

Czech University of Life Sciences Prague

Faculty of Economics and Management

Department of Economic Theories



Bachelor Thesis

**Cryptocurrencies: Comparative Advantage of
Bitcoin, Ethereum and Cardano**

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Thesis title

Cryptocurrencies: Comparative Advantage of Bitcoin, Ethereum and Cardano

Objectives of thesis

The main objective of the following thesis lies in assessing the investment potential of three selected cryptocurrencies – Bitcoin, Ethereum and Cardano. Consequently, the sub-objective is to evaluate the development of prices, market capitalizations and external factors related to the selected currencies. Another sub-objective of the bachelor thesis is to develop recommendation for investors considering either of those cryptocurrencies.

Methodology

The theoretical part is based on a research of scientific publications. The practical part of the thesis uses a quantitative approach for the analysis, that involves volatility analysis, trend analysis and correlation analysis. For the correlation analysis, apart from calculating Pearson's correlation coefficients, statistical verification is conducted using a series of t-tests for the estimated correlation coefficient. Secondary data from a selected database is used for the analysis and the selected time interval covers 3 years – from 2020 to 2023.

The proposed extent of the thesis

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Keywords

Bitcoin, Cardano, Ethereum, cryptocurrencies, volatility, speculation, bubble, investment, profitability

Recommended information sources

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- Zhao, H., & Zhang, L. (2021). Financial literacy or investment experience: which is more influential in cryptocurrency investment?. *International Journal of Bank Marketing*, 39(7), 1208-1226.

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Declaration

I declare that I have worked on my bachelor thesis titled " Cryptocurrencies: Comparative Advantage of Bitcoin, Ethereum and Cardano" by myself and I have used only the sources mentioned at the end of the thesis. As the author of the bachelor thesis, I declare that the thesis does not break any copyrights.

In Prague on 15.03.2023

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Cryptocurrencies: Comparative Advantage of Bitcoin, Ethereum and Cardano

Abstract

The goal of the bachelor thesis is to evaluate three selected cryptocurrencies and define the best crypto asset between them that will be suitable for making an investment. The author implemented a series of quantitative techniques that involved the analysis of time series, correlation analysis, prognostic techniques and basic descriptive statistics. After conducting the analysis, the author managed to come up with a series of recommendations and answers to the questions asked at the beginning of the bachelor thesis.

Ultimately, the author reaches the conclusion that the best investment option out of the three is Ethereum since the currency has lower volatility and a higher rate of returns than Bitcoin and Cardano. Cardano is considered to be the worst investment option out of the three. Additionally, the author suggests investors be careful when venturing into the crypto market due to its highly speculative and bubbly nature and difficulty to predict the future performance of assets even despite its potentially high profitability.

Keywords: Bitcoin, Cardano, Ethereum, cryptocurrencies, volatility, speculation, bubble, investment, profitability

Kryptoměny: komparativní výhoda Bitcoinů, Etherea a Cardana

Abstrakt

Cílem bakalářské práce je porovnat tři vybrané krypto měny a definovat mezi nimi nejlepší krypto aktivum, které bude vhodné pro investici do. Autor implementoval řadu kvantitativních technik, které zahrnovaly analýzu časových řad, korelační analýzu, prognostické techniky a základní popisnou statistiku. Po provedení analýzy se autorovi podařilo přijít s řadou doporučení a odpovědí na otázky položené na začátku bakalářské práce.

Nakonec autor dospěl k závěru, že nejlepší investiční možností ze tří je Ethereum, protože měna má nižší volatilitu a vyšší míru návratnosti než Bitcoin a Cardano. Cardano je považováno za nejhorší investiční možnost ze tří. Autor navíc navrhuje investorům, aby byli opatrní při vstupu na kryptotrž kvůli jeho vysoce spekulativní a temperamentní povaze a obtížnosti předvídat budoucí výkonnost aktiv i přes jeho potenciálně vysokou ziskovost.

Klíčová slova: Bitcoin, Cardano, Ethereum, kryptoměny, volatilita, spekulace, bublina, investice, ziskovost

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List of abbreviations

ADA	Cardano
BTC	Bitcoin
ETH	Ethereum
ARIMA	Autoregressive Integrated Moving Average
OLS	Ordinary Least Squares
USD	United States Dollar
ADF	Augmented Dickey-Fuller
ACF	Autocorrelation Correlation Function
PACF	Partial Autocorrelation Function
CV	Coefficient of Variation
FED	Federal Reserve of the United States of America
FTX	Futures Exchange
UN	United Nations
ICO	Initial Coin Offering
USDC	United States Dollar Coin
XRP	Ripple Coin
USDT	United States Dollar Tether
DeFi	Decentralized Finance
CBDC	Central Bank Digital Currency
DOT	Polkadot
LTC	Litecoin

1 Introduction

The proliferation of cryptocurrencies has brought about a decentralised and trustworthy medium of exchange, which has had a profound effect on the whole financial system. Bitcoin, Cardano, and Ethereum have emerged as important players among the several cryptocurrencies that are now accessible; each of these cryptocurrencies possesses its own set of distinctive characteristics and market dynamics. This bachelor thesis intends to give a detailed examination of these three cryptocurrencies by investigating their technological foundations, market trends, and comparative performance, among other topics. This study aims to shed light on the strengths and weaknesses of Bitcoin, Cardano, and Ethereum by conducting a rigorous examination of various factors such as blockchain architecture, transaction speed, scalability, security, and adoption. This will enable investors, researchers, and enthusiasts to make informed decisions in this rapidly evolving field.

The emergence of blockchain technology in 2008, along with Satoshi Nakamoto's launch of Bitcoin, has resulted in a paradigm change within the framework of the international monetary system. Bitcoin, the first decentralised cryptocurrency, is credited with having cleared the way for a surge of innovation that has resulted in the creation of a wide variety of digital assets. The years that followed were marked by the emergence of a number of alternative cryptocurrencies, each of which was aimed to solve limits that were seen in Bitcoin and to offer fresh answers to the difficulties that are now being faced by the sector. The market for cryptocurrencies is extremely dynamic and complicated, characterised by rapid technology breakthroughs, developing legal frameworks, and altering investor opinion. These factors combine to make the market. Bitcoin, Cardano, and Ethereum have emerged as key actors in this environment, seizing a large portion of the market share and earning global attention in the process. However, according to Fang et al. (2022), there is an urgent need for a comparative examination of these cryptocurrencies in order to give a greater understanding of the technology that underpins them, as well as the performance of their markets and the possible ramifications that this might have for investors and other stakeholders (Fang et al., 2022).

This concept has significant ramifications for a variety of market participants that are active in the Bitcoin industry. Investors who are interested in allocating their cash to digital

assets might benefit from having a well-informed awareness of the advantages and disadvantages that Bitcoin, Cardano, and Ethereum each possess. This study can serve as a foundation for researchers and academic institutions to build upon in order to do more research in the subject of blockchain technology and cryptocurrencies. In addition, policymakers and regulatory bodies have the opportunity to gather useful insights into the constantly shifting environment of cryptocurrencies, which may assist them in developing efficient regulations and frameworks. In conclusion, the purpose of this bachelor's thesis is to make a contribution to the expanding body of knowledge about cryptocurrencies, with a particular emphasis on Bitcoin, Cardano, and Ethereum. This study aims to give significant insights into the technological, market, and investment dynamics of different cryptocurrencies by undertaking an extensive comparative analysis. This will enable stakeholders to traverse the quickly shifting ecosystem with confidence and make educated decisions.

2 Objectives and Methodology

2.1 Objectives

The main objective of the following thesis lies in assessing the investment potential of three selected cryptocurrencies – Bitcoin, Ethereum and Cardano. Consequently, the sub-objective is to evaluate the development of prices, market capitalizations and external factors related to the selected currencies. Another sub-objective of the bachelor thesis is to develop recommendations for investors considering either of those cryptocurrencies.

2.2 Methodology

The theoretical part uses the document study technique and is used for the identification of the current state of knowledge. The practical part of the thesis uses a quantitative approach for the analysis, that involves volatility analysis, trend analysis and correlation analysis, as well as the analysis of time series data. For the correlation analysis, apart from calculating Pearson's correlation coefficients, statistical verification is conducted using a series of t-tests for the estimated correlation coefficient. Secondary data from Yahoo Finance is used for the analysis and the selected time series data covers 365 observations from the 6th of July 2022 until the 6th of July 2023.

When it comes to the analytical part of the thesis, which is solely based on the quantitative approach, it is essential to briefly go through all individual statistical and mathematical measures used in the analysis to present a comprehensive overview of the methodology of the work. The author initially uses descriptive analysis for drawing the main insights from the analyzed dataset. The descriptive analysis involves the computation of a couple of statistical measures, according to De'Fusco et al (2015), which are presented below and based on .

$$\bar{x} = \frac{\sum x_1, x_2 \dots x_n}{n} \quad (1)$$

$$\tilde{x} = \begin{cases} \frac{n+1}{2}, & \text{if } n \text{ is odd} \\ \frac{\binom{n}{2} + \binom{n}{2+1}}{2}, & \text{if } n \text{ is even} \end{cases} \quad (2)$$

$$R = Max - Min \quad (3)$$

For the volatility analysis, the author implements the utilization of two fundamental statistical measures of dispersion – standard deviation and coefficient of variation, which both show variability expressed in different units. Whereas the standard deviation uses natural units of the analyzed variable, the coefficient of variation shows the variation expressed in percentage terms.

$$S = \sqrt{\frac{\sum(x_i - \bar{x})^2}{n-1}} \quad (4)$$

$$CV = \frac{S}{\bar{x}} \quad (5)$$

In addition to the volatility analysis, the author implements the analysis of return, where the daily return is calculated with the help of chain indices. Chain indices are calculated as follows:

$$Chain\ Index\ (\%) = \left(\frac{x_{n+1}}{x_n} - 1 \right) * 100 \quad (6)$$

Based on the calculated daily returns, the author uses the geometric mean of returns, which is traditionally regarded as a useful tool for investors to evaluate potential investments. The geometric mean of return is traditionally calculated in the following way:

$$Geomean = \sqrt[n]{(r_1 + 1) * (r_n + 1)} - 1 \quad (7)$$

Finally, it is also vital to comment on the time series analysis used by the author. As it was mentioned earlier, the author relies on the dataset containing 365 observations. The dataset itself was obtained with the help of Yahoo Finance. For the purpose of processing data, the author uses two applications – Microsoft Excel for the demonstration of scatterplots and Eviews for the estimation of ARIMA models. Additionally, the author estimated linear trends, which are estimated in accordance with the OLS approach the formula for which is shown below.

$$OLS = (X^T X)^{-1} X^T Y \quad (8)$$

3 Literature Review

3.1 History of Cryptocurrencies

The way that one thinks about and interacts with digital money has been fundamentally altered as a result of the rise of cryptocurrencies. Since the launch of Bitcoin in 2009, cryptocurrencies have seen a meteoric rise in popularity thanks to their ability to provide users with an alternative financial system that is both decentralized and safe. In this piece, the author will discuss the evolution of cryptocurrencies as well as the effects that they have had on the economy of the entire world according to the modern scientific framework behind the subject (Brunton, 2020).

In the early 1980s, as per Judmayer et al. (2017), a computer scientist by the name of David Chaum suggested the notion of digital money that he termed "e-cash." This is where the concept of cryptocurrencies can be traced back. The goal of Chaum's vision was to make it possible to conduct safe and private transactions using cryptographic methods. Although it received a lot of attention at the time, his idea did not end up being implemented into a functioning system. Scholars suggest that the main reason behind the scepticism associated with the suggestion is explained by the reluctance of companies and people to perceive technological change as something groundbreaking and serious. Effectively, it took approximately 30 years to reconsider Chaum's idea and finally turn it into reality (Judmayer et al., 2017).

Chohan (2022) indicates the role of a white paper titled "Bitcoin: A Peer-to-Peer Electronic Cash System" was released in 2008 by an unknown person or group under the pseudonym "Satoshi Nakamoto" in the development of crypto market. This was during the height of the global financial crisis. This document is credited with laying the groundwork for Bitcoin, which went on to become the first decentralized cryptocurrency ever created. Through the implementation of a decentralized ledger system known as the blockchain, Nakamoto's innovation was able to resolve the decades-old issue of double-spending in digital currencies. Despite the controversy behind the character of the founding father, Bitcoin started to gain recognition around the globe in just a matter of a couple of years (Chohan, 2022).

Šurda (2014) indicates that Nakamoto successfully mined the first block of the Bitcoin network on January 3, 2009, which is now referred to as the "genesis block." This event heralded the beginning of a new era in banking as well as the launch of the cryptocurrency known as Bitcoin. Initially, there was not much attention paid to Bitcoin; those who were interested in it were mostly cryptography specialists and technology aficionados. Nevertheless, when its potential was brought into greater focus, the number of users increased, and the value of Bitcoin started to go up. Bitcoin passed a key threshold in May of 2010 when a programmer by the name of Laszlo Hanyecz made headlines by purchasing two pizzas for the equivalent of 10,000 Bitcoins. This transaction, which is sometimes referred to as the first instance of Bitcoin's use in the real world, established that it is possible to utilise Bitcoins as a means of exchange (Šurda, 2014).

Based on D'Andrea (2018), alternate cryptocurrencies are often referred to as "altcoins," and their emergence coincided with the rise of Bitcoin's popularity. These alternative cryptocurrencies aimed to overcome the shortcomings of Bitcoin or to provide new capabilities. Charlie Lee introduced Litecoin to the world in 2011, making it one of the early alternative cryptocurrencies. Its primary goals were to provide quicker transaction confirmations and a distinct mining algorithm. To cut it short, every other existing crypto currency apart from Bitcoin is considered to be an "altcoin" (D'Andrea, 2018).

Dannen (2017) traces the history of Ethereum. Ethereum, which was first proposed by Vitaliy Buterin in 2015, is yet another prominent cryptocurrency that has been developed. The revolutionary aspect of Ethereum was that it had the capacity to handle smart contracts, which are essentially agreements that can carry out their terms automatically. This functionality made previously inaccessible opportunities available for decentralised apps (DApps) and was a driving force behind the meteoric rise of initial coin offerings (ICOs) in 2017. The year 2017 was a watershed year for cryptocurrencies, marking a key milestone since it was the year that they acquired popular attention and saw a jump in value. The market value of all cryptocurrencies crossed \$800 billion, while the price of a single Bitcoin almost achieved a new all-time high of nearly \$20,000 per coin. The quick surge did, however, draw the attention of regulatory bodies, which ultimately resulted in a subsequent market correction (Dannen, 2017).

According to Deepika & Kaur (2017), the development of regulatory problems and concerns over the use of cryptocurrencies in illegal operations pushed governments all over the globe to adopt frameworks to control the usage of cryptocurrencies. While some nations have shown support for cryptocurrencies and blockchain technology, others have either placed limitations on their use or outright banned them. This regulatory environment is always shifting as governments strive to find a middle ground between fostering innovation and safeguarding consumers' interests. In addition to Bitcoin and Ethereum, a plethora of other cryptocurrencies have developed, each with its own unique applications. Ripple (XRP) is a cryptocurrency that wants to make international transactions cheaper and faster, whereas Cardano (ADA) is more concerned with creating a platform that is both safe and scalable for the development of decentralised apps. In addition, stablecoins like Tether (USDT) and USD Coin (USDC) provide price stability by anchoring their value to traditional fiat currencies such as the United States Dollar (Deepika & Kaur, 2017).

The emergence of cryptocurrencies has also piqued the curiosity of conventional financial institutions and institutional investors, as per Madey (2017). Traditional financial institutions have begun selling goods and services connected to cryptocurrencies, while major corporations like Tesla and Square have made investments in Bitcoin. Individuals now have an easier time buying, selling, and storing bitcoins thanks to the proliferation of centralised exchanges and custodial services. Beyond the realm of monetary exchanges, the notion of cryptocurrencies has found new applications. Applications for blockchain technology, the underlying technology that powers cryptocurrencies, have been identified in a variety of different fields. Blockchain technology has the potential to revolutionise how data is kept, validated, and secured across a variety of industries, including supply chain management, healthcare, and voting systems (Madey, 2017).

When one looks into the future, one can see that the future of cryptocurrencies is both unpredictable and hopeful. In order to circumvent scalability and transaction time constraints, recent technological developments like the Lightning Network for Bitcoin and Ethereum 2.0 are being developed. The continued growth of the cryptocurrency ecosystem is highlighted by the incorporation of cryptocurrencies into regular life, improvements in

decentralised finance (DeFi), and the investigation of central bank digital currencies (CBDCs) (Makarov & Schoar, 2022).

3.2 Application of Cryptocurrencies

As it was briefly specified earlier, cryptocurrencies were originally destined to substitute money, so the fact that there was really no initiative to develop the concept even further during the early years of the 21st century is mainly explained by the hope that bank cards and the potential development of systems such as Apple and Google pay, as well as PayPal can provide a real alternative to fiat money. However, Xie (2019) indicates that as people and cryptographers around the globe saw that those internet banks and payment systems took a centralized approach instead, the main objective of introducing cryptocurrencies became in fact slightly different. Instead of just introducing digital currencies, inventors of Bitcoin and other crypto assets were actually aiming at providing a decentralized network for people, where they will not be anyhow dependent on natural fluctuations of economic systems (Perkins, 2020). Evidently, central banks and international institutions are not really satisfied with the way how the situation is evolving. Many scholars suggest that the attitude of the world's most powerful economic subjects such as the United States of America, the European Union and others is likely to negatively influence the potential that those currencies might have (Xie, 2019).

On the other hand, based on Hashemi et al. (2020) there is also another application of cryptocurrencies that can be found today. One of the most interesting uses of cryptocurrency is in smart contracts. A smart contract is a computer-encoded contract that fulfils its own conditions. When the requirements specified in the contract are satisfied, the contract immediately executes and becomes enforceable. Smart contracts may be executed on a decentralised and trusted platform, which cryptocurrencies allow. Most cryptocurrencies are based on blockchain technology, which is a distributed ledger that can't be altered once it's created. Smart contracts may be used in a wide range of contexts. P2P lending, decentralised exchanges, and fully automated investment management are just some of the financial applications that might benefit from them. Smart contracts can make financial transactions more efficient and transparent while also reducing the need for middlemen. Smart contracts may automate payments upon delivery of items and follow their progress through the supply chain. This facilitates fraud prevention, product traceability, and supply chain efficiency.

Smart contracts are also streamlining the rental agreement process, handling escrow funds, and transferring ownership of real estate. Smart contracts can streamline deals by eliminating the need for middlemen like real estate brokers and attorneys. Smart contracts also have uses in the healthcare industry, where they may be used to handle patient information safely, speed up the filing of insurance claims, and keep medical records private while being transferred between different medical facilities. This improves the confidentiality of patient information as well as the effectiveness of healthcare networks (Hashemi et al., 2020).

Voting systems are another area where smart contracts might have a serious impact, according to Fusco et al. (2018). Smart contracts can facilitate trustworthy and unpenetrable voting procedures by capitalising on the immutability and transparency of blockchain technology. This safeguards the legitimacy of voting and boosts confidence in democratic processes. In addition, smart contracts are being used for content licencing, rights management, and royalty distribution in the entertainment business. Smart contracts automate and improve upon existing industry practices to ensure that creators are fairly compensated and that copyright violations are kept to a minimum (Fusco et al., 2018).

Konowicz (2018) highlights that the use of cryptocurrencies as a means of evading sanctions is a divisive issue that might have far-reaching effects on international finance and politics. Financial sanctions imposed by international organisations or individual governments can be avoided through the use of cryptocurrencies. This programme has the potential to be used to sidestep regulations, but it also raises questions about the efficacy of sanctions and the inappropriate usage of cryptocurrency. Cryptocurrencies are an alternative to centralised monetary systems since they are distributed globally and may be exchanged anonymously. Because of this feature, people often assume that cryptocurrencies may be used to evade regulation. Sanctioned persons or organisations can use cryptocurrencies to do business with counterparties that are ready to deal in digital assets rather than fiat currency. Cryptocurrencies, in principle, might make it difficult for authorities to track and regulate the transfer of cash since they permit anonymous and covert trades. Regulators and politicians are worried that cryptocurrencies' ability to circumvent sanctions regimes might facilitate criminal activities including money laundering, terrorism funding, and the spread of nuclear, chemical, or biological weapons. There have been many recorded incidents when cryptocurrency was utilised to circumvent sanctions. It has been claimed, for instance, that

North Korea has used cryptocurrency to circumvent UN sanctions by financing its military programmes. Some Iranian, Venezuelan, and Russian citizens and businesses have reportedly looked into or used cryptocurrency to get around sanctions according to Tlitter & Yaffe-Bellany (2022) and Konowicz (2018).

3.3 Altcoins

The term altcoins emerged alongside the emergence of numerous different coins that were created following the verge of the success of Bitcoin. Scholars, on the other hand, tend to criticize the term, which is especially popular among investors since dividing the market into two terms, where the first term is represented by just one currency and the second one by more than a million does not really logical to many scientists (Wisniewska, 2016).

However, based on Kukacka & Kristoufek (2023), the phenomenon of altcoins gained its popularity in 2017-2019, when the first commercial projects based on blockchain technology started to be perceived and talked about by different companies. In fact, the whole movement promoting the concept of investing in altcoins and other emerging coins is strongly related to marketing and viral campaigns. Undeniably, when talking about marketing and viral campaigns, the very first altcoin that comes to anyone's mind is definitely Dogecoin, which was created in 2013 as a meme but started to gain worldwide popularity in 2019-2020 thanks to active campaigns launched by Elon Musk who presumably pursued a commercial interest in increasing the capitalization of the coin. In fact, the very situation with Dogecoin is responsible for the label that is often associated with the crypto market – speculation or bubble (Kukacka & Kristoufek, 2023).

Of course, the case of Dogecoin does fully seem to fall under the description of a bubbly or speculative asset, but it definitely cannot be said about other major projects, such as Ethereum that was already briefly discussed in the thesis (Arslanian, 2022). The potential of Ethereum is downright high due to the fact that out of infinitely many altcoins, this is the only one that seems to be fixed to a particular value for a very long time. In addition to that, the creator of the coin constantly supplies the general public with news and upgrades to the environment of the coin and the platform that it creates. Further paragraphs will briefly focus on explaining the background behind the biggest players in the altcoin market (Arslanian, 2022).

- Binance coin is another major player in the altcoin market as the coin itself is supported by the biggest crypto trading platform as of 2023 – Binance. Binance coin’s utilization is inevitably associated with its integrity with the Binance ecosystem, which helps people to get benefits on the trading platform, such as reducing trading fees and participation in token sales on the Binance Launchpad. Apart from its obvious branding as an integral part of the Binance ecosystem, the coin is also widely used in a series of other DeFi projects thus leading to a higher adoption rate and consequently higher capitalization, based on Garewal & Garewal (2020).
- Cardano is a blockchain platform that aims to provide a secure and scalable infrastructure for the development of decentralized applications and smart contracts. It differentiates itself through a rigorous academic approach and peer-reviewed research. Cardano utilizes a proof-of-stake consensus algorithm called Ouroboros and emphasizes sustainability, security, and scalability. The ADA cryptocurrency powers the Cardano network and is used for transaction fees and staking, as per Damsgaard (2022).
- Ripple (XRP): Ripple is both a digital payment protocol and a cryptocurrency. It was designed to enable fast and low-cost international money transfers. Ripple's technology focuses on facilitating real-time gross settlement systems, currency exchange, and remittances. XRP, the native cryptocurrency of the Ripple network, plays a vital role as a bridge currency, providing liquidity for cross-border transactions. Ripple has established partnerships with numerous financial institutions, contributing to its widespread adoption and recognition in the banking industry, according to Kristoufek & Vosvrda (2019).
- Litecoin (LTC): Launched in 2011, Litecoin is often considered one of the earliest altcoins and a direct descendant of Bitcoin. It was created by Charlie Lee, a former Google engineer, with the aim of improving Bitcoin's shortcomings. Litecoin features faster block generation times and a different hashing algorithm (Scrypt) compared to Bitcoin's SHA-256. It has gained popularity for its ability to process

transactions more quickly and its potential to serve as a medium of exchange for everyday transactions (Agarwal et al., 2021).

- Polkadot (DOT): Polkadot is a multi-chain platform that enables different blockchains to interoperate and share information. It aims to create a decentralized and scalable network where different blockchain projects can collaborate and communicate with each other. Polkadot's native cryptocurrency, DOT, serves as the governance token for the platform and allows holders to participate in the network's decision-making process (Larrier, 2021).

Furthermore, Figure 1 presents the logotypes of the biggest and most popular altcoins.

Figure 1, logos of the biggest altcoins



Source: The Economist, 2023 .

4 Practical Part

4.1 Descriptive Analysis

For the purpose of identifying the best possible investment option out of three and understanding the comparative advantage of each option, it is downright essential to perform a series of different analyses that will help the author ultimately reach the objective stated at the beginning of the thesis. In fact, it is essential to note that the practical part of the thesis is largely based on the dataset collected with the help of Yahoo Finance and available in the list of appendices in Table 7.

The first part of the analysis involves the application of the main measures of central tendency from the methodology of the work. Computed measures of central tendency (alongside one measure of variation – range) between 06.07.2022 and 06.07.2023 are indicated in Table 1.

Table 1, descriptive statistics

	Bitcoin, USD/coin	Ethereum, USD/coin	Cardano, USD/coin
Mean	22693.96	1576.42	0.38
Median	22429.76	1608.21	0.38
Min	15787.28	1038.19	0.24
Max	31156.44	2120.01	0.57
Range	15369.16	1081.81	0.33

Source: own processing based on Yahoo Finance, 2023

According to the first row indicating the results for the average measure, it is quite evident that the highest average price was identified for Bitcoin, which had a stunning average of 22693.96 USD per coin on average over the course of one year. When it comes to Ethereum, its average price over the course of the year is equal to 1576.42 USD per coin, whilst the average cost of Cardano is the lowest at just 0.38 USD per coin. When it comes to the median for three coins, they almost perfectly replicate the value for the mean, so the author promptly continues with the minimum value for each coin. The lowest boundary to which Bitcoin descended was 15787.28 USD per coin, and considering that its average price is at the level of 22 thousand dollars, it is essential to say that this bottom seems to be rather

concerning. When it comes to Ethereum and its lowest value, it is possible to conclude that it remained at the level of one thousand, so its lowest value does not seem to be so astonishing. In turn, the lowest value for Cardano was just 0.24 USD and considering its price, this does not really seem like a big deal. On the other hand, the maximum values underpin the suggestion that cryptocurrencies are classified as volatile assets, which is especially visible when continuing to the range measure. According to the range of Bitcoin, it is possible to say that the price of the crypto asset was fluctuating at an interval equal to 15369.16 USD per coin, which is itself a very huge value. On the other hand, the ranges of Ethereum and Cardano, respectively to their prices are still pretty big. Nevertheless, for the further identification of precise figures for volatility, the author will proceed to the return and volatility analysis in one of the further sub-chapters of the analytical part of the work.

4.2 Correlation Analysis

Correlation analysis is one of the most important and valuable tools that can help investors and people interested in cryptocurrencies to try to identify factors that can be used for references and comparisons when thinking about the future development of the price of a crypto asset. The correlation analysis will be based on the dataset from the list of appendices once again and the author is particularly interested in the identification of correlation between the three selected crypto assets. This will be done to identify if the statement that the price of altcoins is fully dependent on the price of Bitcoin is a myth or true. The author selected the Pearson correlation coefficient for the case, whose formula is discussed in the methodology of the work. The correlation matrix for the case is indicated in Table 2.

Table 2, the correlation matrix

	<i>Bitcoin, USD/coin</i>	<i>Ethereum, USD/coin</i>	<i>Cardano, USD/coin</i>
<i>Bitcoin, USD/coin</i>	1		
<i>Ethereum, USD/coin</i>	0.92	1	
<i>Cardano, USD/coin</i>	0.09	0.23	1

Source: own processing based on Yahoo Finance, 2023

Based on the results of the correlation matrix, it is possible to assume that Bitcoin and Ethereum are likely to be correlated in a very strong and significant manner. On the other

hand, it remains pretty likely that it is bitcoin that triggers a positive change in the price of Ethereum rather than vice versa. The problem with the correlation coefficient is the fact that the indicator shows a two-sided relationship and not a causal one. However, based on the literature framework behind the phenomenon, the author suggests that a piece of evidence to support the claim that Bitcoin significantly influences the price of altcoins has been found. On the other hand, the correlation between Bitcoin and Cardano is rather a small one – just 0.09 which becomes rather insignificant when comparing it to the stunning correlation for the first pair of 0.92. At last, the correlation between Ethereum and Cardano seems to be really low as well, as the Pearson correlation coefficient for the pair is equal to just 0.23. However, basing one’s conclusions on those raw indicators without any implementation of hypothesis testing will not be correct at all, so it is essential to proceed to the test of hypotheses associated with those correlation coefficients’ significance. The matrix containing t-ratios for the correlation coefficients is presented in Table 3.

Table 3, the matrix of t-ratios

	<i>Bitcoin, USD/coin</i>	<i>Ethereum, USD/coin</i>	<i>Cardano, USD/coin</i>
Bitcoin, USD/coin	1		
Ethereum, USD/coin	45.98	1	
Cardano, USD/coin	1.73	4.53	1

Source: own processing based on Yahoo Finance, 2023

Based on the sample size and the significance level of 5 per cent selected for the study, it is possible to perform three hypothesis testing procedures, which will be described in Table 4. The critical value of the Student’s t distribution corresponding to the case is equal to 1.96, which is incredibly similar to the critical value of the normal distribution with similar input data. The explanation behind the coincidence is the fact that the Student’s t distribution approaches the shape of the normal distribution as the sample size and, accordingly, the number of degrees of freedom gets larger.

Table 4, hypothesis testing for correlation coefficients

<i>H₁: ETH and BTC are not correlated</i>	<i>H₁: ETH and ADA are not correlated</i>	<i>H₁: ADA and BTC are not correlated</i>
<i>H₂: ETH and BTC are correlated</i>	<i>H₂: ETH and ADA are correlated</i>	<i>H₂: ADA and BTC are correlated</i>
45.96 > 1.96 <i>ETH and BTC are correlated</i>	4.53 > 1.96 <i>ETH and ADA are correlated</i>	1.73 < 1.96 <i>ADA and BTC are not correlated</i>

Source: own processing based on Yahoo Finance, 2023

Interestingly enough, there is still a statistically significant correlation between Ethereum and Cardano even despite a relatively low figure for the correlation coefficient. This is, undoubtedly, explained by the fact that the dataset has 365 observations and the boundary for being significant is lower than for other cases, which would involve significantly fewer observations. All in all, it is possible to draw the conclusion that Bitcoin and Ethereum are correlated, and so are Ethereum and Cardano, whilst Cardano and Bitcoin are not really correlated. The next chapter is focused on the analysis of return and volatility for three investment options.

4.3 Return and Volatility

The analysis of return and volatility is based on two different techniques. When it comes to volatility analysis, it involves the utilization of measures of variation from statistics, notably the standard deviation and the coefficient of variation. For the return analysis, the author uses the formula from the methodology of the work, where he first calculates daily return and then finds the geometric mean of daily returns for the selected crypto assets.

First, the author proceeds to the volatility analysis with the results of calculations presented in Table 5.

Table 5, volatility analysis

	Bitcoin, USD/coin	Ethereum, USD/coin	Cardano, USD/coin
Standard Deviation	4248.79	251.83	0.07
Average	22693.96	1576.42	0.38
Coefficient of Variation	19%	16%	19%

Source: own processing based on Yahoo Finance, 2023

According to the result of the volatility analysis, it is identified that the variation of Bitcoin over the selected time period is equal to 19%, which is definitely not a small number but on the other hand, given the reputation of crypto assets and the label that is often put on them of being too risky and unstable, it is rather surprising that such universally acclaimed volatile assets have a rather common figure for the variation. The same is also identified for Ethereum, which is even less volatile than Bitcoin and that in fact suggests that Ethereum's price is not fully dependent on Bitcoin as they are not perfectly correlated. As for the case of Cardano, it also has acceptable volatility, whose value is identical to the volatility of Bitcoin. All in all, it is possible to say that based on the daily performance of the three selected crypto assets, they do not have high volatility as the market situation seems to have stabilized.

The next analysis is the analysis of returns, which involves the computation of geometric means of daily returns for all selected crypto assets. After applying the formula from the methodology of the work, it is possible to get the results presented in Table 6.

Table 6, computed geomeans

<i>Geomean of Returns</i>		
Bitcoin, return	Ethereum, return	Cardano, return
0.11%	0.13%	-0.13%

Source: own processing based on Yahoo Finance, 2023

Based on the calculation of computed geometric means, it is possible to say that 2 out of 3 investment options have a positive value for the indicator. Positive values for the

geomean are treated as positive phenomena adding points to the attractiveness of potential investments, while negative figures traditionally suggest the opposite. Based on the result of the calculation, it is possible to say that the best investment option according to the return is Ethereum, followed by Bitcoin. Alternatively, it is not suggested to invest in Cardano due to the fact that the return is negative meaning a net loss for investors. Despite the finding, it is still essential to proceed further with the analytical part to provide a definite answer of the best investment option out of the three.

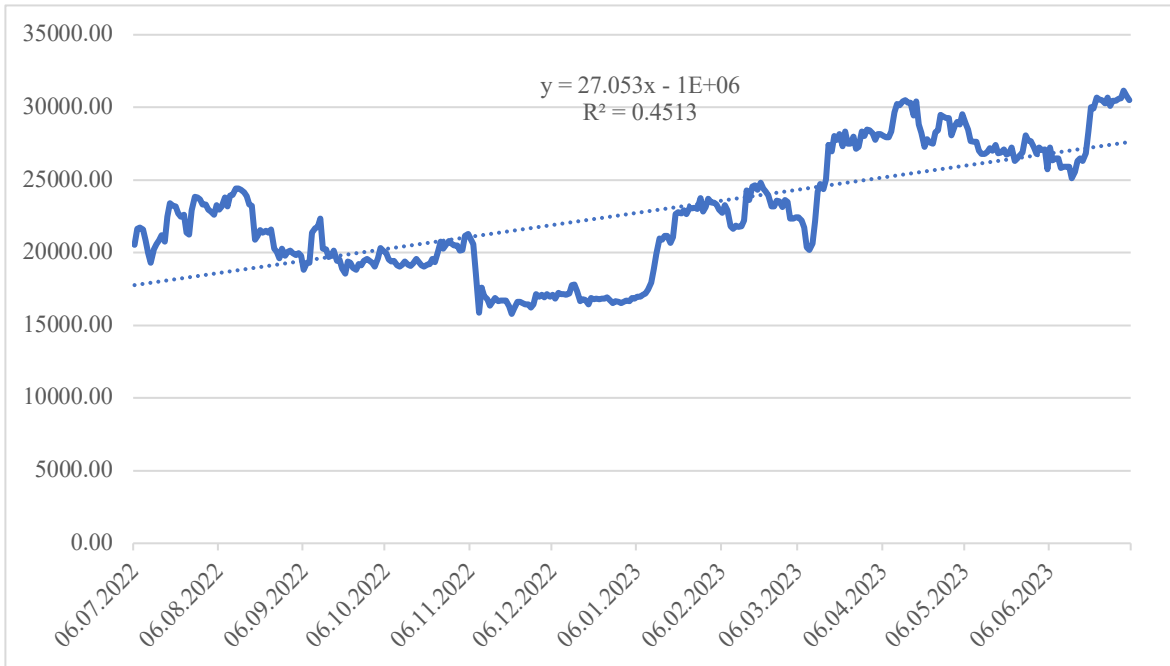
4.4 Time Series Analysis

4.4.1 Trend Analysis

The final chapter of the analytical part of the work is split into two individual sub-chapters, where the first sub-chapter is dedicated to the utilization of general linear trends to identify the main tendencies behind the development of the selected crypto assets, whilst the second chapter will try to predict the future development of crypto assets using a more sophisticated and complex technique.

To begin with, it is essential to start by looking at the scatterplot of Bitcoin for the period between 06.07.2022 and 06.07.2023, which is presented in Figure 2.

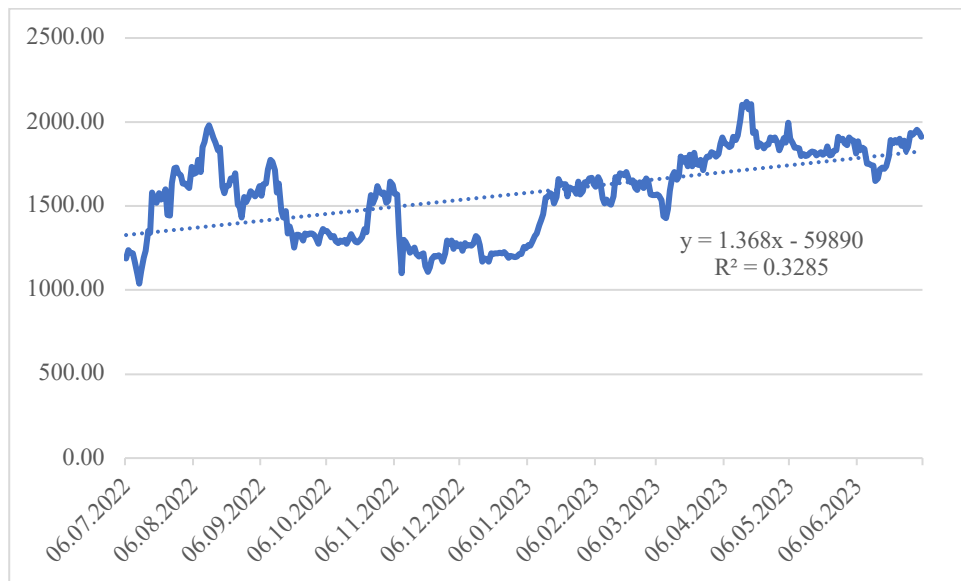
Figure 2, the scatterplot of Bitcoin price



Source: own processing based on Yahoo Finance, 2023

According to the scatterplot containing daily observed prices for the first-ever crypto asset, it is possible to suggest that the asset is definitely going through a bull market since its capitalization and price are both rising, which is a good sign. In addition to that, the development of the asset in time hints that there is a presence of a trend in the dataset, so the author tried to fit in a linear one. The result of the estimation is not outstanding, as the coefficient of determination is equal to just 0.45 or 45%, but the author is still able to draw an essential insight that based on the annual time series, it is possible to say that the price of Bitcoin was rising by 27.053 USD daily on average. The author will proceed to the next analysis, which is concerned with Ethereum, whose scatterplot for the period between 06.07.2022 and 06.07.2023 is presented in Figure 3.

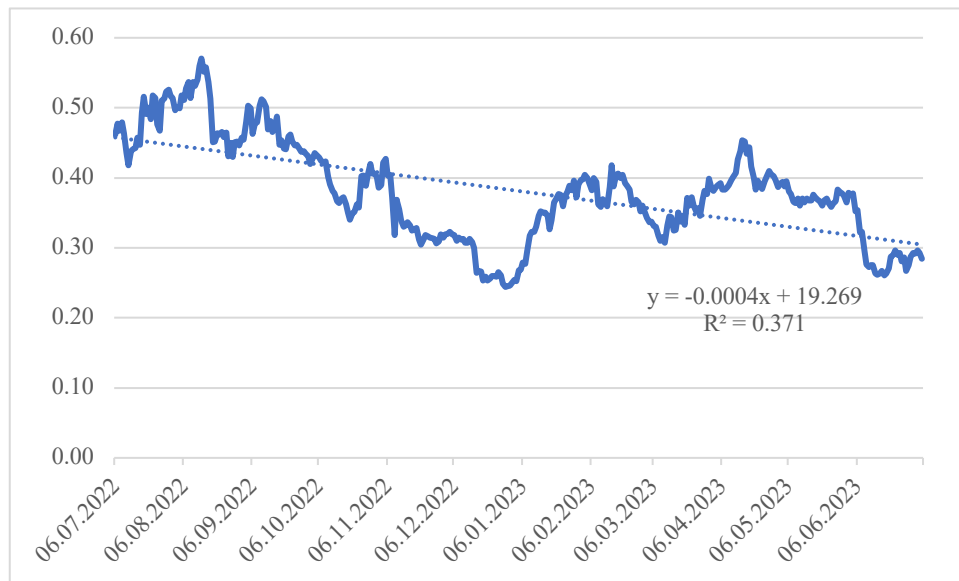
Figure 3, the scatterplot of the Ethereum price



Source: own processing based on Yahoo Finance, 2023

According to the scatterplot of Ethereum, it is possible to say that the situation for Ethereum is much more unpredictable than for Bitcoin since the fitted trend has lower precision than the one projected for Bitcoin – just 0.32 or 32% of the variation in the price of Ethereum explained by the trend. However, it is definitely possible to say that the crypto asset is also going through optimistic and good times indicating a presence of a potential bull cycle. At the same time, the daily average increment in the price of Ethereum, according to the projected trend, is equal to 1.368 USD, which is not a lot but still a decent result. Finally, the author proceeds to the final crypto asset from the list with the scatterplot for the period between 06.07.2022 and 06.07.2023 presented in Figure 4.

Figure 4, the scatterplot of Cardano prices



Source: own processing based on Yahoo Finance, 2023

Contrary to the first two crypto assets analyzed, the situation of Cardano is far from being optimistic since the crypto asset is likely to be going through the bearish stage of the market. In fact, there is still room for similarity, especially with Ethereum, but just with the fact that the linear trend might not be fully able to explain the development of the asset – just 0.371 or 37.1% of the variation explained. According to the fitted trend, it is possible to say that the price of the asset was decreasing by 0.0004 USD daily, which is surely not a good sign at all. Finally, the author will continue with the estimation of ARIMA models for the three in the final subchapter of the analytical part of the work.

4.4.2 ARIMA

Given the inability to create a good forecasting tool using just the time variable and a linear trend, the author is interested in trying to create three ARIMA models for each of the investment options. ARIMA models are models that traditionally have 2 main components – an autoregressive component (lagged values of the dependent variable) and a moving average component. The letter "I" indicates the presence of a differentiation, which is used to get rid of the non-stationarity. In other words, it is already obvious to the author that all three variables (prices of the crypto assets) are far from being stationary, so there is a need for the differentiation and implementation of ARIMA rather than ARMA. The author's

original assumption is that if he will be able to implement ARIMA and get a relatively good result in terms of the quality of the adjusted R square, it would mean that it is possible to project the future performance of a crypto asset using just lagged values and lagged errors.

Due to the complexity of the calculation, the author will not use Excel anymore and he will proceed to another application traditionally used for the econometric estimation – Eviews. The author uses the same dataset from the list of appendices, and he will first focus on estimating an ARIMA model for Bitcoin. Hence, it is essential to first perform the ADF test to identify if there is a unit root that will confirm the absence of stationarity. The result of the testing is presented in Figure 5.

Figure 5, the ADF test for Bitcoin

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-1.832302	0.6871
Test critical values:		
1% level	-3.983471	
5% level	-3.422218	
10% level	-3.133955	

Source: own processing based on Yahoo Finance, 2023

Based on the P value, it is possible to say that there is a presence of the unit root and the time series is not stationary, so it will be essential to perform the first differentiation of the price variable. After performing the first differentiation, it was identified that the unit root for the first difference was absent, so the author will use the first difference for the "I" component of ARIMA. Effectively, it is now vital to proceed to the identification of the other 2 orders – the order of AR and the order of MA. This will be done with the help of a correlogram showing ACF and PACF. The correlogram of Bitcoin’s first difference is shown in Figure 6.

Figure 6, correlogram for Bitcoin

Autocorrelation	Partial Correlation	AC	PAC	Q-Stat	Prob	
		1	0.010	0.010	0.0346	0.852
		2	0.059	0.059	1.3058	0.521
		3	0.006	0.005	1.3213	0.724
		4	-0.059	-0.063	2.6243	0.623
		5	-0.001	-0.000	2.6245	0.758
		6	-0.013	-0.006	2.6870	0.847
		7	0.009	0.010	2.7195	0.910
		8	-0.065	-0.068	4.2969	0.829
		9	0.007	0.007	4.3162	0.889
		10	-0.040	-0.033	4.9099	0.897
		11	-0.033	-0.032	5.3292	0.914
		12	0.101	0.099	9.1612	0.689
		13	-0.012	-0.009	9.2192	0.756
		14	-0.058	-0.077	10.493	0.725
		15	-0.000	-0.001	10.493	0.788
		16	-0.103	-0.090	14.568	0.556
		17	-0.004	-0.001	14.575	0.626
		18	0.043	0.047	15.298	0.641
		19	0.005	-0.001	15.307	0.703
		20	-0.019	-0.027	15.451	0.750
		21	-0.082	-0.091	18.090	0.643
		22	-0.050	-0.046	19.069	0.641
		23	-0.017	0.004	19.188	0.690
		24	0.064	0.045	20.803	0.650
		25	0.167	0.166	31.777	0.165

Source: own processing based on Yahoo Finance, 2023

Based on the correlogram of Bitcoin's first difference and both AC and PAC functions, it is possible to suggest that it is highly likely that the lag of the 25 is the best fit for both parts of the ARIMA model. Therefore, the author will include it in the model and proceed to the estimation. The output of the estimation is shown in Figure 7.

Figure 7, ARIMA model for Bitcoin

Dependent Variable: D(BITCOIN__USD_COIN)
Method: ARMA Maximum Likelihood (OPG - BHHH)
Date: 07/07/23 Time: 16:34
Sample: 7/07/2022 7/05/2023
Included observations: 364
Convergence achieved after 15 iterations
Coefficient covariance computed using outer product of gradients

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	30.77426	36.74917	0.837414	0.4029
AR(25)	-0.182318	0.250500	-0.727816	0.4672
MA(25)	0.384703	0.238935	1.610078	0.1083
SIGMASQ	353887.3	17163.32	20.61882	0.0000
R-squared	0.040133	Mean dependent var		27.37890
Adjusted R-squared	0.032134	S.D. dependent var		608.0289
S.E. of regression	598.1801	Akaike info criterion		15.63992
Sum squared resid	1.29E+08	Schwarz criterion		15.68275
Log likelihood	-2842.466	Hannan-Quinn criter.		15.65694
F-statistic	5.017260	Durbin-Watson stat		1.997810
Prob(F-statistic)	0.002028			

Source: own processing based on Yahoo Finance, 2023

In fact, the adjusted R square of just 3.2%, which is significantly lower than the trend function estimated in one of the earlier sub-chapters suggests that there is no way to properly estimate and predict the price of Bitcoin based on its previous performance. Then, the author will perform the same procedure for the other two crypto assets starting with Ethereum. The output of the ADF test is shown in Figure 8.

Figure 8, the ADF test for Ethereum

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.611862	0.2753
Test critical values:	1% level	-3.983471	
	5% level	-3.422218	
	10% level	-3.133955	

Source: own processing based on Yahoo Finance, 2023

Based on the result of the ADF test and the subsequent hypothesis testing, it is possible to confirm that the time series of Ethereum’s price is not stationary, so it is essential to implement the differentiation procedure after which it has been identified that the time series is stationary, according to the second ADF test. Now, the author will proceed to the visualization of the correlogram for Ethereum presented in Figure 9.

Figure 9, the correlogram for Ethereum

Autocorrelation	Partial Correlation	AC	PAC	Q-Stat	Prob
		1 -0.058	-0.058	1.2241	0.269
		2 0.015	0.012	1.3117	0.519
		3 0.051	0.053	2.2787	0.517
		4 -0.076	-0.070	4.3956	0.355
		5 -0.010	-0.020	4.4306	0.489
		6 -0.001	-0.003	4.4313	0.619
		7 -0.012	-0.004	4.4838	0.723
		8 -0.088	-0.094	7.3947	0.495
		9 0.072	0.062	9.3637	0.404
		10 -0.051	-0.041	10.334	0.412
		11 -0.033	-0.034	10.747	0.465
		12 0.075	0.055	12.887	0.377
		13 0.037	0.059	13.414	0.416
		14 -0.119	-0.125	18.837	0.171
		15 0.008	-0.019	18.862	0.220
		16 -0.103	-0.104	22.945	0.115
		17 -0.032	-0.014	23.345	0.138
		18 0.029	0.000	23.666	0.166
		19 0.018	0.033	23.795	0.204
		20 0.022	0.022	23.975	0.243
		21 -0.035	-0.048	24.450	0.272
		22 -0.064	-0.100	26.052	0.249
		23 -0.016	-0.000	26.152	0.294
		24 0.023	0.001	26.358	0.335
		25 0.157	0.168	36.004	0.072

Source: own processing based on Yahoo Finance, 2023

Based on the second correlogram, it becomes pretty apparent that the combination of 25 for the AR and MA components is likely to be the best fit. Henceforth, the author will proceed to the estimation of the ARIMA model in the following order (25, 1, 25). The result is presented in Figure 10.

Figure 10, ARIMA model for Ethereum

Dependent Variable: D(ETHEREUM__USD_COIN)

Method: ARMA Maximum Likelihood (OPG - BHHH)

Date: 07/07/23 Time: 16:42

Sample: 7/07/2022 7/05/2023

Included observations: 364

Convergence achieved after 18 iterations

Coefficient covariance computed using outer product of gradients

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	2.229077	3.266172	0.682474	0.4954
AR(25)	-0.248555	0.250742	-0.991278	0.3222
MA(25)	0.454891	0.244688	1.859062	0.0638
SIGMASQ	2956.053	147.6799	20.01663	0.0000
R-squared	0.042693	Mean dependent var		1.987951
Adjusted R-squared	0.034716	S.D. dependent var		55.64523
S.E. of regression	54.67082	Akaike info criterion		10.85529
Sum squared resid	1076003.	Schwarz criterion		10.89811
Log likelihood	-1971.662	Hannan-Quinn criter.		10.87231
F-statistic	5.351665	Durbin-Watson stat		2.113121
Prob(F-statistic)	0.001289			

Source: own processing based on Yahoo Finance, 2023

The situation for the ARIMA model for Ethereum is somewhat similar to what has been observed for Bitcoin – both AR and MA parts with the 25th lag are not significant, and the quality is low – just 3.4% of the variation is explained. Hence, it is not appropriate to predict the future performance of Ethereum based on its previous performance. Finally, the author proceeds to the very last model – ARIMA for Cardano. The output of the ADF test is presented in Figure 11.



















































Figure 11, the ADF test for Cardano

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-2.297184	0.4339
Test critical values:		
1% level	-3.983471	
5% level	-3.422218	
10% level	-3.133955	

Source: own processing based on Yahoo Finance, 2023

The time series of the price of Cardano is also not stationary since the unit root is present. Henceforth, the author implements the differentiation once again. After performing a subsequent ADF test, it was revealed that the first difference variable helped to remove the non-stationary nature of the time series. The next step would be the utilization of a correlogram, which is presented in Figure 12.

Figure 12, correlogram of Cardano

Autocorrelation	Partial Correlation	AC	PAC	Q-Stat	Prob
		1 -0.078	-0.078	2.2072	0.137
		2 -0.003	-0.009	2.2115	0.331
		3 0.012	0.011	2.2636	0.520
		4 -0.020	-0.018	2.4116	0.661
		5 0.018	0.015	2.5278	0.772
		6 -0.027	-0.025	2.7921	0.834
		7 0.051	0.048	3.7673	0.806
		8 -0.067	-0.061	5.4690	0.706
		9 0.048	0.041	6.3327	0.706
		10 -0.049	-0.047	7.2492	0.702
		11 0.014	0.013	7.3248	0.772
		12 0.010	0.005	7.3592	0.833
		13 0.021	0.031	7.5334	0.873
		14 -0.050	-0.057	8.5041	0.861
		15 -0.066	-0.064	10.156	0.810
		16 -0.069	-0.093	11.962	0.747
		17 -0.012	-0.012	12.017	0.799
		18 0.085	0.073	14.775	0.677
		19 -0.020	-0.000	14.930	0.727
		20 0.034	0.027	15.385	0.754
		21 -0.085	-0.080	18.211	0.636
		22 -0.015	-0.030	18.295	0.688
		23 -0.051	-0.058	19.316	0.683
		24 -0.019	-0.028	19.456	0.727
		25 0.128	0.118	25.891	0.413

Source: own processing based on Yahoo Finance, 2023

Based on the correlogram, it is possible to once again come to the conclusion that the order of 25 is the best fit for both the AR and MA parts of the ARIMA model. Henceforth, the author will implement the following structure of the model: (25, 1, 25) once more. The result of the estimation is presented in Figure 13.

Figure 13, ARIMA model for Cardano

Dependent Variable: D(CARDANO__USD_COIN)
Method: ARMA Maximum Likelihood (OPG - BHHH)
Date: 07/07/23 Time: 16:57
Sample: 7/07/2022 7/05/2023
Included observations: 364
Convergence achieved after 26 iterations
Coefficient covariance computed using outer product of gradients

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.000444	0.000820	-0.541868	0.5882
AR(25)	-0.137715	0.371733	-0.370467	0.7113
MA(25)	0.288609	0.375290	0.769030	0.4424
SIGMASQ	0.000190	1.06E-05	17.94413	0.0000

R-squared	0.022218	Mean dependent var	-0.000488
Adjusted R-squared	0.014069	S.D. dependent var	0.013960
S.E. of regression	0.013861	Akaike info criterion	-5.706833
Sum squared resid	0.069166	Schwarz criterion	-5.664007
Log likelihood	1042.644	Hannan-Quinn criter.	-5.689812
F-statistic	2.726695	Durbin-Watson stat	2.147880
Prob(F-statistic)	0.043995		

Source: own processing based on Yahoo Finance, 2023

Both parts – AR and MA are insignificant, and the quality of the estimated model is extremely low, so it is possible to suggest that it is once again not possible to predict the price of a crypto asset based on its previous performance. Ultimately, the author suggests that the previous price (lags) is absolutely pointless for the identification or prediction of the future performance of cryptocurrencies.

5 Results and Discussion

To begin with, it is essential to provide a brief overview of the author's findings in the analytical part of the thesis. First, it was identified that the geometric return is positive for Bitcoin and Ethereum, where Ethereum has the highest return, whilst the return for Cardano is negative. Additionally, it was identified that both Bitcoin and Ethereum are likely to be going through the bullish cycle of the market, while Cardano is likely to experience the bearish stage. When it comes to volatility, it was identified that all analyzed crypto assets have similar volatility ranging between 16% and 19%, and for every single crypto asset from the list, it was impossible to create a significant model able to predict the future price based on the previous performance. Finally, Bitcoin and Ethereum are correlated in a significant way – the same as Ethereum and Cardano, while Cardano and Bitcoin are not correlated at all, according to the pertinent hypothesis testing performed by the author.

In fact, the author believes that he was able to identify a series of interesting observations, which partially contradict the suggestions of many investors and scholars, who believe that Bitcoin is the safest bet out of all crypto assets. Undeniably, the position of Cardano is far from being perfect or optimistic in the short run, while both Bitcoin and Ethereum seem to have a good actual performance. Yet, Ethereum has a higher return and lower volatility, so the author believes that Ethereum is definitely a better bet in 2023-2024 than Bitcoin. A similar tendency was also identified by Ante (2022) and Singh & Krishna (2022). In fact, the author believes that the comparative advantage of Ethereum is something that might in fact change the position of Bitcoin in the hierarchy of crypto assets and can finally lead to the situation when Ethereum will become the leading currency according to its influence and also the market capitalization. In fact, the author believes that the presence of a correlation between Ethereum and Cardano and the absence of one between Bitcoin and Cardano is one of the biggest signs that the positions of Bitcoin are crumbling.

On the other hand, there are still suggestions that venturing into the crypto market is not likely to bring any good at all to potential investors. To be more specific, the biggest piece of evidence for that is the fact that there is no way to predict the future

performance of none of the analyzed crypto assets with the help of their lagged values, which is pretty common in stocks and other traded commodities. In other words, the author coincides with the finding with Auer & Tercero-Lucas (2022) and Bazán-Palomino (2022), who suggested that the crypto market as a whole is likely to be a big speculation, where the price of assets is not underpinned by anything rather than media and advertisements related to those assets.

However, even despite the negative remark from the previous chapter and the belief in the purely speculative nature of the market, the author believes that there is still room for making money with the help of crypto assets even despite their relatively high risk. Undeniably, aiming for the long-term perspective might not at all prove itself reliable since crypto assets are identified to be changing cycles quicker than ordinary stocks, for which bear and bull periods of the market last significantly longer, which is directly tied to the performance of domestic economies. Therefore, the author believes that the best way for making positive gains from the crypto market is short-term investment, which will be done during the first stages of the bull market.

Of course, the author believes that even the holding strategy might prove itself reliable. At least, it had been rather fruitful prior to shocks that happened with the crypto market in 2020-2022 which involved the price of Bitcoin first reaching its peak and then dropping to a three-year low following a series of external shocks, such as the fall of Luna that significantly damaged the confidence that already sceptical investors had in crypto assets as a whole, and the collapse of FTX that forced Bitcoin and almost all altcoins to start their free fall.

At last, it is essential to comment on another crucial aspect that is likely to influence the potential that cryptocurrencies will have in the future. Undeniably, the FED and other major Central Banks might not at all be satisfied with the growing popularity that decentralized currencies started to gain lately, so it will definitely be in their best interest to inflict considerable amounts of damage to the new emerging power in the international world of finance. Therefore, it is essential to monitor the situation closely and during periods, where the intervention of Central Banks and their correction is highly likely, it is suggested to postpone all potential investments until

the market situation will stabilize under the force of external factors and obstacles imposed by international institutions and central banks.

6 Conclusion

The goal of the bachelor thesis was to evaluate three selected cryptocurrencies and define the best crypto asset between them that will be suitable for making an investment. The author implemented a series of quantitative techniques that involved the analysis of time series, correlation analysis, prognostic techniques and basic descriptive statistics. After conducting the analysis, the author managed to come up with a series of recommendations and answers to the questions asked at the beginning of the bachelor thesis.

Based on the analysis, it was identified that the best investment option out of the three selected cryptocurrencies is Ethereum, which has lower volatility and higher return than Bitcoin. According to the author, Ethereum is emerging as a potential power that can significantly change the hierarchy in the crypto world and ensure that Bitcoin will soon be replaced as a leader of the market according to the price and, consequently, the capitalization. In turn, Cardano is considered to be the worst investment option as the performance of the crypto asset is far from being able to provide optimistic and positive insights for potential investors.

In the end, the author recommends investors seriously consider the idea of venturing into the market since its speculative nature has not gone anywhere and the development of the capitalization of the market is likely to be influenced solely by mentions in media and other types of promotion rather than the previous performance of those assets. However, once an investor has firmly made up his or her mind to venture into the market, the author recommends investing during the early stages of the bull market and not aiming for the long-term or holding position due to shorter bear and bull cycles for the crypto market than for the stock and other commodities.

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8 Appendices

Table 7, the dataset for the analysis

Date	Bitcoin, USD/coin	Ethereum, USD/coin	Cardano, USD/coin
06.07.2022	20548.25	1186.97	0.46
07.07.2022	21637.59	1237.59	0.48
08.07.2022	21731.12	1222.51	0.47
09.07.2022	21592.21	1216.98	0.48
10.07.2022	20860.45	1168.40	0.46
11.07.2022	19970.56	1097.24	0.44
12.07.2022	19323.91	1038.19	0.42
13.07.2022	20212.07	1113.59	0.44
14.07.2022	20569.92	1191.53	0.44
15.07.2022	20836.33	1233.13	0.44
16.07.2022	21190.32	1352.63	0.46
17.07.2022	20779.34	1338.64	0.45
18.07.2022	22485.69	1578.72	0.49
19.07.2022	23389.43	1542.98	0.52
20.07.2022	23231.73	1520.20	0.49
21.07.2022	23164.63	1576.75	0.50
22.07.2022	22714.98	1537.41	0.48
23.07.2022	22465.48	1549.30	0.52
24.07.2022	22609.16	1599.48	0.51
25.07.2022	21361.70	1445.38	0.48
26.07.2022	21239.75	1441.81	0.47
27.07.2022	22930.55	1636.23	0.51
28.07.2022	23843.89	1725.47	0.51
29.07.2022	23804.63	1727.41	0.52
30.07.2022	23656.21	1695.97	0.53
31.07.2022	23336.90	1681.52	0.52
01.08.2022	23314.20	1635.20	0.51
02.08.2022	22978.12	1632.95	0.50
03.08.2022	22846.51	1618.87	0.50
04.08.2022	22630.96	1608.21	0.50
05.08.2022	23289.31	1732.25	0.52
06.08.2022	22961.28	1691.66	0.51
07.08.2022	23175.89	1699.35	0.53
08.08.2022	23809.49	1775.52	0.54
09.08.2022	23164.32	1703.03	0.51

10.08.2022	23947.64	1851.74	0.54
11.08.2022	23957.53	1881.22	0.53
12.08.2022	24402.82	1957.25	0.54
13.08.2022	24424.07	1981.34	0.56
14.08.2022	24319.33	1936.80	0.57
15.08.2022	24136.97	1904.23	0.55
16.08.2022	23883.29	1878.14	0.56
17.08.2022	23336.00	1833.00	0.54
18.08.2022	23212.74	1847.01	0.51
19.08.2022	20877.55	1612.99	0.45
20.08.2022	21166.06	1577.00	0.45
21.08.2022	21534.12	1619.32	0.46
22.08.2022	21398.91	1622.51	0.46
23.08.2022	21528.09	1662.77	0.47
24.08.2022	21395.02	1657.06	0.46
25.08.2022	21600.90	1696.46	0.46
26.08.2022	20260.02	1507.78	0.43
27.08.2022	20041.74	1491.40	0.45
28.08.2022	19616.81	1430.55	0.43
29.08.2022	20297.99	1553.04	0.45
30.08.2022	19796.81	1523.84	0.45
31.08.2022	20049.76	1553.68	0.45
01.09.2022	20127.14	1586.18	0.46
02.09.2022	19969.77	1577.22	0.45
03.09.2022	19832.09	1556.87	0.48
04.09.2022	19986.71	1577.64	0.50
05.09.2022	19812.37	1617.18	0.50
06.09.2022	18837.67	1561.75	0.46
07.09.2022	19290.32	1629.91	0.48
08.09.2022	19329.83	1635.35	0.48
09.09.2022	21381.15	1719.09	0.50
10.09.2022	21680.54	1776.20	0.51
11.09.2022	21769.26	1761.80	0.51
12.09.2022	22370.45	1713.77	0.50
13.09.2022	20296.71	1580.79	0.47
14.09.2022	20241.09	1634.76	0.48
15.09.2022	19701.21	1471.69	0.47
16.09.2022	19772.58	1432.45	0.47
17.09.2022	20127.58	1469.74	0.49
18.09.2022	19419.51	1335.33	0.45
19.09.2022	19544.13	1377.54	0.45

20.09.2022	18890.79	1324.39	0.44
21.09.2022	18547.40	1252.61	0.44
22.09.2022	19413.55	1327.68	0.46
23.09.2022	19297.64	1328.26	0.46
24.09.2022	18937.01	1317.99	0.45
25.09.2022	18802.10	1294.22	0.45
26.09.2022	19222.67	1335.32	0.45
27.09.2022	19110.55	1330.13	0.44
28.09.2022	19426.72	1337.41	0.44
29.09.2022	19573.05	1335.65	0.44
30.09.2022	19431.79	1327.98	0.43
01.10.2022	19312.10	1311.64	0.43
02.10.2022	19044.11	1276.09	0.42
03.10.2022	19623.58	1323.44	0.43
04.10.2022	20336.84	1362.13	0.44
05.10.2022	20160.72	1352.84	0.43
06.10.2022	19955.44	1351.71	0.43
07.10.2022	19546.85	1332.52	0.42
08.10.2022	19416.57	1315.50	0.42
09.10.2022	19446.43	1322.60	0.42
10.10.2022	19141.48	1291.34	0.40
11.10.2022	19051.42	1279.58	0.39
12.10.2022	19157.45	1294.91	0.38
13.10.2022	19382.90	1288.12	0.38
14.10.2022	19185.66	1297.42	0.37
15.10.2022	19067.63	1274.87	0.36
16.10.2022	19268.09	1306.30	0.37
17.10.2022	19550.76	1331.71	0.37
18.10.2022	19334.42	1310.45	0.36
19.10.2022	19139.54	1285.74	0.35
20.10.2022	19053.74	1283.20	0.34
21.10.2022	19172.47	1299.95	0.35
22.10.2022	19208.19	1314.30	0.35
23.10.2022	19567.01	1363.45	0.36
24.10.2022	19345.57	1345.00	0.36
25.10.2022	20095.86	1461.67	0.40
26.10.2022	20770.44	1566.57	0.40
27.10.2022	20285.84	1514.37	0.39
28.10.2022	20595.35	1555.48	0.40
29.10.2022	20818.48	1619.70	0.42
30.10.2022	20635.60	1590.78	0.41

31.10.2022	20495.77	1572.71	0.41
01.11.2022	20485.27	1579.70	0.40
02.11.2022	20159.50	1519.71	0.39
03.11.2022	20209.99	1531.54	0.39
04.11.2022	21147.23	1645.09	0.42
05.11.2022	21282.69	1627.97	0.43
06.11.2022	20926.49	1572.23	0.40
07.11.2022	20602.82	1568.59	0.40
08.11.2022	18541.27	1332.84	0.37
09.11.2022	15880.78	1100.17	0.32
10.11.2022	17586.77	1299.46	0.37
11.11.2022	17034.29	1287.22	0.35
12.11.2022	16799.19	1255.27	0.34
13.11.2022	16353.37	1221.82	0.33
14.11.2022	16618.20	1241.60	0.33
15.11.2022	16884.61	1251.74	0.34
16.11.2022	16669.44	1215.60	0.33
17.11.2022	16687.52	1200.81	0.32
18.11.2022	16697.78	1212.30	0.33
19.11.2022	16711.55	1218.43	0.33
20.11.2022	16291.83	1142.47	0.31
21.11.2022	15787.28	1108.35	0.30
22.11.2022	16189.77	1135.17	0.31
23.11.2022	16610.71	1183.20	0.32
24.11.2022	16604.46	1203.98	0.32
25.11.2022	16521.84	1198.93	0.31
26.11.2022	16464.28	1205.90	0.31
27.11.2022	16444.63	1195.13	0.31
28.11.2022	16217.32	1170.09	0.31
29.11.2022	16444.98	1216.90	0.31
30.11.2022	17168.57	1295.69	0.32
01.12.2022	16967.13	1276.27	0.31
02.12.2022	17088.66	1294.30	0.32
03.12.2022	16908.24	1243.33	0.32
04.12.2022	17130.49	1280.26	0.32
05.12.2022	16974.83	1259.68	0.32
06.12.2022	17089.50	1271.65	0.32
07.12.2022	16848.13	1232.44	0.31
08.12.2022	17233.47	1281.12	0.31
09.12.2022	17133.15	1264.28	0.31
10.12.2022	17128.72	1266.38	0.31

11.12.2022	17104.19	1263.87	0.31
12.12.2022	17206.44	1274.62	0.31
13.12.2022	17781.32	1320.55	0.31
14.12.2022	17815.65	1309.33	0.31
15.12.2022	17364.87	1266.35	0.30
16.12.2022	16647.48	1168.26	0.26
17.12.2022	16795.09	1188.15	0.27
18.12.2022	16757.98	1184.72	0.27
19.12.2022	16439.68	1167.61	0.25
20.12.2022	16906.30	1217.70	0.26
21.12.2022	16817.54	1213.60	0.25
22.12.2022	16830.34	1218.18	0.26
23.12.2022	16796.95	1220.16	0.26
24.12.2022	16847.76	1221.15	0.26
25.12.2022	16841.99	1218.96	0.26
26.12.2022	16919.80	1226.97	0.27
27.12.2022	16717.17	1212.79	0.26
28.12.2022	16552.57	1189.99	0.25
29.12.2022	16642.34	1201.60	0.24
30.12.2022	16602.59	1199.23	0.25
31.12.2022	16547.50	1196.77	0.25
01.01.2023	16625.08	1200.96	0.25
02.01.2023	16688.47	1214.66	0.25
03.01.2023	16679.86	1214.78	0.25
04.01.2023	16863.24	1256.53	0.27
05.01.2023	16836.74	1250.44	0.27
06.01.2023	16951.97	1269.38	0.28
07.01.2023	16955.08	1264.27	0.28
08.01.2023	17091.14	1287.36	0.30
09.01.2023	17196.55	1321.54	0.32
10.01.2023	17446.29	1336.59	0.32
11.01.2023	17934.90	1387.93	0.32
12.01.2023	18869.59	1417.94	0.33
13.01.2023	19909.57	1451.61	0.35
14.01.2023	20976.30	1550.71	0.35
15.01.2023	20880.80	1552.48	0.35
16.01.2023	21169.63	1576.83	0.35
17.01.2023	21161.52	1567.85	0.35
18.01.2023	20688.78	1515.51	0.33
19.01.2023	21086.79	1552.56	0.34
20.01.2023	22676.55	1659.75	0.36

21.01.2023	22777.63	1627.12	0.37
22.01.2023	22720.42	1628.38	0.38
23.01.2023	22934.43	1628.25	0.38
24.01.2023	22636.47	1556.60	0.36
25.01.2023	23117.86	1611.71	0.37
26.01.2023	23032.78	1603.11	0.38
27.01.2023	23078.73	1598.16	0.39
28.01.2023	23031.09	1572.44	0.38
29.01.2023	23774.57	1646.16	0.40
30.01.2023	22840.14	1567.33	0.37
31.01.2023	23139.28	1586.54	0.39
01.02.2023	23723.77	1641.79	0.40
02.02.2023	23471.87	1643.24	0.40
03.02.2023	23449.32	1664.75	0.40
04.02.2023	23331.85	1667.06	0.40
05.02.2023	22955.67	1631.65	0.39
06.02.2023	22760.11	1616.25	0.38
07.02.2023	23264.29	1672.00	0.40
08.02.2023	22939.40	1650.72	0.39
09.02.2023	21819.04	1546.44	0.36
10.02.2023	21651.18	1514.87	0.36
11.02.2023	21870.88	1539.93	0.37
12.02.2023	21788.20	1515.03	0.36
13.02.2023	21808.10	1507.17	0.36
14.02.2023	22220.80	1556.88	0.39
15.02.2023	24307.84	1673.75	0.42
16.02.2023	23623.47	1640.07	0.39
17.02.2023	24565.60	1694.78	0.40
18.02.2023	24641.28	1691.82	0.41
19.02.2023	24327.64	1681.44	0.40
20.02.2023	24829.15	1702.68	0.40
21.02.2023	24436.35	1658.04	0.39
22.02.2023	24188.84	1643.23	0.39
23.02.2023	23947.49	1651.07	0.38
24.02.2023	23198.13	1608.37	0.37
25.02.2023	23175.38	1594.91	0.36
26.02.2023	23561.21	1640.82	0.37
27.02.2023	23522.87	1634.33	0.36
28.02.2023	23147.35	1605.90	0.35
01.03.2023	23646.55	1663.43	0.36
02.03.2023	23475.47	1647.32	0.35

03.03.2023	22362.68	1569.17	0.34
04.03.2023	22353.35	1566.92	0.34
05.03.2023	22435.51	1564.47	0.34
06.03.2023	22429.76	1567.40	0.33
07.03.2023	22219.77	1561.93	0.33
08.03.2023	21718.08	1534.09	0.32
09.03.2023	20363.02	1438.66	0.31
10.03.2023	20187.24	1429.16	0.32
11.03.2023	20632.41	1482.62	0.31
12.03.2023	22163.95	1590.29	0.33
13.03.2023	24197.53	1680.31	0.34
14.03.2023	24746.07	1703.51	0.34
15.03.2023	24375.96	1656.18	0.32
16.03.2023	25052.79	1677.22	0.33
17.03.2023	27423.93	1792.49	0.35
18.03.2023	26965.88	1761.66	0.34
19.03.2023	28038.68	1785.58	0.35
20.03.2023	27767.24	1735.32	0.33
21.03.2023	28175.82	1806.76	0.37
22.03.2023	27307.44	1737.72	0.36
23.03.2023	28333.97	1816.41	0.37
24.03.2023	27493.29	1752.04	0.36
25.03.2023	27494.71	1743.76	0.35
26.03.2023	27994.33	1775.68	0.36
27.03.2023	27139.89	1715.46	0.35
28.03.2023	27268.13	1772.79	0.37
29.03.2023	28348.44	1793.00	0.38
30.03.2023	28033.56	1792.74	0.38
31.03.2023	28478.48	1822.02	0.40
01.04.2023	28411.04	1813.86	0.39
02.04.2023	28199.31	1795.71	0.38
03.04.2023	27790.22	1810.30	0.39
04.04.2023	28168.09	1871.01	0.39
05.04.2023	28177.98	1909.11	0.39
06.04.2023	28044.14	1872.92	0.38
07.04.2023	27925.86	1865.64	0.38
08.04.2023	27947.79	1849.50	0.39
09.04.2023	28333.05	1859.39	0.39
10.04.2023	29652.98	1911.21	0.40
11.04.2023	30235.06	1892.19	0.40
12.04.2023	30139.05	1920.68	0.41

13.04.2023	30399.07	2012.63	0.43
14.04.2023	30485.70	2101.64	0.44
15.04.2023	30318.50	2092.47	0.45
16.04.2023	30315.36	2120.01	0.45
17.04.2023	29445.04	2076.24	0.43
18.04.2023	30397.55	2104.54	0.44
19.04.2023	28822.68	1936.40	0.42
20.04.2023	28245.99	1943.10	0.40
21.04.2023	27276.91	1850.00	0.38
22.04.2023	27817.50	1874.23	0.40
23.04.2023	27591.38	1862.06	0.39
24.04.2023	27525.34	1842.76	0.38
25.04.2023	28307.60	1866.75	0.39
26.04.2023	28422.70	1866.56	0.40
27.04.2023	29473.79	1908.79	0.41
28.04.2023	29340.26	1892.51	0.40
29.04.2023	29248.49	1908.92	0.40
30.04.2023	29268.81	1876.92	0.40
01.05.2023	28091.57	1831.95	0.39
02.05.2023	28680.54	1870.79	0.39
03.05.2023	29006.31	1904.65	0.39
04.05.2023	28847.71	1877.70	0.39
05.05.2023	29534.38	1995.06	0.39
06.05.2023	28904.62	1900.22	0.38
07.05.2023	28454.98	1873.08	0.38
08.05.2023	27694.27	1849.04	0.37
09.05.2023	27658.78	1848.60	0.36
10.05.2023	27621.76	1842.40	0.37
11.05.2023	27000.79	1796.49	0.36
12.05.2023	26804.99	1808.02	0.37
13.05.2023	26784.08	1796.11	0.37
14.05.2023	26930.64	1800.50	0.37
15.05.2023	27192.69	1817.55	0.37
16.05.2023	27036.65	1824.12	0.37
17.05.2023	27398.80	1821.86	0.38
18.05.2023	26832.21	1801.73	0.37
19.05.2023	26890.13	1812.59	0.37
20.05.2023	27129.59	1820.48	0.37
21.05.2023	26753.83	1804.53	0.36
22.05.2023	26851.28	1817.53	0.37
23.05.2023	27225.73	1854.38	0.37

24.05.2023	26334.82	1800.10	0.36
25.05.2023	26476.21	1805.95	0.36
26.05.2023	26719.29	1828.69	0.36
27.05.2023	26868.35	1831.12	0.37
28.05.2023	28085.65	1910.91	0.38
29.05.2023	27745.88	1893.08	0.38
30.05.2023	27702.35	1901.03	0.38
31.05.2023	27219.66	1874.13	0.37
01.06.2023	26819.97	1862.20	0.36
02.06.2023	27249.59	1907.26	0.38
03.06.2023	27075.13	1892.41	0.38
04.06.2023	27119.07	1890.51	0.38
05.06.2023	25760.10	1811.83	0.35
06.06.2023	27238.78	1884.49	0.35
07.06.2023	26346.00	1832.40	0.32
08.06.2023	26508.22	1846.30	0.32
09.06.2023	26480.38	1840.23	0.30
10.06.2023	25851.24	1752.38	0.28
11.06.2023	25940.17	1753.42	0.27
12.06.2023	25902.50	1742.53	0.28
13.06.2023	25918.73	1739.04	0.27
14.06.2023	25124.68	1650.52	0.26
15.06.2023	25576.39	1665.52	0.26
16.06.2023	26327.46	1716.67	0.26
17.06.2023	26510.68	1727.20	0.27
18.06.2023	26336.21	1720.58	0.26
19.06.2023	26851.03	1737.66	0.26
20.06.2023	28327.49	1792.12	0.27
21.06.2023	30027.30	1891.01	0.29
22.06.2023	29912.28	1872.94	0.29
23.06.2023	30695.47	1892.86	0.30
24.06.2023	30548.70	1876.06	0.29
25.06.2023	30480.26	1900.51	0.29
26.06.2023	30271.13	1859.43	0.28
27.06.2023	30688.16	1889.70	0.29
28.06.2023	30086.25	1827.97	0.27
29.06.2023	30445.35	1852.23	0.28
30.06.2023	30477.25	1933.19	0.29
01.07.2023	30590.08	1924.57	0.29
02.07.2023	30620.77	1937.44	0.29
03.07.2023	31156.44	1955.39	0.30

04.07.2023	30777.58	1936.63	0.29
05.07.2023	30514.17	1910.59	0.28

Source: Yahoo Finance, 2023