if the value of the cryptocurrency was withdrawn at a time of low. It is also important to specify against which asset it is expected to create a refuge, because for cryptocurrencies to fulfill this function they must present a negative correlation with the markets, which tend to go down in times of crisis, and must have a positive correlation with refuge assets such as gold, the percentage that is invested in the refuge asset also influences, therefore, a balance must be sought that maximizes benefits. Finally, it was evidenced that despite the fact that both cryptocurrencies work through a "blockchain" and Ethereum is an "Altcoin", both have totally independent trading values. Also, Ethereum had better benefits as an asset against several markets, since its system has the characteristic of applying smart contracts.

Therefore, Bitcoin and Ethereum served as a refuge asset only for a few markets, this depended on the period of time in which it was proposed to invest against them, and they had a favorable result only at certain times when their price had a negative correlation against the fall. However, volatility was an impediment for other markets, since in some months, prices had drastic drops. But, it´s able to provide benefits to investors, who expected long-term capital growth. Because, Bitcoin increased by 627.45% and Ethereum by 1,127.13% from the start of the pandemic, to March 2021. So, they are classified as weak safe haven during the COVID-19 pandemic.

7. References

Alves, P., Arrizabalaga, F., Delgado, J., Galán, J., Pérez Asenjo, E., Pérez Montes, C., & Trucharte, C. (2021). The role of crypto assets as legal tender: the example of El Salvador. *Economic Bulletin , 1/2021 ,* 27. https://www.bde.es/f/webbde/SES/Secciones/Publicaciones/InformesBoletinesRevistas/ArticulosAnaliticos/21/T1/descargar/Fich/be2101-art02.pdf

World Bank. (2020a). *COVID-19 (coronavirus) plunges the world economy into the worst recession since World War II* . https://www.worldbank.org/en/news/press-release/2020/06/08/covid-19-to-plunge-global-economy-into-worst-recession-since-world-war-ii

World Bank. (2020b). The economy in the times of covid-19. *Semiannual Report on the Region: Latin America and the Caribbean , 1 ,* 1–66. https://openknowledge.worldbank.org/bitstream/handle/10986/33555/211570SP.pdf?sequence=12&isAllowed=y

Baur, D.G., & Lucey, B.M. (2010). *Is Gold a Hedge or a Safe Haven? An Analysis of Stocks, Bonds and Gold . 45 ,* 217–229. https://doi.org/https://doi.org/10.1111/j.1540-6288.2010.00244.x

Bauwens, M., Kostakis, V., & Pazaitis, A. (2019). *Peer to Peer* . Manifesto London: University of Westminster Press. https://doi.org/https://doi.org/10.16997/book33

Będowska-sójka, B., & Kliber, A. (2021). North American Journal of Economics and Finance Is there one safe-haven for various turbulences? The evidence from gold, Bitcoin and Ether. *North American Journal of Economics and Finance , 56* (July 2020), 101390. https://doi.org/10.1016/j.najef.2021.101390

Binance.com. (2022). *Binance* . Popular Cryptocurrencies. https://www.binance.com/es

Bitcoin.org. (2022). *Bitcoin* . Bitcoin: A Peer-to-Peer Electronic Cash System. https://bitcoin.org/en/faq#what-is-bitcoin

Bouri, E., Jawad, S., Shahzad, H., & Roubaud, D. (2019). Cryptocurrencies as hedges and safe-havens for US equity sectors. *Quarterly Review of Economics and Finance* , 1–14. https://doi.org/10.1016/j.qref.2019.05.001

Bouri, E., Molnár, P., Azzi, G., Roubaud, D., & Ivar, L. (2016). On the hedge and safe haven properties of Bitcoin: Is it really more than a diversifier? *Finance Research Letters* , *0* , 1–7. https://doi.org/10.1016/j.frl.2016.09.025

Buterin, B.V. (2013). *A NEXT GENERATION SMART CONTRACT & DECENTRALIZED APPLICATION PLATFORM* . *January* , 1–36. https://doi.org/https://ethereum.org/

Cambridge Dictionary. (2022). Cryptocurrency. In Cambridge Dictionary. *Cryptocurrency. In Cambridge Dictionary* . https://dictionary.cambridge.org/en/english/dictionary/cryptocurrency

Chaum, D. (1998). Blind Signatures for Untraceable Payments. *Springer-Verlag* . https://sceweb.sce.uhcl.edu/yang/teaching/csci5234WebSecurityFall2011/Chaum-blind-signatures.PDF

Chawki, M. (2022). Cybercrime and the Regulation of Cryptocurrencies. In *Lecture Notes in Networks and Systems: Vol. 439 LNNS* . https://doi.org/10.1007/978-3-030-98015-3_48

Cocco, L., Tonelli, R., & Marchesi, M. (2022). Bitcoin as a Safe Haven during COVID-19 Disease. *Bitcoin as a Safe Haven during COVID-19 Disease* . https://doi.org/https://doi.org/10.3390/fi1404009

Coinbase.com. (2022). *What is market capitalization?* https://www.coinbase.com/es-LA/learn/crypto-basics/what-is-market-cap#:~:text=For a cryptocurrency like Bitcoin, it is currently a single currency.

Coinbase. (2022). *Cryptocurrency prices* . Cryptocurrency prices. https://www.coinbase.com/en/explore

Coingecko. (2022a). *Bitcoin Price Chart (BTC/USD)* . https://www.coingecko.com/en/coins/bitcoin?chart=7_days#panel

Coingecko. (2022b). *Ethereum Price Chart (ETH/USD)* . https://www.coingecko.com/en/coins/ethereum

Coinmarketcap.com. (2022). *Coinmarketcap* . Top 100 Cryptocurrencies By Market Cap. https://coinmarketcap.com/en/

Conlon, T., Corbet, S., & McGee, R.J. (2020). Are cryptocurrencies a safe haven for equity markets? An international perspective from the COVID-19 pandemic. *Research in International Business and Finance* , *54* (June), 101248. https://doi.org/10.1016/j.ribaf.2020.101248

Dai, W. (1998). *B-Money* . http://www.weidai.com/bmoney.txt

Dwita, M.C., Ekaputra, I.A., & Husodo, Z.A. (2020). Are Bitcoin and Ethereum safe-havens for stocks during the COVID-19 pandemic? *Finance Research Letters Journal* , *May* . https://doi.org/10.1016/j.frl.2020.101798

Ethereum.org. (2022). *Ethereum* . https://ethereum.org/en/

Kindleberger, C. P., Aliber, R. Z., & Wiley, J. (2005). *Manias, Panics, and Crashes* (5th ed.). John Wiley & Sons, Inc. https://delong.typepad.com/manias.pdf

Klein, T., Pham Thu, H., & Walther, T. (2018). Bitcoin is not the New Gold – A comparison of volatility, correlation, and portfolio performance. *International Review of Financial Analysis* , *59* , 105–116. https://doi.org/10.1016/j.irfa.2018.07.010

Law, L., Sabethr, S., & Solinas, J. (1996). How To Make a Mint: the Cryptography of Anonymous Electronic Cash. In *the American University Law Review* (Vol. 46, Issue 4). http://digitalcommons.wcl.american.edu/cgi/viewcontent.cgi?article=1389&context=aulr

Lu, Y. (2019). The blockchain: State-of-the-art and research challenges. *Journal of Industrial Information Integration* , *15* (April), 80–90. https://doi.org/10.1016/j.jii.2019.04.002

Maganini, N., Diniz, E. H., & Rasheed, A. A. (2021). Bitcoin's price efficiency and safe haven properties during the COVID-19 pandemic: A comparison. *Research in International Business and Finance* , *58* , 101472. https://doi.org/10.1016/j.ribaf.2021.101472

Melki, A., & Nefzi, N. (2021). Tracking safe haven properties of cryptocurrencies during the COVID-19 pandemic: A smooth transition approach. *Finance Research Letters* , *June* , 102243. https://doi.org/10.1016/j.frl.2021.102243

Meshcheryakov, A. (2020). Ethereum as a Hedge: The intraday analysis. *Economics Bulletin* , *40* (1), 101–108.

Mokni, K., Youssef, M., & Ajmi, AN (2022). COVID-19 pandemic and economic policy uncertainty: The first test on the hedging and safe haven properties of cryptocurrencies. *Research in International Business and Finance* , *60* (November 2021), 101573. https://doi.org/10.1016/j.ribaf.2021.101573

Nakamoto, S. (2009). *Bitcoin : A User-to-User Electronic Cash System Introduction Transactions* . 1–9. https://bitcoin.org/bitcoin.pdf

WHO. (2020a). Epidemiological Update Novel coronavirus (2019-nCoV) 5. *World Health Organization* , *2019* (Cdc), 1–10. https://www.paho.org/sites/default/files/2020-02/2020-feb-28-phe-actualizacion-epi-covid19.pdf

WHO. (2020b). *PAHO/WHO response. March 31, 2020. Report No 1* . paho.org

WHO. (2020c). *Monitoring of SARS-CoV-2 variants* . World Health Organization. https://www.who.int/en/activities/tracking-SARS-CoV-2-variants

WHO. (2022a). *Coronavirus Disease (COVID-19): Vaccines* . https://www.who.int/en/news-room/questions-and-answers/item/coronavirus-disease-(covid-19)-vaccines#

WHO. (2022b). *WHO Coronavirus (COVID-19) Dashboard* . World Health Organization. https://covid19.who.int/

Raheem, ID (2021). COVID-19 pandemic and the safe haven property of Bitcoin. *Quarterly Review of Economics and Finance* , *81* , 370–375. https://doi.org/10.1016/j.qref.2021.06.004

Royal Spanish Academy. (2022). *Cryptocurrency. In Dictionary of the real Spanish language.* Cryptocurrency. In Dictionary of the Royal Spanish Language. https://dle.rae.es/cryptocurrency?m=form

Sandoval, L., & Franca, IDP (2012). Correlation of financial markets in times of crisis. *Physica A* , *391* (1–2), 187–208. https://doi.org/10.1016/j.physa.2011.07.023

Smalls, L.A. (2018). Bitcoin as a safe haven: Is it even worth considering? *Finance Research Letters* . https://doi.org/10.1016/j.frl.2018.11.002

The World Bank. (2020). *COVID-19 to Plunge Global Economy into Worst Recession since World War II* . https://www.worldbank.org/en/news/press-release/2020/06/08/covid-19-to-

plunge-global-economy-into-worst-recession-since-world-war-ii

Urquhart, A., & Zhang, H. (2019). *Is Bitcoin a hedge or safe-haven for currencies? An intraday analysis* . 1–25. https://doi.org/https://doi.org/10.1016/j.irfa.2019.02.009

Vidal, T. (2022). Which cryptocurrency data sources should scholars use? *International Review of Financial Analysis , 81* . https://doi.org/10.1016/j.irfa.2022.102061