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DEPARTMENT OF ECONOMIC AND REGIONAL DEVELOPMENT

THESIS TITLE

RISK AND VOLATILITY OF CRYPTOCURRENCIES

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Conducting a study is a procedure that demands a lot of time, patience, and persistence. I am very proud that I successfully finished this journey.

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Abstract

The purpose of the current thesis is to make a historical presentation of cryptocurrencies so that the reader could understand the risk and volatility of an investment in them. First of all, the thesis defines some very initial information about money. Liu and Hilton (2005) believe that when someone knows about the past, he or she can control the present better and forecast the future. For example, by knowing about the progression of money, someone could understand Bitcoin and other cryptocurrencies more effectively, because the reasons why a type of money stopped or started existing could be similar to the question about the skyrocketing supply and demand for cryptocurrencies. Moreover, by examining the increase and decrease of cryptocurrencies throughout the years, potential investors will benefit from whether it is a good option to buy or sell cryptocurrencies. Furthermore, some basic differences between different cryptocurrencies will be presented to make a general comparison and for this reason, the assignment would be helpful for further investigation about how risky could be considered for an investor to allocate his or her money to gain big chances of winning more. Is there a limit to where investors could invest in cryptocurrencies and be considered as a safe house? The next question, which this thesis will try to answer is what dangers will bring on cryptocurrencies if they become the main transaction method. It will be focused on whether Covid-19 and other financial crises affected stock performance. Most people, when they refer to cryptocurrencies and especially to the risk of developing and investing in them, they do not think about their consequences on our planet. They are only interested in the possible profits and losses of an investment. The question being asked is if cryptocurrencies are a lurking risk for the environmental burden. The research method is quantitative because numerical data will be used in this analysis, especially secondary data. These data have already been collected for other purposes-analyses and also used for this case; to analyze and examine if an investment in cryptocurrencies is risky and volatile.

Keywords: Cryptocurrencies, Risk, Volatility, Investment, Money, Blockchain, Planet

Περίληψη

Σκοπός της συγκεκριμένης διπλωματικής είναι μέσω μιας ιστορικής αναδρομής των κρυπτονομισμάτων, ο αναγνώστης να κατανοήσει τον κίνδυνο μιας επένδυσης σε αυτά λόγω της μεταβλητότητας των τιμών τους. Ξεκινώντας, είναι πολύ χρήσιμη η αναφορά που γίνεται στο χρήμα και την εξέλιξή του. Οι Liu and Hilton (2005) πιστεύουν ότι όταν κάποιος γνωρίζει το παρελθόν, μπορεί να ελέγξει καλύτερα το παρόν και να προβλέψει το μέλλον. Για παράδειγμα, όταν κάποιος μάθει για την εξέλιξη του χρήματος, μπορεί να καταλάβει το Bitcoin και τα άλλα κρυπτονομίσματα πιο αποτελεσματικά. Αυτό συμβαίνει, διότι, οι λόγοι για τους οποίους ένας είδος χρήματος σταμάτησε ή άρχισε να υπάρχει, μπορεί να είναι αντίστοιχος για τον λόγο που η προσφορά και η ζήτηση των κρυπτονομισμάτων εκτινάχθηκε. Επιπλέον, εξετάζοντας τις αυξομειώσεις στην ζήτηση αλλά και στις τιμές των κρυπτονομισμάτων με το πέρασμα των ετών, οι δυνητικοί επενδυτές μπορεί να επωφεληθούν σχετικά με το εάν είναι σωστή η απόφαση να επενδύσουν τα χρήματά τους σε αυτά. Στη συνέχεια, με την σύγκριση ανάμεσα στα πιο γνωστά κρυπτονομίσματα, ένας επενδυτής μπορεί να βοηθηθεί, ώστε να καταλήξει αν μια επένδυση σε κάποιο ή κάποια κρυπτονομίσματα αποτελεί ένα ασφαλές καταφύγιο. Αν δηλαδή, επενδύοντας ένα μέρος των χρημάτων του μπορεί να μειώσει τον συνολικό κίνδυνο της επένδυσης. Έπειτα θα αναλυθεί η πιθανότητα, τα κρυπτονομίσματα να γίνουν το κύριο μέσο συναλλαγής σε παγκόσμιο επίπεδο. Σημαντικό ρόλο σε όλα τα προηγούμενα θα έχει και η περίοδος της Covid-19, η οποία μαζί με άλλες περιόδους, όπως κάποιες οικονομικές κρίσεις, επηρεάζουν τις τιμές των μετοχών. Τέλος, πολλοί άνθρωποι όταν αναφέρονται στα κρυπτονομίσματα και ιδιαίτερα στον κίνδυνο που ελλοχεύεται σε αυτά, δεν αναλογίζονται τις συνέπειες που προκύπτουν εις βάρος του πλανήτη εξαιτίας της έντονης ενασχόλησής τους με αυτά. Ενδιαφέρονται μόνο για τα πιθανά ατομικά κέρδη ή τις ζημιές που θα προκληθούν με κάποια επένδυσή τους σε αυτά. Ένα καίριο ερώτημα λοιπόν, που τίθεται, είναι αν τα κρυπτονομίσματα συμβάλλουν στην περιβαλλοντική επιβάρυνση του πλανήτη. Η μέθοδος έρευνας είναι ποσοτική με δευτερογενή δεδομένα, δηλαδή, με δεδομένα που χρησιμοποιήθηκαν σε άλλες έρευνες και εξυπηρετούν στους στόχους της συγκεκριμένης έρευνας που αφορούν εάν μία επένδυση στα κρυπτονομίσματα θεωρείται επικίνδυνη.

Λέξεις-Κλειδιά: Κρυπτονομίσματα, Κίνδυνος, Μεταβλητότητα, Επένδυση, Χρήμα, Πλανήτη

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Introduction: Historical Evidence about cryptocurrencies and a few examples of the most famous of them (When, how, from whom started, etc.).

Main Body: i) Risk of cryptocurrencies (to invest or not invest in cryptocurrencies, a financial and environmental glance at cryptocurrencies' footprint).

ii) Volatility of cryptocurrencies (the progression of the most known cryptocurrencies through ages and significant moments of history, comparison with other assets)

Conclusion: Forecasting the future of cryptocurrencies, and suggesting new studies to clarify and understand better the world of cryptocurrencies, the chances, and the dangers, which they hide.

Unit 1: Introduction

Nowadays, technology is developing more and more rapidly, not only influencing people's lives positively or negatively but also almost changing the way they think, act, and live. Technological innovations affect individuals, companies, organizations, and countries differently. It is known that the fourth industrial revolution has already come and cryptocurrencies comprise an important part of that. Only by being well-informed about these changes and the speed at which these occur can someone benefit or at least protect him or herself from wrong decisions.

Cryptocurrencies gained power and reputation very quickly. They became an important element of the global financial market (Gajardo et al., 2018) and a new asset category (Corbet et al., 2018). Despite their volatility and massive carbon footprint, cryptocurrencies are still considered an attractive investment for many people. Acemoglu (2021) claimed that there are five reasons why people are urged to support investments in cryptocurrencies. First is the desire to get richer quickly, especially when few other financial opportunities could offer relevant returns. Even workers with college degrees have not ensured their financial and sustainable future, which is why they strive for an important profit from cryptocurrencies. Secondly, Bitcoin is state-of-the-art creativity, because it has such a decentralized system, which allows it not to be under the supervision of governments. But, some governments also, support cryptocurrencies, even though they cannot completely control them, because their citizens gain the seigniorage of such new currencies. So governments use this to pay their obligations (i.e. nation's debt, purchasing services, etc.). Consequently, the truth is that the criminal world skyrocketed the power of cryptocurrencies because, in its early days, the demand for Bitcoin was boosted by the dark web. Last but not least, the political dimension of cryptocurrencies, based on which the advocates claim that the state's power will be decreased through Bitcoin and other digital currencies.

For all these reasons, many people believe that Bitcoin and other cryptocurrencies function as currencies. It is a medium of exchange, a unit of account, and can be considered a store of value (Ciaian et al, 2016) and this is the reason why it could become the new global currency. At the moment, it is unclear whether cryptocurrencies will find their way into our daily transactions, though some countries have recognized at least Bitcoin as a standard currency within their sphere of influence. But, replacing completely the present financial system with Bitcoin's decentralized, seems to be a fantasy and not a realistic goal. A new global currency like Bitcoin or another cryptocurrency will not only solve the aforementioned problems but also create new ones because as it will be analyzed further next, the risk for something like this is extremely huge.

Especially, Smith (2018) stated that the most important reason for the future failure of cryptocurrencies is their mechanism; optimistic buyers who are willing to obtain bitcoin and other cryptocurrencies for a higher price than actually worth. Stiglitz (2019) argues that communities should strive for electronic payment mechanisms to have a more regulated and fair economy. This will improve the efficiency and transparency of the economy and not the possible investments in cryptocurrencies. The latter has not had the attributes that fiat currencies like US Dollar or Euro have and they should be shut down.

This paper aims to advocate the economists who are not only reluctant but also against investments in cryptocurrencies. The reasons for them are many but this thesis will focus on the risk and volatility of cryptocurrencies, contributing at the same time to the growing literature on this subject. The current study, as a theoretical thesis, is created based on accessible data and papers in order to identify the issue statement and find solutions to the

research questions. For this reason, evidence has been gathered from various sources and inductive reasoning is used to forecast the future of cryptocurrencies and the risk of a possible investment in them. Inductive reasoning is the process of generalizing specific interesting information to solve a problem. Deductive reasoning, on the other hand, is a logical road to the conclusion, so maybe the two lines of reasoning may lead to two different conclusions. In this paper, the volatility of cryptocurrencies will be analyzed through studies that have included time series with calculating the historical volatility or even with implied volatility and various indexes as methods of forecasting the price of the most important cryptocurrencies.

In general, associating price returns and volatility plays an important role in such conventional assets. It helps in understanding better the stress periods (i.e. financial crises, pandemic periods, wars, etc.) and their propagation mechanisms, detecting systemic risk (Louzis, 2015). In that way, it will be clarified, if the threats of a possible investment in cryptocurrencies are bigger than the hypothetical benefit from that.

Unit 2: Money

2.1. Money's history

To begin with, for someone to understand the future of money, he or she should first know its history. Before humanity invented money to facilitate trade, the exchange of foods and services in society took place in direct replacement. A fisher may trade some fish with a gatherer to obtain a basket of berries. This meant making a deal. Known as the double match (Sabzo, 2002), a person should find another with opposed needs to offer him or her what already has and acquire the product or service he or she needs. But this type of exchange, which was the basis of the barter economy is now impossible for several reasons. Firstly, what can be realized in the modern world, where the division of labor is progressing is not easy for many professions to exchange their services or products. For instance, how could a teacher of biology pay his or her hairdresser? It is very difficult to find a way to do so. For that reason, indirect bartering became dominant and the norm (Abildgren 2018).

At first, grains or cattle became the standard goods, which were the base for exchanges, because were partly satisfied the three functions of money; a store of value, medium of exchange, and unit of account (Jevons, 1875). Later, other goods such as silver and gold substituted grain, becoming the most popular medium of exchange. This shift affected positively the communities because metals are more durable, divisible, and easier to store (Weatherford, 1998). The only but very important drawback of paying with metals was the transportation, because of their weight, they were heavy to be carried while someone was traveling. For that reason, paper bills gained traction first in China and later in Europe. But most of that currency was not money in the traditional sense. Instead, it acted as a promissory note; a promise to pay a specified amount of gold or silver. This was essential to the development of banking (Tikkanen, 2020). But again, this system had also a serious problem, because countries could print as much money as they wanted, making the currency worthless. To deal with that problem, the United Kingdom introduced the gold standard, in which each country's monetary system had a standard unit of currency, which was in balance with a fixed quantity of gold of this country. However, this system had also downsides. Indicatively, with this system, the country's ability to isolate its economy from inflation and depression from the countries globally. This system was becoming more and more limited and in 1971 in the USA was completely abandoned. Last but not least, credit cards existed for many years before 1950, when the first universal credit card appeared. The magnetic stripe on the credit cards from IBM, developed, even more, electronic transactions because they contained

personal account information. Nowadays, in some countries, such as Greece, citizens are obliged to use and pay with their credit or debit cards in order to reach the limit of 30% of their income. For instance, if someone earns 10.000€ per year, he or she is obliged to fulfill at least, 3000€ with card or web banking for the daily payments. As it seems, the power of cards and in general, electronic transactions will gain more and more ground (Chawla & Joshi, 2019).

Figure 1



But, the question is whether Bitcoin or another cryptocurrency could be the next dominant currency system globally. If someone observes the history of money, he or she will agree with Mankiw (2016), who argues that money is a stock of assets that someone can use to make transactions. Bitcoin is a currency not issued by a central bank and not regulated, so could it be considered valuable and trustworthy, or is it volatile both in the short and long term? Radziwill (2018) believes that society will become cashless because services with cash could be too impractical to use. For this reason, blockchain technology will play a major role in this transition.

Unit 3: Cryptocurrencies

3.1. Historical Data

To begin with historical evidence, cryptocurrencies appeared in 2008. The first one was Bitcoin and today the number of active cryptocurrencies surpasses 9000 different cryptocurrencies. Its peak was on February 2022 at 10.397 according to Statista (2022). Generally speaking, cryptocurrencies rely on a decentralized network to validate transactions and public ledgers known as blockchain to avoid double-spending. The transactions are verified through a process known as the proof-of-work consensus mechanism. Network participants are called miners and they will be rewarded by confirming transactions and receiving new Bitcoins. The first bitcoin was mined by using the computational ability to solve math problems that need to be solved as part of the verification process. Monetary base growth is fixed and determined by the rate at which network participants can add transactions blockchain. The newly introduced cryptocurrencies then; Ethereum, Tether, Litecoin, Ripple, etc, were gradually taking shares from Bitcoin's dominant market. According to Ji et al. (2019), this had positively affected investors in taking a breather from Bitcoin and maximizing the returns of their investments. But, what are the differences between the most famous cryptocurrencies? What are the advantages and disadvantages of each one? Below, the five most famous will be analyzed and compared, which account for more than 75% of the total market of cryptocurrencies.

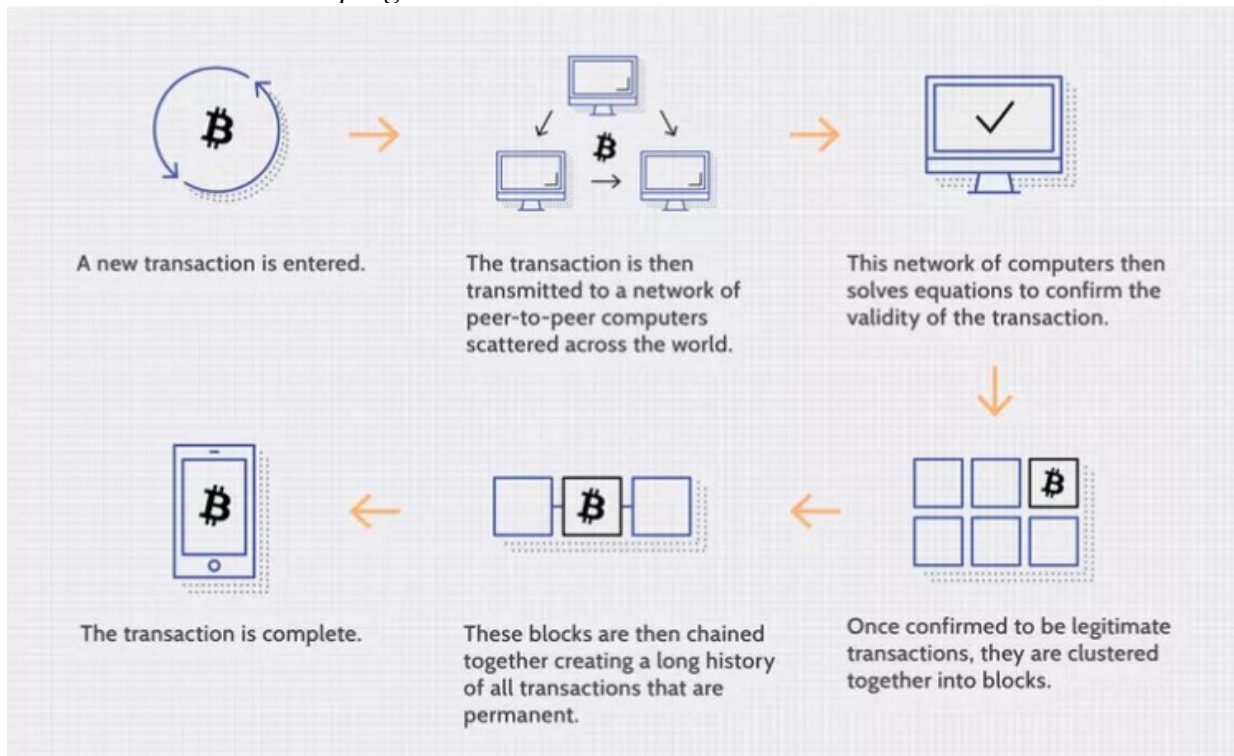
3.2 Bitcoin

Bitcoin was the first cryptocurrency and its protocol was represented by an unknown author or group, under the pseudonym Satoshi Nakamoto (2008). It remains the world's most popular and valuable digital currency to this day. This digital currency is created within a peer-to-peer network and it is operated by a network of users who verify and record transactions relying on a central authority. Furthermore, it was designed to be a trustworthy transaction system with low costs (Grinberg, 2012). Now, with the other cryptocurrencies, it has the potential to replace the role of financial third parties. Two groups of people earn money from Bitcoin. The first one is miners, who provide the system with the computational

power necessary for the solution of blocks uploaded to the blockchain using their computers. As a peer-to-peer network is accessible to everyone with a suitable device. No specific permission is required for entry, nor is there any personal control in place. According to the parameters built into the system, the last Bitcoin will be created in 2140. The second group is investors and speculators who are buying and selling Bitcoin, which can be exchanged for fiat currency through virtual currency exchanges and used for purchases from merchants and retailers, who accept Bitcoin.

Figure 2

Bitcoin's Transaction progress



Note. Bitcoin's decentralized system, through which, transactions are kept. This method is known as the Bitcoin blockchain. From *Blockchain Facts: What Is It, How It Works and How It Can Be Used*, by Hayes A. (2022). Copyright 2022 by Investopedia.

Currently, Bitcoin is considered an alternative to fiat currencies such as the US dollar or Euro controlled by governments and banks, without becoming a fiat currency according to Cermak (2017). While some Bitcoin advocators consider virtual currency simply as a commodity for trading and speculation, others believe that it could become the dominant currency worldwide. While the system was proposed as a form of digital cash, Bitcoin has been also called fiduciary currency, synthetic commodity money, and speculative investment. Meanwhile, Popper and Lee (2018) claimed that for many people, bitcoin and in general, cryptocurrencies are considered a big bubble and they hide high risk which derives from their volatility. Unlike typical investments such as company shares, whose prices are affected by business performance, Bitcoin has no underlying asset. This means that its price changes are entirely connected with investor speculation about whether it will rise or fall in the future. And Bitcoin is not the only cryptocurrency that is characterized by high volatility.

3.3 Ethereum

Ethereum was launched in 2015 and it is based on Bitcoin's innovation with some differentiations. It is considered a payment network but at the same time is also a marketplace of financial services, games, social networks, and other apps. Ethereum diverges from other networks because users' identity is private and cannot be tracked down. The most important difference is that Ethereum is programmable, and someone can develop decentralized applications on its network. This means that he or she can use the blockchain to store data and manage the possibilities of their app according to their plans. The reason why someone can do that is that Ethereum represents a blockchain with a built-in programming language. As a result, the users have no limitations and the network enables them to create their own rules about transactions, ownership, and other functions. Ethereum's cryptocurrency is called ETH, which depicts digital assets and funds and is vital for transactions through the network of Ethereum (Ethereum, n.d.-b).

But what are the advantages of using Ethereum? Transactions through Ethereum help people with some very serious and common problems such as the need for a trusted third party and the retrieval of privacy when someone uses repetitively the same platform. For this reason, Ethereum and smart contracts resolve these problems by replacing the intermediary according to Bogner et al. (2016). A smart contract is a computerized transaction protocol that executes a contract's terms, as stated by Szabo (1994). They are computer programs that run on the Ethereum platform and they can control certain types of agreements. However, they have no direct relationship with legal contracts.

McMahon (2022) believes Ethereum will exceed \$16k in 2025. This rapid expansion of this cryptocurrency introduces new challenges resulting from the vulnerabilities, which should be addressed. Ethereum enables many new examples to run on top of its blockchain, including finance, exchange, gaming, etc. As a result, Ethereum should monitor and improve the security of its vital platform in order to protect the value of its cryptocurrency and at the same time the services, it provides according to Kabla et al (2022). What is more, the authors assert that the most effective security countermeasure for Ethereum is the Intrusion Detection System, which is still not being used effectively to counter the threats that Ethereum is facing, but it could be built to detect abnormalities in the network, through predefined attack patterns.

3.4 Tether

Although Bitcoin remains the most popular cryptocurrency, it is affected by volatility in its price. Mita, Ito, Ohsawa, and Tanaka (2019) state that despite the benefits, most online systems have not used cryptocurrencies as a substitute for fiat currency. Especially, in 2019, the awareness of cryptocurrencies was 74% on average while ownership was 7%. Most online store owners do not use decentralized payment systems because of the high volatility of cryptocurrencies. This volatility may be beneficial to traders, but it transforms everyday transactions such as purchases into dangerous speculation for buyers and sellers. Developed societies try to reduce economic instability through rules and measures (Ando & Modigliani, 1965).

To solve that problem some early adopters and enthusiasts of Bitcoin launched Tether. It is the most popular and the first stablecoin in the world. Tether tokens combine the stability and simplicity of fiat cryptocurrencies with the innovative nature of blockchain technology, providing the best of both worlds. The concept behind stablecoins aims to eliminate the high volatility of the most popular cryptocurrencies. In particular, Hassani, Huang, and Silva (2018) claim that stablecoins are digital tokens pegged to some fiat currency and function as

a means of exchange, a store of value, and a measurement unit for accounting in blockchain transactions. So, the main objective of Tether is to facilitate fixed-rate transactions between crypto exchange platforms. At the same time, people are drawn to this currency for a great variety of reasons. First of all, as it has already been analyzed, the feature of stability helps Tether stand out amongst other currencies. Furthermore, Tether is known for its transparency and reliability, because it is connected with the U.S. dollar; its price is equivalent to 1 dollar. For instance, when an investor buys Tether, he or she is well aware of the cost of buying coins. Conlon, Corbet, and McGee (2020) state that between Bitcoin, Ethereum, and Tether, only the latter could be considered a haven for investors, and wonder about the reasons someone to invest in Tether and not in U.S. dollars.

Last but not least, Tether is the most preferred and trusted cryptocurrency for trading in the whole market of cryptocurrencies. This means, that investors who are interested in stability and not quick profits, trust Tether coin for their investments. They consider Tether as a useful tool for completing transactions with greater assurance. The danger of price variations throughout the transaction procedure is reduced due to its constant value. For this reason, Tether's stability offers a viable option for enabling payments and settlements, particularly in cases where speed and certainty are critical (Baur & Hoang, 2021).

3.5 U.S. Dollar Coin (USDC)

This crypto coin was launched in 2018, it is similar to the Tether coin, and its concept. They are both fully backed by USD. USDC was created by Circle, a financial business, and Coinbase, a renowned Bitcoin exchange. One of the primary goals of USDC is to offer stability and reduce the volatility that is frequently associated with other cryptocurrencies such as Bitcoin or Ethereum. Individuals and corporations can purchase USDC through regulated exchanges or trading platforms. Users can keep their USDC in compatible wallets or utilize them for different transactions and payments after they have obtained them. Whenever a trader buys a USDC with fiat currency, this currency is deposited and stored as 1 USD and if he or she sells it, the stablecoin is destroyed. For this reason, the USDC platform has an abundance of liquidity and for many investors is a safer investment than other cryptocurrencies. Furthermore, USDC's transparency is also a crucial element that distinguishes it from other cryptocurrencies. Circle conducts audits regularly to guarantee that the quantity of USDC tokens in circulation matches the amount of US dollars kept in reserve. These audits are carried out by independent accounting companies, and the results are made public to reassure users. USDC has gained popularity as a way of conserving buying power in nations with volatile fiat currencies, allowing users to get access to the steadiness of the US dollar without the need for traditional banking infrastructure.

But, considering that the Tether coin dominates the larger portion, automatically USDC is becoming the second choice. Someone maybe prefers and buys USDC because of its blockchain and the applications, with which he or she desires to engage. For instance, those who pursue to have a higher yield without considering the higher risk too. Looking back, when a myriad of withdrawals led to a collapse of the stablecoin terraUSD. Terra, the largest algorithmic stablecoin by market capitalization has failed. Terra's value allegedly pegged to the US dollar but collapsed from a 1:1 ratio to 1:0,10. At the same time, private investors submitted lawsuits against stablecoin issuer GMO Trust and Coinbase, for allegedly deceptively selling a volatile stablecoin named GYEN. The investors accused Coinbase that causing them to lose millions by freezing GYEN trading during the chaos. Boutros, Engel, and Spangler (2022) informed that while American federal politicians and authorities have stated a desire to adopt stablecoin rules, private plaintiffs have sought to fill the gaps.

Although it is questionable whether Congress will be able to pass complete legislation, lawmakers on both sides of the aisle agree that further regulation of stablecoins is desirable.

In summary, USDC has established itself as a notable stablecoin that provides stability and transparency within the cryptocurrency ecosystem. Because of its one-to-one peg to the US dollar, smart contract technology, and regulatory compliance, it is a popular choice for people, corporations, and institutions looking for a dependable and transparent digital currency. As the cryptocurrency sector evolves, USDC will play an important role in influencing the future of digital banking

3.6 Binance Coin (BNB)

More and more people are investing in cryptocurrencies, focusing more on trading than mining them. Especially, investors became more aware when Binance coin came to the surface of the cryptocurrency market. The convenience of entry into the world of cryptocurrencies and the desire for higher profits attract more investors who lack experience. Generally speaking, more of those investors are amateurs, without a clear understanding of the mechanisms, with which the price is calculated. Imagine that, almost every second, an investor suffers a loss as a result of not knowing the factors, on which price depends and reacts (Grossman & Petrov, 2017).

Binance Coin began as an ERC-20 token on the Ethereum blockchain in 2017. The total amount was 200 million coins. Later, on April 18th, 2019, Binance introduced the Binance Chain blockchain and released the native token of this chain, the BEP-2 BNB. When Binance created its platform and blockchain, the users of the ERC-20 token substituted their coins with BEP-2 BNB at a ratio of 1:1. Nowadays, it is the fifth-largest cryptocurrency by market capitalization, behind only Bitcoin, Ethereum, USDT, and USDC. The advantages of BNB coin are that it has low fees and a great variety of trading options and order types; travel expenses, payment of goods, creation of smart contracts, and for other transactions.

On the opposite side, Binance has some drawbacks. Firstly, it runs into regulatory and legal issues in several countries, therefore a cryptocurrency investor could hesitate to invest in and select other exchanges. These concerns are normal because according to Hofstede (1980) and his dimension of culture, the avoidance of uncertainty is extremely important, for companies that aim to establish a subsidiary in a foreign country. This component reflects a culture's willingness to accept future uncertainty because is useful for investors to avoid countries and societies, where there are high possibilities for cryptocurrencies to be banned, like Algeria, Bolivia, and many others.

3.7 To invest or not invest?

But why does somebody prefer cryptocurrencies, in order to transfer money, buy products and services or just invest? The advocators of cryptocurrencies believe that by using this type of transaction, they gain mainly money and time. For example, transaction fees are lower than those associated with traditional payment systems and there is no chargeback risk for merchants, even the time to create a digital wallet for Bitcoin and other cryptocurrencies is less time-consuming than opening a bank account. Early adopters and miners were compensated for the support they provided to the network because of the mining process. Although bitcoins were initially worthless, at the same time, rewards in bitcoins were merely a promising start that developed into current genuine worth.

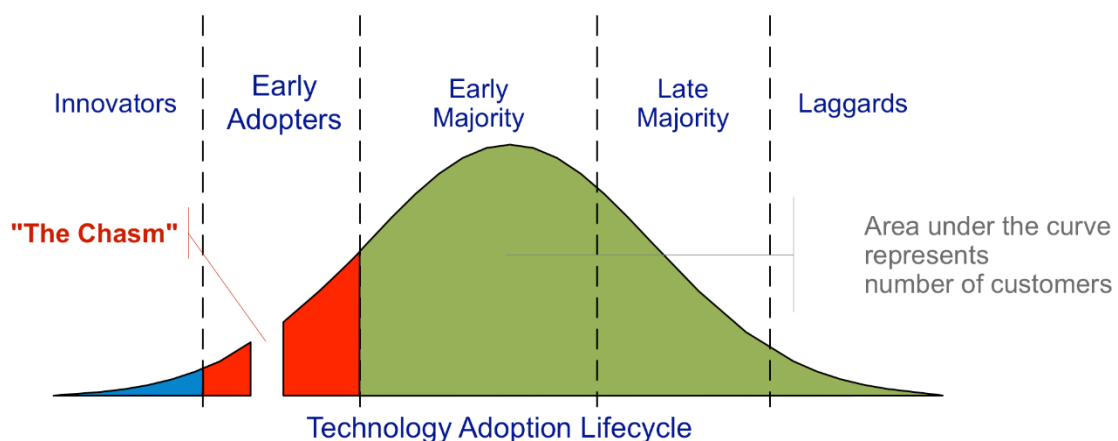
According to Palos-Sanchez, Saura, and Ayestaran (2021), the use of cryptocurrencies and blockchain technologies is currently restricted. The acceptance of Bitcoin and other cryptocurrencies as a payment method is still low in many prosperous regions of Europe.

Trust and privacy are the most important factors for the use of cryptocurrencies. Perceived usefulness (PU) is influenced by privacy, whereas trust and dangers affect perceived ease of use (PEOU). Their study shows, while privacy is the most critical characteristic that enhances PU, trust in the ease of use of Bitcoin transaction software is also crucial. However, trust has a notable influence on privacy, which businesses and entrepreneurs considered an important factor for the use of cryptocurrencies. The supporters of Bitcoin, Ethereum, and other cryptocurrencies prefer to take the risk of using and investing in them because they mainly disagree with the current situation; excessive budgetary pressure, lack of information about the need of paying extremely high taxes, and many other factors

On the other hand, Moore and McKenna (1999) claimed that the adoption of new technologies has many stages, from which all the stakeholders should pass. The model suggests that this adoption follows a predictable pattern, that starts with innovators and early adopters, followed by early and late majorities, and finally laggards. It is important to understand at which stage of Moore's technology adoption life cycle because only then the stakeholders will take the right decisions not only about the route of cryptocurrencies but also about their investments. For example, marketers should focus on one group of customers at a time, using each group as a base for marketing to the next group. The most difficult step is making the transition between visionaries (early adopters) and pragmatists (early majority).

Figure 3

Moore's Technology Adoption Life Cycle Moore's Technology Adoption Life Cycle



Craig Chelius (2009) Wikimedia Commons

This is the chasm that Moore and McKenna (1999) refer to and it also has several risks associated with Bitcoin and other cryptocurrencies. With global regulatory uncertainty, stock market failure, outright theft from digital wallets, and the reluctance of traditional banks to support entrepreneurs and users, there are competing alternative cryptocurrencies. In addition to Moore's chasm, price volatility plays a significant role contributes to his speculative trading and hoarding. But the question being asked is not at which stage are the cryptocurrencies but if there will be the stage of early and late majority. Will Bitcoin and other cryptocurrencies become a worldwide means of transaction and money or has already reached its peak? Can it be widely adopted? First of all, the media are also reluctant about cryptocurrencies, which does not help. For example, the media should adopt a three-pronged strategy. They should explain digital money in plain terms to the audience in order to be informed. What then is the secret to widespread adoption? New clients must understand both why and how they should invest in the cryptocurrency market, which is why at this stage of

the market, creating a strong communications plan is essential. Marketing strategies that are active help people understand the worth and importance of new technological products. In the case of cryptocurrencies, media must adopt a three-pronged strategy: explaining digital money in plain terms, securing the support of influential thought leaders, and educating consumers about the competition, which primarily consists of banks, the Federal Reserve, and equities — those determined to squelch cryptocurrencies. Additionally, if cryptocurrency as a product hopes to attract pragmatists, and people on the cusp of the technology adoption lifecycle, it must consider the fact that these consumers prefer to deal with a market leader with a solid reputation. The process has already begun, and it will probably continue to accelerate as new possibilities to invest in cryptocurrencies present themselves. Supporters believe that the cryptocurrencies will anticipate significant industry developments in the upcoming months, including the provision of crypto custody services by major banks, the expansion of access to crypto products by brokerages, the acceptance of digital currency by new merchants, and the launch of large-scale applications on public blockchains (Bunjaku, Gjorgieva-Trajkovska, & Miteva-Kacarski, 2017).

Despite all these estimations of a bright future for cryptocurrencies, there are still plenty of possible obstacles. Rejeb, Rejeb, and Keogh (2021) believe that the absence of governance in peer-to-peer networking transactions is one of the main challenges to the adoption of cryptocurrencies. Users run the danger of falling prey to scams and online threats, having a high possibility to lose access to their wallets and their ability to conduct transactions with third parties, because the cryptocurrencies are affected by bugs or the private key is taken. In addition to these disadvantages, investors and companies may also think about utilizing cryptocurrencies to make it easier to evade taxes, launder money, and finance illegal operations. The question is whether or not should someone choose clearly which side wants to be; supporters or opponents. For all these reasons, we should delve deeper in order to understand some terms better.

Unit 4: Risk management

4.1 What is risk?

Everyone faces some kind of risk every day, from the mean of transportation, someone will use, to the spicy meal from a local restaurant he will eat, and even to a possible accident he or she will have. The potential for loss, injury, or bad repercussions that may result from unclear events or situations is referred to as risk. It is ingrained in many parts of life, including business, money, health, and daily activities. In general, risk consists of two components: the possibility or probability that an event will occur and the potential effect or severity of its consequences. The greater the likelihood of a bad event, the greater the risk associated with it. Natural catastrophes, accidents, financial market swings, health concerns, technical failures, and human conduct are all potential causes of risk. Depending on the situation, it can be defined as financial risk, operational risk, market risk, and many others.

Particularly, when investing and capital planning come to the surface as a decision, which should be taken. So, every investment has also some level of risk. It can be considered as the degree of uncertainty and potential financial loss involved in an investment choice. But the risk is a complex issue that must be studied, understood, and identified in investment processes. There are many differentiations in risk. For example, when someone refers to risk, he or she worries about the speed and convenience that could get the money of the investment back or the speed they will gain the profits of it. There are many categories of risk, in business, volatility, inflation, interest rate, and liquidity (What is Risk?, n.d.).

Considering risk management as a control problem and serving to reflect the control system involving all levels of society for each specific hazard category. It is stated that risk management must be simulated by cross-disciplinary research (Rasmussen, 1997). Both business and public life involve risk. The environment in which businesses and government entities operate is more unpredictable as a result of dynamic market interactions. In order to maintain high competitiveness, businesses must launch projects with a variety of potential outcomes. The risk associated with an organization's operation is based on the likelihood that certain outcomes may occur. In order to directly and effectively achieve the organization's goals, the risk is a concept that encompasses all facets of organizational activity. Risk management is an ongoing activity that is highly dependent on changes in the organization's internal and external environments. For this reason, environmental changes necessitate ongoing attention to risk detection and management according to Tchankova (2002).

4.2 What is risk in investments?

As previously stated, it is crucial, investment decisions not be made without conducting a risk analysis because the consequences could be dramatic for an individual or a company. Risk management is responsible for risk analysis and it was first studied after World War II. Especially, Snider (1956) observed that there were still no books on risk management at that time, and no universities offered courses on the subject. According to Dionne (2013), the first two scholarly books about risk management were published by Mehr and Hedges (1963) and Williams and Hems (1964). But also, their content covers only pure risk management, excluding financial risk. At the beginning of the 1970s, started the use of derivatives as instruments to control insurable and uninsurable risks, which were advanced significantly in the 1980s. At that time, companies started to think about financial management or portfolio management as well. Nowadays, most companies have developed risk management, approaches, methods, and techniques to address the issues of capital sufficiency and capital investment in business units. An effective decision-making process requires agreement on basic terms because only with conceptual clarity, miscommunication can be avoided. There are plenty of strategies for risk management and which of them will a company or even an individual will apply, depends on their financial situation and their goals.

One major risk management component is diversification, based on Koumou (2020). Many investors and financial managers seek to spread investment into various assets. For example, they invest not only in stocks but also in bonds or real estate, because if one of their investment fails, they will gain from other investments. There are two types of diversification, across assets, which means distributing the capital among different assets, and within assets, which is about allocating the investing money to multiple options but in the same category. Buying stocks from different firms in the same field is an example of the latter.

The question being asked is why investors do not prefer investments with low risk. Fischhoff, Watson, and Hope (1984) answer that, many times the choices with the least risk, are unable to give back a reasonable return. For this reason, the most suitable treatment for risk management is to give a logical and consistent articulation of one subset of the consequences that risky decisions have. For Fischhoff et al. (1984), decision-making about risk management cannot begin without equivalent conceptual evaluations of the other outcomes. Hence, only then it is possible to start making hard tradeoffs between risks, benefits, and externalities that a decision could induce. This is why, another aspect of risk management is consistent investing, which means purchasing stocks or other assets in tiny amounts at regular intervals of time. For instance, an investor, one time will buy high and another low, in order to keep the investment's starting cost price constant. If the market price

of the investment rises, the investors will benefit from the entire investment, but if not, then they could control the extent of the loss.

Last but not least, investing for the long term can be considered a way of managing risk. Long-term value creation indicates that a company or an organization strives to maximize its financial, social, and environmental value over time, contributing to a more sustainable economic model according to Dyllick and Muff (2016). Fulton, Kahn, and Sharples (2012) inform that organizations with high ratings for Corporate Social Responsibility (CSR) and Environmental-Social-Governance (ESG) issues have reduced their obligations; debt, and equity costs. Moreover, CSR and risk management are closely related, as CSR can help a company manage various risks (Lu, Liu & Falkenberg, 2022). For example, a company that engages in CSR activities such as reducing its environmental impact or promoting ethical business practices may be less likely to face reputational or regulatory risks. Furthermore, by engaging in CSR companies can also identify opportunities for growth and innovation, which can help mitigate risks associated with market disruption, new competition, and changing customer needs. Meanwhile, ESG refers to a set of criteria used to evaluate companies' and organizations' sustainability and societal impact. ESG data is usually used by investors to assess the long-term performance and potential risks of companies according to Antoncic (2019). In the context of ESG investing, risk management would involve identifying potential negative impacts a company may have on the environment or society, assessing the likelihood of those risks, and taking steps to control them. In summary, both CSR and ESG can be considered as a form of risk management that help companies to identify and manage risks, while also creating opportunities for growth and innovation. Hence, the market recognizes that these firms are less risky than others and compensates them appropriately.

In conclusion, investment risk refers to the possibility that an investment's actual return will be different from the expected return (Iyiola, Munirat, & Nwifo, 2012). The level of risk can vary widely among different types of investments and different investors have different risk tolerances. Investors can manage investment risk by diversifying their portfolios, investing in low-risk assets, and regularly monitoring their investments. It is worth noting that, while risk and returns are closely related, high-risk investments may not always yield high returns, and vice-versa

4.3 What is risk in cryptocurrencies?

Crypto enthusiasts have long anticipated that the cryptocurrencies' independence will face effectively inflation and catastrophes. It is known that Bitcoin is controlled by no central issuer or authority, and exactly this decentralization skyrocketed Bitcoin's price. Many people believed that Bitcoin would have retained its value after a financial crisis, war, or policy changes, because of its independence from authorities and governments. But, analysts assert that a mix of free time and disposable income has led cryptocurrencies to rise at an astounding rate. There are several risks associated with investing in cryptocurrencies.

4.3.1 Risk in Security

Firstly, there is a risk of hacking and theft, as many cryptocurrency exchanges and wallets have been subject to cyber-attacks in the past. Grobys et al. (2022) highlight that in the 2011-2021 period, approximately 1.7 million units of Bitcoin were stolen in cyberattacks. It is crucial to understand the importance of this number because it is referred only to Bitcoin; the largest and for many people the safest cryptocurrency against cyber-attacks. state that cyberattacks on cryptocurrency exchanges occur every year, and cryptocurrencies worth millions of dollars are lost. Cryptocurrency prices are erratic, and cyberattacks on exchanges make them much more volatile. When these cyberattacks strike, users may lose trust in that

certain tokens and cryptocurrencies, according to Marella, Kokabha, Merikivi, and Tuunainen (2021).

Karame, Androulaki, and Capkun (2012) claim that the expenses associated with computing transactions and increasing security take additional 10 minutes to the procedure overall. Cryptocurrencies should not be utilized for quicker transactions where timing is crucial, because quicker payments will be succeeded by lowering the security, which would boost efficiency. But then, there will be a serious problem with the risk of double spending that might make cryptocurrencies extremely insecure.

Navamani (2021) believes that there are several methods that hackers might attack a cryptocurrency. Many assaults may be employed to take advantage of the system's weaknesses. It is noticeable that the number of attacks against cryptocurrencies is highly concerning, especially with the rapid increase in cryptocurrencies' popularity. The author advocates that it can only be avoided by properly developing the blockchain's architecture and implementing the algorithms required by cryptocurrencies.

Many people advocate the usage of stable cryptocurrencies and this is revealed because of two stablecoins; Tether and USDC, which are also among the most famous cryptocurrencies. But, this usage is not without danger, since there is always a chance the stablecoins to lose their value as a result of market activity. The linked risks include fraud by the cryptocurrency's creator or cyber assaults or even the risks related to treasury operations. If the financial system collapses, even assets held by commercial banks, such as securities or cash, might be at risk. The truth is that stablecoins use has grown significantly in recent years despite the dangers involved and they could stand as an essential tool for the Cryptocurrency economy and the wider financial system. (Cearnău, 2023).

4.3.2 Lack of Regulation

One of the main advantages of cryptocurrencies, which skyrocketed their prices, market power, and reputation is their lack of regulation. In other words, the decentralized system that Bitcoin first adopted could also be considered a negative aspect of cryptocurrencies. According to Chohan (2022), the cryptographic technology-based blockchain ecosystem involves the user, and hence the investor in the issuing process of this procedure. So another risk is this lack of regulation in the cryptocurrency market, which can make it difficult for investors to protect their assets and can also lead to fraud and scams. Could decentralization be the cause of cryptocurrencies demise? It is known that the lack of regulation can affect the cryptocurrency market in a variety of ways. On the one hand, it allows for more freedom and innovation in the development and use of these digital assets. On the other hand, it can also lead to increased risk and fraud, as fewer protections exist for individuals and businesses using cryptocurrencies. Additionally, it can make it more difficult for governments and financial institutions to monitor and track transactions which can have implications for financial stability and law enforcement.

Cobanoglu and Della Corte (2021) assert that each nation has a unique approach to cryptocurrencies, and understanding this can assist in better comprehending the legal difficulties that cryptocurrencies bring up and the solutions that nations are either considering or imagining to handle them. For instance, cryptocurrencies may be used to facilitate a wide range of crimes including those that are sensitive to international relations such as money laundering, financing of terrorism, tax evasion, and other criminal activities (Narayanan, Bonneau, Felten, Miller, & Goldfeder, 2016).

Furthermore, Chohan (2022) and his research on the governance of the digital economy and cryptocurrencies assert that the world of cryptocurrencies has significant concerns regarding regulation and accountability gaps. His suggestion is for governments to find a way to balance the issue of regulation, keeping, on the one hand, the decentralized character of cryptocurrencies but on the other hand preventing the illegal actions of hackers, companies, or even nations and at the same time, protecting the investors.

4.3.4 Environmental Risk

But have you ever thought that mining, transactions, and in general the association with cryptocurrencies have serious drawbacks except for the financial part? Despite having no physical representation, could Bitcoin and other cryptocurrencies negatively affect our planet? Bitcoin's growing popularity could have lasting negative effects on the environment. Borio, Claessens, and Tarashev (2023) stated that climate change is one of the top issues of our day. It is commonly known that human activity is to blame for climate change, that is occurring and a switch from emission-intensive (“brown”) to emission-light (“green”) is necessary. This reallocation is certain to be unpleasant and challenging to design, especially when is associated with cryptocurrencies.

To begin with, cryptocurrency mining requires significant computing power and electricity, and increasing Bitcoin purchases leave a significant carbon footprint. Some evidence shows that the electricity demand for Bitcoin is larger than in many countries such as Greece or Sweden. This is why Ethereum, the second most famous cryptocurrency, altered its mechanism on 15th September 2022 to reduce its energy consumption. The first mechanism that Ethereum was based on was Proof of Workone, which consumes the most energy and for this reason, Ethereum substituted with Proof of Stake. According to Ethereum Foundation, Ethereum’s energy consumption has been reduced by nearly 99.95%. But why do cryptocurrencies need so much energy? To begin with, most blockchain projects use one of these two consensus algorithms, Proof of Work (PoW), and Proof of Stake (PoS).

i) Proof of Work

Cryptocurrencies in this type of blockchain do not have centralized gatekeepers that would check the veracity of newly uploaded transactions and data to the blockchain. They rely on a dispersed network of participants to validate incoming transactions and put them as new blocks on the chain. As a consensus technique, Proof of Work is used to determine which network users, known as miners, are permitted to take on the lucrative duty of validating fresh data. It’s profitable because miners are paid with new cryptocurrency when they correctly validate fresh data and do not game the system. Beccuti and Jaag (2017) claim that the main problem that has previously hampered the creation of a useful digital money was the double-spend problem. Since cryptocurrency is only data, a method is required to stop users from using the same units multiple times before the system can record the transactions. This problem was resolved via Nakamoto’s consensus process. Proof of Work assists in preventing duplicate spending by encouraging miners to examine the legitimacy of fresh cryptocurrency transactions before adding them to the blockchain’s distributed ledger. For example, think about a standard bank account. How does someone ensure that they will be credited for the correct account that someone else deposited as a check in their savings account? How can the check’s author be sure that their account will only be charged for the sum specified on the check? Every party to a transaction relies on the bank to appropriately transfer funds, which is what gives banks their value. With cryptocurrencies, no banks or other financial organizations guarantee confidence. Instead, miners and the proof of work ensure transparent, correct transactions. Miners are the stewards and facilitators that ensure

the smooth and correct operation of the system for blockchains that employ proof of work. This system is used for validation in about 64% of all cryptocurrencies with market capitalization, mainly because Proof of Work contributes to securing the blockchain against possible assaults that can result in financial losses for people operating blockchain-based enterprises. Bitcoin, Dogecoin, Litecoin, Monero, and Bitcoin Cash are the most famous cryptocurrencies which use Proof of Work. But are there any drawbacks to this mechanism?

Proof of Work (PoW) energy consumption arises from the computational requirements of solving demanding cryptographic puzzles. In order to obtain the proper nonce (a cryptographic number) that fulfills the network's difficulty level, miners compete with one another and use sophisticated technology. These calculations consume a lot of energy due to the processing power needed. Several studies have examined the energy consumption of PoW-based cryptocurrencies, with Bitcoin being the most extensively analyzed. Proof of Work technology has emerged as a fundamental component of many blockchain systems, providing a robust mechanism for achieving consensus and validating transactions. The probabilities of success greatly depend on the computing power. Such excessive energy use has negative environmental effects. Fossil fuels, which are a primary source of non-renewable energy and are linked to greenhouse gas emissions and global warming, provide the majority of the world's energy. Due to their energy-intensive nature, PoW-based cryptocurrencies have come under fire for aggravating the climate efforts to move toward a sustainable energy future.

According to De Vries (2019) estimation, the yearly energy usage of the Bitcoin networks as of May 2018 was around 63 terawatt-hours (TWh), which is equivalent to the use of whole nations as has been mentioned previously. Additionally, it was calculated that the carbon impact connected with Bitcoin mining was between 22 and 22.9 megatonnes of CO₂ yearly, exceeding that of other countries. Similar estimates were made by Krause and Tolaymat (2018), who found that each Bitcoin transaction used about 200kWh, which is comparable to the typical daily energy use of an American home. Furthermore, decentralization is one of the benefits of cryptocurrencies that appeals to investors the most, but mining activities have become consolidated in a few key companies as a result of the high computational and energy needs of proof of work. This can result in a small number of companies dominating the majority of Bitcoin business activities.

ii) Proof of Stake

Indeed, for Gencer, Basu, Eyal, Van Renesse, and Sirer (2018) decentralization is very important for blockchain technology and cryptocurrencies. A blockchain's data and transaction history is managed and decentralized without a central gatekeeper. Instead, The network depends on many users to approve incoming transactions and add them as new blocks to the chain. The consensus technique known as proof of stake helps choose which individuals get to undertake this profitable duty. This activity is valuable since the selected participants will receive new cryptocurrencies if they successfully validate the new data and do not manipulate the system.

As an alternative to PoW, Proof of Stake (PoS) is a consensus process used in blockchain networks. PoS uses a different strategy to reach consensus than PoW, which calls for miners to carry out demanding computational activities to validate transactions. As a more energy-efficient replacement for PoW, King, and Nadal (2012) created PoS. In the PoS system, people who are involved, referred to as "validators" lock up predetermined quantities of Bitcoin or other crypto coins in a blockchain-based smart contract. In return, they are allowed to validate new transactions and get a reward; a cryptocurrency. However, they risk losing all

or part of their stake if they incorrectly validate false or fraudulent data. Some of the major cryptocurrencies that employ Proof of Stake are Solana, Terra, and Cardano. Proof of stake has recently replaced proof of work in Ethereum; the second largest cryptocurrency by market capitalization behind Bitcoin, in order to become eco-friendlier.

In the beginning, this system could be considered fairer than Proof of Work because if someone deposits 100€ in the network, he or she has 10 more chances to be selected than someone other who deposits 10€ for the first time. The simplest way to think about staking is like interest income that needs you to perform work to receive the interest and check blockchain transactions. Only by confirming good deals can someone earn interest on his or her asset. But, at the same time, bad transactions will result in penalties and the loss of part of their assets, so a validator should be extremely careful in order not to face the danger to be eliminated if they provide inaccurate data. If they do not act properly, then their stake is “burned”, or transferred to a wallet address that no one can access, leaving them completely worthless. The irrevocable affirmation of a block’s validity is referred to as finality and it can be attained through techniques like Byzantine Fault Tolerance (BFT), where a predetermined number of validators must concur that a block is valid before it is deemed final. Usually, a random or deterministic algorithm that takes into account the stake of validators underlies the selection process. The likelihood of getting chosen to propose and validate a block increases with stake level.

For many people, Proof of Stake is better than Proof of Work because it provides better environmental outcomes given the growing concern over the effects of blockchains using Proof of Work such as Bitcoin. This issue is resolved and infrastructure is widely distributed through Proof of Stake, potentially strengthening a blockchain system. Moreover, more individuals may take part in blockchain systems as validators thanks to Proof of Stake. If someone wishes to stake cryptocurrency, he or she does not need to purchase expensive computing equipment or use a lot of power. Furthermore, Proof of Stake has not undergone the same level of scrutiny as PoW, which has been protecting billion-dollar blockchains for many years. Blockchains may be more susceptible to alternative types of attacks than PoW, such as low-cost payment assaults, due to some PoS implementations. Attack vulnerability reduces the blockchain’s overall security. Large-scale holders of a blockchain’s token or cryptocurrency may have disproportionate power over a PoS system. A difficult and well-thought-out method must be followed to convert a cryptocurrency from PoW to PoS. To preserve the blockchain’s integrity from the very beginning to the very end and beyond, any cryptocurrency that wishes to modify the consensus processes will need to go through a difficult planning process. Last but not least, by enabling anybody with a stake to become a validator, PoS promotes more involvement. This strategy encourages a more decentralized network by reducing the concentration of power in the hands of a small number of miners.

On the contrary, PoS has also to face some serious problems. First of all, the initial distribution of cryptocurrencies presents difficulties for PoS systems. Early adopters’ unequal wealth distribution may cause a power imbalance in the network, with a select few validators exerting a sizable amount of control. What I mean is that the participant's influence or "stake" in the network is inversely correlated with the number of coins they own and are willing to "stake." This can result in a concentration of wealth within a select group of early adopters or significant players. As a result, people who have sizable shares are more likely to be selected as validators and get incentives, thereby growing their stake.

The second threat and for Deirmentzoglou, Papakyriakopoulos, and Patsakis (2019) the largest one to PoS protocols may come from long-range assaults because they pose a risk to one of the core characteristics that people believe blockchains have: immutability. A

successful Long-Range attack would allow an opponent to rewrite the history of all transactions contained in a blockchain, not just tweak a few blocks here and there. The attacker just wants to obtain the 51% of all the validators in the PoS system, to achieve it. According to them, it is possible that the design of a particular protocol, rather than its implementation, is to blame for these assaults, making it challenging to fix. In addition, the consequences of these attacks may not be seen until it is too late.

But, what factors influence the price of cryptocurrencies? In general, setting the price of any currency or commodity is a strange and difficult variable. Some of the characteristics that influence price discovery include extraction complexity, market availability, and investor interest at the time. It is known as the law of demand and supply. The supply of Bitcoin; the king of cryptocurrencies, is considered perfectly inelastic. The elasticity of financial assets is a significant component in asset pricing theory (Atanasov & Merrick, 2011), as it aids in predicting changes in asset demand in response to changes in key factors. Many people advocate the usage of stable cryptocurrencies and this is revealed because two stablecoins; Tether and USDC are among the most famous cryptocurrencies. But, this usage is not without danger, since there is always a chance the stablecoins to lose their value as a result of market activity. The linked risks include fraud by the cryptocurrency's creator or cyber assaults or even the risks related to treasury operations. If the financial system collapses, even assets held by commercial banks, such as securities or cash, might be at risk. The truth is that stablecoins use has grown significantly in recent years despite the dangers involved and they could stand as an essential tool for the Cryptocurrency economy and the wider financial system. (Cearnău, 2023). Anyway, one of the most important risks is the high volatility of the prices of these assets which can lead to extremely significant losses in a short period according to McAleer and Medeiros (2008).

Unit 5: The term of volatility

5.1 What is volatility

Volatility is a term used to describe the amount of fluctuation in the price of an asset or security over a certain period. It is a statistical measure of the dispersion of returns for a specific security or market index. This means, that it provides a measure of an asset's sensitivity to changes in the broader market. It is essential to understand that volatility is a major concept in investments and finance because it immediately impacts an investment's risk and potential returns; gains or losses (Poon & Granger, 2003). In general, higher volatility is associated with higher risk, because it raises the chance of huge price movements in an asset.

Two main types of volatility are used in finance, in order to understand and forecast the progress of an asset. Firstly, historical volatility refers to the actual fluctuations in the price of an asset over a predetermined period. What I mean is, the ups and downs of the price of a product, service, or asset in a certain period, could give some very important results, which buyers or investors should take seriously into consideration, before their actions. This study of volatility through days, months, or years is known as time-series analysis. Time series data refers to an ordered sequence or a set of data points that a variable takes equal time intervals, according to Idrees et al. (2019). Especially, some studies have shown that increased volatility is connected with short-term returns and the reason why is that investors are becoming more and more risk-averse during periods of high volatility.

The other type of volatility is implied, which is known as the "market's" volatility forecast, which for many people it is considered better than historical volatility. Moreover, researchers frequently utilize implied volatility as an ex-ante measure of perceived asset price

risk¹ in other models (Canina & Figlewski, 1993). It focuses on the market price at which someone will trade, and because almost all the markets are so large, he or she will be a price taker. Although some technical or quantitative indicators can be used to forecast the direction of implied volatility, it could be completely different in the end.

5.2 When an investment could be considered volatile

Most of the time, when the volatility of a stock or other asset is big, then the risk for the investment is also increased. But what factors have an impact on investments' volatility? Economic and political changes in market mood, variations in supply and demand, and many other variables can all contribute to volatility.

Volatility can be caused by various factors, including market conditions, global events, and company changes in market conditions. When there is a change in market conditions, such as an unexpected change in interest rates, it can significantly impact the value of an investment. Global events such as political instability, natural disasters, or pandemics can also contribute to market volatility. For instance, the COVID-19 pandemic led to a significant increase in volatility in the stock market, with the S&P 500 experiencing several record-breaking moves in both directions (Kristof & Johnson, 2021). Parker and Jarrow (2011) stated that the causes of volatility can include changes in market conditions, financial and political instability, changes in investor sentiment as well as the level of liquidity. For instance, the impact of volatility on financial markets can be significant, because, besides the opportunities that provide for investors to make gains, it can also cause uncertainty and decreased investment activity, according to Jalil and Feridun (2011). Meanwhile, Bordo and Schwartz (2019) believe that especially, extreme volatility can lead even to market crashes and financial crises, destroying economies, societies, and even countries in its path. Markets frequently experience spikes in volatility. This explains why an investor should anticipate 15% volatility in annual returns and up to 30% volatility once every five years.

There are several ways to evaluate volatility, but time-varying volatility models have been given significant attention in the literature (Rastogi, 2014). The properties of volatility are crucial in the creation of numerous models. The Garch model has consistently been shown to produce the most trustworthy results, becoming the standard technique for illustrating the unpredictability in financial time series data (Brooks, Olan, & Persaud, 2002). Analysts examine asymmetric volatility behavior in financial data, often known as the leverage effect. For example, in the equity market, the presence of negative news has a greater impact on conditional volatility than favorable news. Horpestad, Lyócsa, Molnár, and Olsen (2019) investigated the asymmetric behavior of nineteen global indices from around the world. Some of them were Nasdaq 100, S&P500, Germany Dax, etc. It will be interesting to see if cryptocurrencies exhibit a similar pattern of behavior.

5.3 Are cryptocurrencies volatile?

The study and analysis of volatility has generated an abundance of interest among researchers in the field of financial study up to the present. The development of technology enabled the growth of the financial market and, as a result, of trading activities, which raised the availability of information, the volume of daily transactions, and, most importantly, the ability to track real-time asset values.

¹ Stein (1989) employed implied volatility as a proxy for the instantaneous price volatility of the underlying asset in his study of the "term structure" behavior of implied volatility.

5.3.1 Historical Volatility

A crucial term in financial markets, historical volatility refers to the measurement and study of historical price changes of an asset. It gives important information about the asset's risk profile and trend over time, which is based mainly on past price data. That derives from that historical models are an accurate evaluation of real volatility and practical issues and secondly, when high-frequency data is available the volatility estimation is improved (Poon & Granger, 2005). Afterward, the volatility is calculated using statistical measurements, most frequently standard deviation or variance. The amount of volatility experienced by the asset over a certain period is often stated as a percentage or annualized number. Furthermore, using exogenous factors is a topic for Poon and Granger (2005) that can contribute even more positively to this subject. Not only there is a positive relationship between trading volume and volatility but also the latter is linked to macroeconomic news and systemic factors; interest rates, recessions, etc. Buyers and sellers can learn more about risks linked with an asset and especially with cryptocurrencies, by examining their historical volatility. Higher historical volatility implies larger price swings and uncertainty, which raises the risk factor. On the other hand, less historical volatility suggests more steady price changes and reduced perceived risk. Many financial applications take advantage of historical volatility. It is an essential component of risk management models, aiding portfolio managers and investors in determining the possible risk exposure of their assets. Investors may choose appropriate portfolio diversification, asset allocation, and risk management techniques by taking this type of volatility into account.

Additionally, traders use past volatility to evaluate future trading opportunities. When using short-term trading techniques, traders frequently look for assets with higher historical volatility since volatile assets provide greater profit potential through price changes. Furthermore, historical volatility could play a major role when measuring the effectiveness of investing strategies and the precision of volatility projections. It offers a comparison point between actual asset volatility and levels that have been calculated or predicted in the past. The improvement of forecasting models and risk management tactics can be guided by discrepancies between expected and realized volatility. (Weber, Siebenmorgen & Weber, 2005)

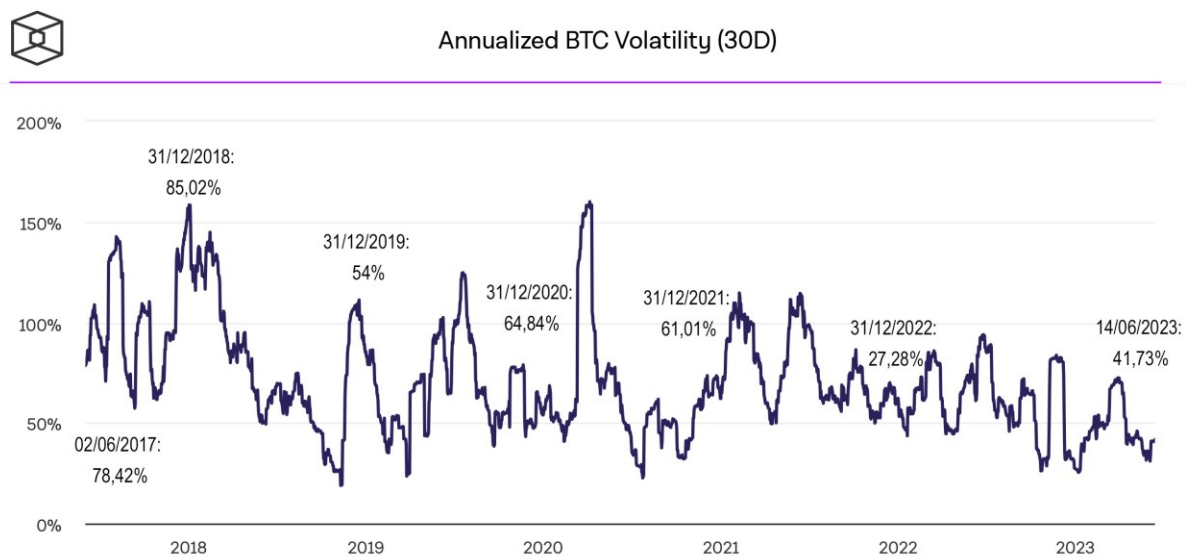
For all these reasons, historical volatility is a numerical representation of the cyclical nature and volatility of prior asset values, which gives useful information on the risk profile and the possible evolution of an asset. This information has an impact on risk management choices, trading tactics, and option pricing. But how can an investor examine historical volatility?

Historical volatility is typically measured using statistical methods that analyze the price data of an asset or security. These series exhibit dynamism, and the distribution also exhibits significant fluctuations over time, according to Cao and Tay (2003), without exhibiting an obvious and consistent pattern in its disposal. Volatility forecasting is crucial to financial series analysis because it significantly impacts risk management and derivatives pricing. Financial series conditional variance is often non-constant, according to one of the fundamental stylized facts in this field. In the analysis of financial time series, the data can be divided into groups based on how frequently they occur throughout time; in seconds or minutes, daily, and monthly. According to Reboredo, Matas, and Garcia-Rubio (2012), current events or the accessibility of market information have a significant impact on them, especially, daily frequency data are the standard periodicity for financial data analysis, such as volatility estimation and stock market forecasting, but in recent years, the literature has been moving toward higher time frequencies or even a volume-based paradigm, so that the daily data is used as a low-frequency baseline to which the higher frequency data are

compared. In that study, authors chose hourly periodicity as the high frequency and daily data as the low frequency. Because recent information is so crucial to asset prices, Andersen and Bollerslev (1998) argue that financial series exhibit unusually volatile behavior because they take into account the expectations and responses of economic agents to changing circumstances. The composition of derivatives pricing, portfolio risk analysis, and investment risk analysis itself all heavily rely on forecasting and estimating market asset volatility. Investors are therefore very interested in the development of decision-supporting methodologies.

Many academics and financial market participants have taken a particular interest in high-frequency data analysis due to its ability that gives to analysts to pinpoint noteworthy moments of various events. For instance, in the financial market, important cautions and situations, such as technical issues and constraints in protocols for reporting erroneous data, can be easily and swiftly imposed via high-frequency data analysis. According to Easley, López de Prado, and O'Hara, (2012), there has been a dramatic increase in global financial transaction volumes, making high-frequency trading a useful paradigm for modern finance. Many studies on volatility estimation have shown that exchange rates and cryptocurrency intra-day volatility are likely to be extremely high, as demonstrated by Elik and Ergin (2014), encouraging its investigation utilizing high-frequency data. In other words, volatility is the variation in a price of an asset over a certain period. The asset has minimal volatility if the price remains largely constant, alternatively, the asset could face sudden increases and spectacular decreases if its volatility is high.

Figure 4

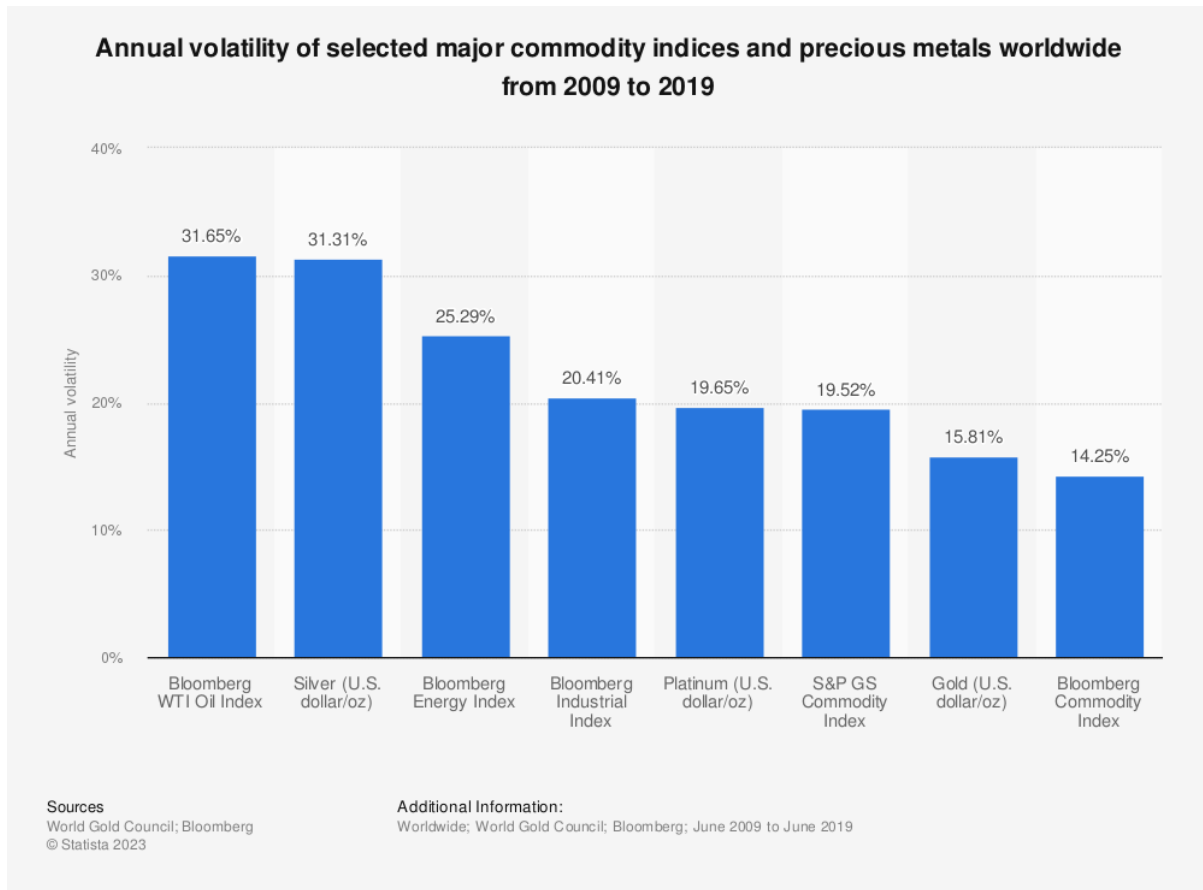


Note: Volatility is defined as the standard deviation of the last 30 days' daily percentage change in BTC price. Numbers are annualized by multiplying by the square root of the investment days, so 365, as BTC trades all year round. From *TheBlock: Annualized BTC Volatility (30D)*.

The volatility of Bitcoin seems to be high continuously with its percentages of annualized volatility surpassing 20%. These numbers derive from the rapid and significant fluctuations in Bitcoin's price. The given period in Figure 4 is the last 30 days of the daily percentage change. The figure shows that at the end of 2017 and the beginning of 2018, the annualized volatility overcame 150%, which means that there were too many buys and sells in that period, which skyrocketed Bitcoin's volatility. Some researchers and investors believe that

this happened, because of investors' enthusiasm, the media spotlight, and Asian exchanges (Hileman & Rauchs, 2017). Something similar happened at the beginning of 2020 when Covid-19 came and changed people's lives globally. The months of isolation helped Bitcoin and generally speaking, cryptocurrencies to flourish. The reason why this happened in that period is that funds moved out of the stock market rapidly and reinvested in cryptocurrencies and gold.

Figure 4



Note: Between June 2009 and June 2019, gold had an annualized daily volatility of 15,81%, which made it considerably less volatile than silver and many other indexes. From *Statista: Annual volatility of selected major commodity indices and precious metals worldwide from 2009 to 2019*.

Figure 4 shows the annual volatility of some important commodity indices and precious metals. The indices with the lowest volatility from 2009 until 2019 are Bloomberg Commodity Index and Gold. The first one tracks the future prices of physical commodity markets and includes 23 exchange trade futures, which are mainly focused on market liquidity (Shahzad, Jena, Tiwari, Doğan, & Magazzino, 2022). The second one is the volatility of gold, which has also a good level of volatility and shows that many times acts as as a safe haven for investors. The same claim Shahzad, Bouri, Roubaud, Kristoufek, and Lucey (2019) about gold's distinction from Bitcoin until the appearance of Covid-19. Then, according to Akhtaruzzaman, Boubaker, Lucey, and Sensoy (2021), gold also acts as a safe haven, but only during the first months of Covid-19 isolation and more specifically until 16 March. Later, when governments intervened with monetary and fiscal stimulus packages gold lost its safe-haven property for equity indexes. At that time, gold had characteristics similar to hedges to design portfolios during crisis and noncrisis periods.

The actions that most governments have taken to combat the spread of Covid-19 have caused worries that global economic growth would plummet and many investors strived for safe-haven assets such as gold. Yousef and Shehadeh (2020) highlight that an increase in the number of global coronavirus cases correlates with an increase in gold prices, which can be attributed to the virus's uncertainty about future economic conditions and the fact that gold is considered a safe investment in uncertain times. Furthermore, Yousef and Shehadeh (2020) discover that the disease of Covid-19 has a substantial influence on the conditional variation equation, which means the virus is enhancing the volatility of gold returns. Gold investment is a key diversification asset in portfolios and comparable increases in gold prices and return volatility which also have been seen in prior crises. This derives from that gold is uncorrelated or even negatively associated with other forms of assets.

Investors commonly evaluate historical volatility and believe that the past is a prologue since predicting the future risk of an asset or in general of a portfolio can be challenging. The term 'Historical Volatility' refers to standard deviation, as the asset's annualized standard deviation. But, it is crucial when deciding on the sample size for this calculation, because, on the one hand, the investors want to have more data to feel more sure about their potential investments. For instance, many companies are making their strategies based on these historical data, because they identify trends and seasonality, understand spending patterns, and most of the time improve the accuracy and the reliability of their decisions. On the other hand, in order to acquire these data through the years, there is a danger, the data to be irrelevant in the future. In other words, historical volatility is not the perfect gauge, but it can be very useful in order to understand the risk profile of an investment or an asset, even if it is not a precise metric (Harper, 2021). For this reason, with the comparison of gold's and bitcoin's volatility in recent years, someone can conclude via historical volatility that Bitcoin is extremely volatile. The high volatility should not be believed, that is definitely a downside because it could create chances for the investors to gain a lot, but the risk of loss is bigger.

5.3.2 Implied Volatility

In recent years, there is a plethora of methods for examining and forecasting volatility in the stock market or commodities. From linear regression to neural networks, each approach has both advantages and disadvantages. Even the machine learning methodology has consistently outperformed traditional econometric models in numerous research topics within the finance literature, as noted in Hsu, Lessmann, Sung, Ma, and Johnson (2016), making such a class of methods extremely well-liked in recent studies. The phrase implied volatility is used in financial markets, notably in trading. Based on the current pricing of options contracts, shows the market's anticipation of an underlying asset's future volatility. The degree of fluctuation or change in the price of an asset over a certain period is referred to as volatility. It is important in the context of options since it impacts the possibility of the option reaching its strike. The implied volatility that would cause the theoretical option price to match the observed market price can be calculated using an options pricing model, such as Black-Scholes. This implied volatility represents the market's expectations and attitude toward the underlying assets' potential price variations. High implied volatility indicates that traders anticipate big price movements in the future, whilst low implied volatility shows that traders estimate relatively stable prices. Because it gives insights into the market's view of prospective price fluctuations, implied volatility is frequently utilized as an input for options pricing models and risk management methods. Furthermore, according to Poon and Granger (2005), option-implied volatility outperforms the time-series model, in which historical volatility is included. The reason why is this happening is because the market option price completely accounts for the information, that is currently available and anticipated volatility in the future. This means that option-implied techniques deliver the best forecast without

contradicting market efficiency because accurate volatility predictions do not conflict with accurate underlying asset and option prices.

The Volatility Index (VIX) is primarily used to measure implied volatility and represents the market's expectation of future price fluctuations, while historical volatility measures the actual price movements observed in the past. It is obtained from Chicago Board Options Exchange Market Volatility and is based on a highly liquid options market for a specific period (Koopman, Jungbacker, & Hol, 2005). The VIX is more concerned with implied volatility. The market's anticipation of future volatility, as calculated from the pricing of options on the underlying asset, is referred to as implied volatility. The VIX is computed using a formula that considers the values of a variety of near-term and next-term options on the S&P500 index, which reflects the US stock market. The VIX attempts to forecast future volatility by evaluating option prices over the following 30 days. The VIX measures market participants' implied volatility levels, which are derived from the pricing of the S&P500. Higher VIX levels are typically seen as a gauge of market mood and anxiety. For this reason, this index is also known as the fear index, since it reflects market worry and tension. Many studies have used the VIX as a sentiment indicator (Rathilal, 2021).

On the one hand, the research on the volatility of crypto-assets is dominated by portfolio risk questions, such as determining the potential of this new asset class for portfolio diversification or hedging. Those studies, which analyze historical price data frequently find that cryptocurrencies, despite a significant speculative component (Fry & Cheah, 2016), have the potential for portfolio diversification and hedging according to Akhtaruzzaman, Sensoy, and Corbet (2020). On the other hand, Klein et al. (2018) counter this favorable viewpoint, claiming that Bitcoin is "not a safe haven and offers no hedging capabilities for developed markets." Similarly, Bouri, Das, Gupta, and Roubaud, (2018) discover spillover effects between Bitcoin and other assets. Previous research on Bitcoin volatility has been focused on historical volatility, with little literature on implied cryptocurrency volatility. One important element in this is that liquid cryptocurrency volatility markets are a relatively new trend. Bitcoin exchange prices are unaffected by traditional asset values, but their volatility is, with a negative and lagged impact (Giudici & Polinesi, 2021). The CBOE VIX index technique is used by Alexander and Imeraj (2020) to construct a Bitcoin volatility index. It must serve as the benchmark and starting point for the production of all volatility indices. Goes beyond the market standard by recognizing that the market liquidity of Bitcoin options is substantially inferior to the market liquidity of S&P 500 options, which is the foundation for the original VIX index, as Woebbeking (2021) claimed. Furthermore, the research on Bitcoin volatility is limited and market players have little access to useful benchmarks that exploit the information available through option markets. Today's price for insuring future volatility is an essential dimension and useful source of information.

That volatility is an essential statistic and the most often used risk indicator in finance. Access to steady and trustworthy volatility information is critical for both investors and risk managers. However, especially implied volatility must be based on a wide range of liquid and trustworthy option prices, requiring a far bigger data set than realized volatility. When compared to volatility benchmarks for established assets, the strategy, that Woebbeking (2021) has followed, overcomes liquidity difficulties for this emerging asset class by widening the pool of relevant options. He discovered that the liquidity on cryptocurrency option exchanges is sufficiently established to achieve steady outcomes using this strategy. When the study compares the volatility dynamics represented by CVX to standard volatility benchmarks, someone sees that the cryptocurrencies live a fairly isolated life and so have diversification potential, which is consistent with the literature. Despite the latency, the Covid-19 issue is an excellent example of a worldwide shock that impacts both

cryptocurrencies and traditional markets. The same has also been claimed by Conlon et al. (2020), who assert that cryptocurrencies cannot be considered a safe haven for equity markets. So, this is another proof of the limits of diversification at a time when it is most needed. Especially, Akyildirim, Corbet, Lucey, Sensoy, and Yarovaya, (2020) assert the relationship between the implied volatility of US and European financial markets and twenty-two cryptocurrencies. Their study reveals a favorable time-varying interdependence between cryptocurrency and financial market stress. Furthermore, correlation rose during periods of significant financial market stress, indicating fear contagion across these markets. According also to Akyildirim et al. (2020), cryptocurrencies exhibit signs of higher volatility during periods when investors' 'fear' is high. Not only does cryptocurrencies' volatility show significant correlations with volatility products like the VIX and VSTOXX² during such elevated implied volatility events, but also they demonstrate strong increases in GARCH-calculated volatility during the highest deciles of stock market implied volatility, incorporating the highest levels of forward-looking fear in both United States and Europe. While there is conflicting evidence regarding the interactions between cryptocurrencies and several international financial market products. As a result, the study, suggests that high additional diversification between cryptocurrencies and other financial market products may not exist during moments of stock market instability, which result in increased levels of implied stock market volatility as assessed by VIX and VSTOXX.

Generally speaking, the implied volatility of Bitcoin options includes valuable information that could be critical for portfolio and risk management. Some closed-form approximations, forecasting abilities, and information quality of implied volatility are subjects of interest among investors and academics. Furthermore, developing an accurate and trustworthy implied volatility prediction is crucial to derivatives market research, which will also be true for Bitcoin and other derivatives markets. However, the most famous is the GARCH model, which was derived from the ARCH model, and it is the main model employed by the academy for volatility estimation (Bollerslev, 1986). The fundamental benefit of the GARCH model is that it can generalize an ARCH, which makes it a sparse and effective model to deal with many common characteristics of financial time series volatility, as noted by Marcucci (2005).

To sum up, the importance of implied volatility indices in the economy is evidenced by their numerous economic uses. In particular, Siriopoulos, and Fassas (2019) claim that implied volatility may be used as a pricing tool for a variety of derivative and structured goods, as it is a crucial component in their pricing. Moreover, because of the demonstrated negative association between volatility indices and total market returns, market players have traditionally utilized volatility indices as a market timing signal. Finally, in the last decade, volatility has developed as a significant asset class. Investors can use volatility as a hedging or diversifying investment because volatility often rises during a bear market or they can try to bet on volatility and take advantage of its mean reversion feature.

Many people also claim that cryptocurrencies are the New Gold because they have similar characteristics with it. For example, in 2015 Anne Haubo Dyhrberg analyzed the financial potentials of Bitcoin using the GARCH model. She found many similarities between Bitcoin and gold or the dollar. Throughout the previous few years, certain media, banks, and data providers have characterized cryptocurrencies, particularly Bitcoin, as the

² The equivalent of VIX in Europe. According to Annaert, De Ceuster, Van Roy, and Vespro (2013), is also known as the Euro Stoxx 50 Volatility Index and is a measure of market volatility in the Eurozone, because it shows the implied volatility of options on the Euro Stoxx 50 index. It monitors the performance of the Eurozone's 50 largest companies. It indicates the market's forecast for potential volatility in the following 30 days.

‘New Gold’. This opinion is derived from the fast and high returns in a gold rush-like scenario and for this reason, Klein, Thu, and Walther (2018) analyzed Gold and Bitcoin from an econometric perspective. They focused on the economic elements of cryptocurrencies as an investment asset and mainly with the association with currently existing asset classes. Bitcoin and other cryptocurrencies can be considered virtual currencies which operate as means of exchange, units of accounts, or stores of value, but they do not have legal tender status in any jurisdiction. Furthermore, they are not the same as fiat currencies, which are coins and paper that are designated as legal tender, circulated, and commonly used and accepted as a medium of exchange. Their paper is divided into three sections. The first is about the volatility of cryptocurrencies compared to stock indices and commodities. According to Blau (2017), Bitcoin’s extreme volatility before 2014 was not due to speculative trading. This contrasts with the findings of Cheah and Fry (2015) who found Bitcoin to create speculative bubbles in the same time frame. The cryptocurrencies are classified inside traditional asset classes in their study, by evaluating volatility. Klein et al. (2018) discovered that Bitcoin volatility differs from other asset types, focusing mainly on stylized facts, long memory,³ and asymmetry.

But now, the rise of digital assets such as cryptocurrencies has brought volatility to the forefront of financial discussions. Bitcoin has gotten a lot of attention since its inception, and until now, cryptocurrencies in general are known for their high levels of volatility, triggering many discussions on their stability and reliability. As a result, understanding Bitcoin’s volatility and the factors which affect its price and share is critical for investing and portfolio diversification. Several recent studies have investigated a variety of specific economic and financial measures that influence Bitcoin volatility, as well as the relationship between Bitcoin and other risky financial assets and safe-haven assets. It is known that digital currencies provide an unregulated system of international trading with extremely high volatility according to McCoy and Rahimi (2020). In other words, volatility is an essential aspect of finance that plays a significant role in investment decision-making and market regulation. For this reason, investors and financial analysts should manage and monitor volatility as much as possible, especially when their investments are connected with cryptocurrencies. But, the question being asked is whether can investors predict the ups and downs of Bitcoin by digging into the most important factors which affect it.

Bakas, Magkonis, and Oh (2022) claimed that multidimensionality is a very important aspect of Bitcoin volatility that should be examined. In the past, studies have generally concentrated on single components of determinants, such as financial markets or economic circumstances. For the cryptocurrency market are not only important the supply or demand of Bitcoin and other cryptocurrencies but also other financial and macroeconomic forces, which will be analyzed further down. For example, Conrad, Custovic, and Ghysels (2018) have found that S&P500 realized volatility has a negative and highly significant effect on long-term Bitcoin volatility. But, the S&P500 volatility risk premium and Baltic dry index⁴ have both positive correlations between long-term Bitcoin volatility. Vieira (2017) delves deep into an investigation of the Bitcoin price formation, including volatility and other major causes. His results, which come through the generalized autoregressive conditional heteroscedastic model (E-GARCH), refer to the importance of the S&P500 as an index in the

³ Baillie (1996) stated that long memory is a feature of a financial time series that represents long lasting, i.e. slowly declining autocorrelation effects in conditional returns or volatility.

⁴ Baltic Dry Index (BDI) has been started as one of the foremost indicators of the cost of shipping and of the volume of worldwide trade and manufacturing activity. Nowadays, its usage can be furtherly crucial, because it may forecast a possible crisis in GDP growth for the United States and consequently for all over the world. (Bildirici et al., 2015)

relationship between the behavior of the different variable and their influence on Bitcoin. He also claims that not only volatility can affect price formation positively but also that negative shocks have a greater impact on volatility than positive shocks.

The method that Bakas et al. (2022) used is the dynamic Bayesian model averaging (DBA), which enables investors to enter a large number of possible factors of Bitcoin volatility into the regressions and investigate their impact and relevance over time. This model is an extension of traditional Bayesian inference methods that models not only parameter uncertainty through the prior distribution but also model uncertainty obtaining posterior parameter and model posteriors, allowing for direct model selection, combined estimation, and prediction. Fragoso, Bertoli, & Louzada (2018) claim that multiple models are frequently used in practice to offer acceptable descriptions of the distributions generating the observed data. In such cases, it is a usual statistical practice to select a better model based on some specific criteria, such as model fit to the observed dataset, predictive skills, etc. The selected model probably ignores the existing uncertainty in favor of extremely concrete distributions and assumptions on the model, which may lead to overconfident inferences and riskier decision-making.

Unit 6: Conclusion

In conclusion, through this specific dissertation, an effort was made to help individuals who are not familiar with the world of cryptocurrencies, grasp as much basic information as possible about them. Through the historical retrospective and the evolution of money, someone can comprehend the social and financial context of the past and present. Thus, it becomes apparent how much society buys and sells has changed, from raw materials in pre-Cristian times to the cryptocurrencies of today.

Furthermore, an attempt was made to analyze, in the simplest way possible, the top 5 most significant and largest cryptocurrencies based on their market share. Starting with the historical and most important, Bitcoin, which served as the foundation for all the cryptocurrencies and continues to lead the pack in its category. Following closely are the stablecoins, Tether and USD Coin, which offer greater stability as they are directly linked to the US dollar. Last but not least, the essential aspects of Ethereum and BNB from Binance were also discussed.

Then, a brief analysis was conducted regarding whether cryptocurrencies are considered a good investment. Initially, based on Moore's technology adoption life cycle, where several researchers believe that cryptocurrencies have already reached their peak, while others argue that they are still in the early stages. Subsequently, the main theme of this dissertation regarding the level of risk and volatility associated with investing in cryptocurrencies was analyzed. After explaining the terms "risk" and "volatility" in a general context, a more specific analysis was conducted, concerning cryptocurrencies. This was accomplished through the collection and analysis of findings from other research studies, where the authors utilized various methods to calculate the potential risks involved in investing in cryptocurrencies, as well as the level of volatility associated with their prices.

Nowadays, everything is changing rapidly; products, terms, analytics, and in general the market is continuously developing. It is reasonable, for investors to notice the progress of cryptocurrencies patiently and not be heavily involved in investing and trading them. Furthermore, as Liu, Tsyvinski, and Wu (2022) claim the cryptocurrency industry is in a very undeveloped stage, and maybe is still undergoing several changes. There are lots of rumors and even frauds about the future of Bitcoin and other cryptocurrencies and the market's price dynamics may alter as the whole cryptocurrency market develops. But, studying

cryptocurrencies even in early-stage can be helpful to comprehend the dynamics of new asset classes which derive from cryptocurrencies.

To sum up, Bitcoin and other cryptocurrencies can occasionally work as an effective hedge and safe haven, but it is more often useful as a diversifier according to Bouri, Molnár, Azzi, Roubaud, and Hagfors (2017), whose results derived from a period, which is stable. But, according to Conlon et al. (2020), who examine some of the most famous cryptocurrencies during the Covid-19 period, which is an unstable period, have found that Bitcoin, Ethereum, and Tether cannot be considered as an important safe haven. Traditional investors are still hesitant about an investment in Bitcoin. The liquidity of Bitcoin is a serious drawback for Bouri et al. (2017) Domowitz, Glen, and Madhavan (2001) ensure that in illiquid markets the theoretical returns can be significantly reduced and the reason why is the higher volatility.

Since the world of cryptocurrencies is still so chaotic, researchers should continue to investigate this world, and try to explore it. First of all, further comparison between all the mechanisms that cryptocurrencies use, would be very helpful in order to understand the common points and the details that differentiate the way that each cryptocurrency functions. Delegated Proof of Stake (DPoS), Proof of Capacity (PoC), and Proof of Importance (PoI) are some of the consensus mechanisms, into which should we delve deeper. Afterward, one important aspect of cryptocurrencies is the cryptocurrencies that the countries and the unions try to create or their effort to control the use of cryptocurrencies in general. What impact do these decisions have on the demand and supply of cryptocurrencies and in general in their future? Last but not least, it should be explored more detailed the effectiveness of each of the methods of forecasting the returns and the volatilities of cryptocurrencies, because it is crucial to know and apply the most appropriate method every time and in every situation in order to obtain the best results and minimize the possible losses. We should not forget that new methods are coming to the surface or that the already existing ones are continuously informed with new data. For example, there are many articles about cryptocurrencies and the forecasting methods about it which have not faced difficulties such as the bear market of covid-19 isolation or the war in Ukraine. So it could be considered a major goal to update some of those studies with fresh data and assess if their results have changed from then, either empowering their findings or revising them.

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