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ANALYSIS OF THE CORRELATION BETWEEN CRYPTO CURRENCIES, S&P500 AND US 10-YEAR TREASURY BOND INDEX WITH GRANGER CAUSALITY TEST

Assoc. Prof. Cem KARTAL (Ph.D.) *

Ümran ÖZTÜRK CAN *

ABSTRACT

Blockchain-based cryptocurrencies have gained popularity in traditional and digital channels, with the highest value records of all time broking in a row, both in academic studies and in recent times. In the framework of the study conducted to provide data to those who want to assess their investments in blockchain-based cryptocurrencies. In the research it is aimed to examine correlation between Bitcoin as an independent variable and S&P500 Index, US 10-year Treasury and altcoins like Ethereum, Cardano, Chainlink with Granger causality test. Findings show that Chainlink as an investment tool has the highest return with 6.22% and it is followed by Cardano with 5.74%, Ethereum with 5.20% and ultimately Bitcoin. The US 10-year Treasury offers not only the lowest rate of return with a 10% loss but also a riskier tool than Bitcoin. S&P500 Index offers a lower rate of return and is riskier in comparison to the FED interest rate. According to the covariance values, it has been determined that Bitcoin has an increasing linear relationship with Ethereum, Cardano and Chainlink, and a decreasing linear relationship with the FED interest rates and US 10-year Treasury, while it is unrelated to the S&P500 Index.

Keywords: *Bitcoin, Ethereum, Cardano, Chainlink, S&P 500, US 10-year Treasury.*

Jel Codes: *G20, G21, C50, F31, E42, F00, C22.*

1. INTRODUCTION

In the second half of the 20th century, with the transition from industrial society to information society, productivity increase in international business models and innovative industrial processes emerged with the transformation created by the ICT and network effects in the dynamics of the global economy.

From industrial society to information society, from economies of scale to network economies, state, and international trust the world is witnessing a revolution through information communication

* Sakarya University of Applied Sciences, Faculty of Applied Sciences, Department of International Trade and Logistic, Sakarya/ Turkey, E-mail: cemkartal@subu.edu.tr
* Western Blacksea Development Agency, 67600, Zonguldak/ Turkey, E-mail: ozturkumran@gmail.com

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technologies in terms of the world economic and financial system, from single-centered financial value and asset transfer to P2P (Peer to peer) exchange, from financial value and asset transfer via banks to blockchain technology and bank-independent transfers by the authorities.

Blockchain and related technologies are starting to get the attention of academics and professionals all over the world. Blockchain-based cryptocurrencies have gained popularity in traditional and digital media channels with the highest value records of all time broking in a row. The daily throughput of cryptocurrencies continues to increase unavoidable. Analysis of the evolution and possible effects of cryptocurrencies is important for the financial development of countries, companies, and individual investors. Due to their volatility and uncertainty about legal recognition and restrictions of use, cryptocurrencies are often preferred as investment tools and their impact on the investor portfolio is important.

Corporate investment advisors and individual investors are looking for new ways to achieve higher rates of returns. The search has been ongoing since the time of Traditional Portfolio Theory. Thanks to Markowitz (1952) this search guided to the Modern Portfolio Theory. Bocconi Students Investment Club (2017) carried out research entitled "A Markowitz Walk Down Crypto-land: Modern Assets for Modern Portfolios". The research aimed to adapt cryptocurrencies to the mathematical framework of Modern Portfolio Theory.

Within this research topic has been determined to provide data to those who want to evaluate their investments in blockchain-based cryptocurrencies, which have gained popularity both in academic studies and on television and digital media channels with the highest value of all time (ATH) records that it has recently broken.

Blockchain is a central server that removes the need for a government authority or any central trusted authority or a single central server, and a database that distributes the trust network on the internet. In summary, it is a new technological network that allows the transfer of assets over decentralized cryptographic registers by distributing the central trust structure in trust systems based on a single center for more efficient operation. The trust mechanism is technically strong because it is not based on individuals or institutions. But on the contrary, it is based on the difficulty of many nodes and related mathematical operations.

Basically, the participants included in this database record transfers of valuable assets to other participants so that the transfers are copied by many participants and the accuracy of the records is verified by decentralized trust authorities. The distributed database system, in which each participant can verify, eliminated the requirement for a central trust authority.

Blockchain technology; it stands out and is preferred with its decentralized distributed structure that saves copies of the data in hundreds of thousands of nodes in the network, its transparency that

gives confidence by facilitating the tracking of transaction activity in the network, and its immutability that does not allow operation on the generated data (Bayramoğlu and Başarır, 2019: 251).

The best-known example of blockchain technology within banks is Bitcoin cryptocurrency. Nakamoto (2008) identifies Bitcoin as a creative payment network and a new currency. Blockchain technology is recognized as the technology that reveals Bitcoin and altcoins. Bitcoin, which appeared as the first use of blockchain technology in 2009, and altcoins, thereafter, carried out the technological revolution that brought together four different branches of science. In summary, crypto/digital currencies offer a new money transfer system based on a distributed blockchain network instead of a classic central bank guarantee, by using a new database approach for asset transfers and record keeping. By keeping the blockchain records, by voluntary participants under the name of "mining" the labor and energy spent by the participants in mining activities during cryptographic calculations are met with commodity-like assets or values.

On the other hand, blockchain technology can provide full user privacy in the established systems, eliminate the need for a central system, and obtain a self-managed system, and provide the sustainability of the system by establishing it on many users instead of a single or limited number of authorities.

Nowadays, blockchain technologies are used for the transfer of assets of financial value with a technological infrastructure like data transfer in many areas on the Internet. Blockchain technologies have made it possible for cryptocurrencies to distinguish themselves as a payment unit in the Information Society. According to research conducted by the World Economic Forum in 2018, 58% of business executives predict that at least 10% of global gross national production will be realized in blockchain by 2025 (World Economic Forum, 2018). This study also fills the research gap and responds to the recommendations of the study such as Numes (2017), Kılıç ve Çüçtü (2018), İçellioğlu et al. (2018), Akçalı and Şişmanoğlu (2019), Atik et al. (2021), Papafotis (2021), Özmerdivanlı (2021). There is a need to understand the causality assessment between selected cryptocurrencies and traditional investment tools.

2. LITERATURE REVIEW

The spread of blockchain technology and cryptocurrencies has led to the attention of cryptocurrencies to each other, to exchange rates, to the values of precious metals such as gold and silver, to their relations with US 10-year Treasury and stock market indices, and to gain a popularity that will lead to numerous researches. In this context, academic studies dealing specifically with the variables addressed by the research model are summarized in this section.

Using Granger's causal analysis, Atik et al., (2015) correlated daily Bitcoin prices with commonly used foreign exchange prices from 2009 to 2015. As a result of the study, they determined that there is a causal relationship between Yen (Japan) and Bitcoin, which is one of the exchange rates examined, and that the direction of this relationship is from Japanese Yen to Bitcoin and is unidirectional.

Bocconi Students Investment Club (2017) applying Markowitz portfolio theory, aimed to leverage the common variability (covariance) of assets to reduce overall portfolio portability. The six cryptocurrencies selected, and the findings show that, as expected, it was found that diversification with cryptocurrencies optimizes the portfolio.

Nam (2017), aimed to find answers to questions like "Can Bitcoin improve portfolio efficiency?" and "Which portfolio optimization strategy can create the best risk-return profile for the portfolio where Bitcoin is included?". Nam used Sharpe Ratio, Sortino Ratio, VaR and CVaR methods to examine relationship Bitcoin, Euro, British Pound, Swiss Frans, Japanese Yen, Australian Dollar, Canadian Dollar, and Gold between 2010-2016. Findings showed that Bitcoin has the potential to enhance portfolio performance.

Siami-Namini (2017) aimed to analyze the correlation between exchange rate (EX) and stock price using quarterly data of Iran on liquidity, consumer price index, nominal EX and stock price index from 1994 to 2010 using Julelies's co-integration analysis and Toda-Yamamoto procedure. The findings indicate that there is no significant evidence of a correlation between stock prices and exchange rates.

Nunes (2017) analyzed the existence of a dynamic relationship between economic and financial indicators such as Crude and gold prices, 6-month and 1-year US Tresuary Yields, and S&P 500 Index prices, which are known to be related to Bitcoin and physical currencies and have been researched in the relevant literature. Following the analysis, a long-term relationship was determined between 6 months US Tresuary Yields and Bitcoin price.

Kılıç and Çütçü (2018) linked the BIST Index to Bitcoin prices in their investigations using the Engle-Granger and Gregory-Hansen and Toda-Yamamoto and Hacker-Hatemi-J causal tests. As a result of the research, it has been determined that there is no co-integrated relationship between the variables, and there is a one-way causality relationship from Borsa Istanbul Index to Bitcoin prices.

Güleç et al., (2018) examined the relationship between bitcoin and interest rates, the exchange rate, the stock markets between 2012 and 2018 by applying Johansen's co-integration analysis and Granger's causality.

İçellioğlu et al., (2018) tested the relationship between Bitcoin and US Dollar, Euro, Japanese Yen, Yuan (Chinese) and Pound exchange rates between 2013 and 2017 using Granger causality analysis for short-term relationships and Johansen's co-integration analysis for long-term relationships. As a result of the study, they determined that the short- or long-term results did not make a difference and that a causal relationship could not be established between the selected exchange rates and Bitcoin.

Stocic et al. (2018) used cross-correlation, random matrix theory and minimum spanning trees methods in his study examining the price changes of 119 publicly traded cryptocurrencies between 2016 and 2018 and observed the collective behavior in the cryptocurrencies market as a result of the analysis.

Azimov and Alkan (2019) used the Johansen's co-integration test to examine the long-term relationships, and the relationship setup between the US dollar, Yuan (China), Ruble (Russia) exchange rates and Bitcoin between 2013-2018 was examined. The research found that the identified variables had cointegrated relationships.

Using Toda-Yamamoto causality analysis, Akçalı and Şişmanoğlu (2019) established a correlation among Bitcoin, Ripple, Stellar, Ethereum, Dash, Monero, Nem and Litecoin prices between 2015 and 2018, and a strong positive correlation was determined among the variables as a result of the study. According to the study, there are bidirectional causality correlations between Bitcoin, Stellar and Ripple cryptocurrencies, one-way meaningful causal correlations from Bitcoin to Nem and Litecoin, and one-way meaningful causal correlations from Dash to Bitcoin, but no significant causality correlation has been detected between Ethereum, Bitcoin and Monero cryptocurrencies.

Kartal and Bayramoğlu (2019) wanted to make an estimate of the future prices of Bitcoin, Ethereum, Litecoin and Ripple as an investment tool and analyzed them using the GM (1,1) Rolling Model to explain their cryptocurrencies units and their operation in the market. Following the analysis, the model established with the analysis revealed that the cryptocurrency was successful in the upcoming estimate but failed in the direction forecast.

Hacıoğlu et al. (2020) also focused on blockchain applications in humanitarian logistics in the novel called digital business strategies in blockchain ecosystems and emphasized the importance of blockchain applications as they related to business model design in digital era.

Hacıoğlu et al. (2021) investigated to determine the best cryptocurrency extraction strategy with AHP and Fuzzy-TOPSIS techniques. The results showed that Turkey was number one in home mining relative to the United States and Europe. Turkey is the leading performer among individual countries in terms of cryptocurrency adaptation and use of digital assets.

Soyaslan (2020) analyzed the correlation between Bitcoin and BIST Bank, BIST Technology and BIST 100 indices daily data between 2011 and 2020 using time series analysis methods. As a result of the study there is a balance correlation between Bitcoin & BIST 100 Index in the long term but there is no any correlation between BIST Bank & BIST Technology in the short term.

Kartal (2020) analyzed the 2017-2019 observations recorded between 510 using data mining rather than an econometric model in the next estimation of Bitcoin. The K-Star algorithm, which analyses how macroeconomic variables affect Bitcoin prices, is a lazy learning pattern within the framework of machine learning. The analysis revealed that Bitcoin prices would rise, and the prediction success of the Bitcoin price would be high, and that the prediction success would be low, and although the analysis technique did perform in part, it was determined that estimating Bitcoin prices did not perform as expected yet.

Uyar et al. (2020) analyzed price predictability by analyzing Bitcoin prices between 2014-2018 and Ethereum prices between 2016-2018 using MACD, RSI and Band technical analysis methodologies. As a result of the study, it has been determined that 3 different technical analyzes give different and contradictory trading signals. Therefore, it is risky for investors to trade and earn according to technical analysis.

Menchetti et al. (2021) prepared an analysis to predict Bitcoin volatility and trading volume during major CBOE and CME derivatives trading first introduced Bitcoin futures. C-ARIMA was utilized in the analysis, and it was found that the exchange of CME instrument derivatives increased Bitcoin volatility more than double.

Atik, Köse, and Yılmaz (2021) tested the efficiency of the crypto money market in weak form, under the assumption that it is not possible to predict the future financial value by examining the price movements in efficient markets and to obtain above-average returns in these markets. First (ADF and PP) and second generation (Zivot Andrews Unit Root Test, Clemente-Montanes Reyes) unit root tests and Bitcoin (BTC), Ethereum (ETH), XRP, Litecoin (LTC) and Bitcoin Cash (BCH) cryptocurrencies Considering the dates they were included in, the data were observed starting from 2013, 2015 and 2017 until 9 June 2019. As a result of the analysis, it has been seen that the cryptocurrencies are not stationary, they contain unit roots, and by the random walk theory, the future price predictions can be made over the past price movements, and an above-average return can be obtained.

Özmerdivanlı (2021) examined the relationships between indicators such as oil, gold, Dollar, Euro, interest rate, Bitcoin, BIST 100 and VIX Indices in Turkey under the influence of the Covid-19 pandemic, based on daily data between 11 March 2020 and 31 July 2021. Johansen's co-integration test and causality tests based on VECM were used in the analysis, and it was determined that the long-term movements of the variables were together with the cointegration test. In short-term causality tests, one-way (Euro & Interest => BIST, Dollar & Euro => Bitcoin, Gold & Dollar & Euro => Interest, Dollar & Euro & Interest & Covid-19 => Oil, Gold & Euro & Dollar & Bitcoin => Covid-19, Interest => VIX Index) and bidirectional (BIST ⇔ Dollar) causality relationships have been determined.

Karkkainen (2021) conducted 4 studies in the field of Financial Technology (FinTech) and was conducted in one of the studies to examine the price fluctuations of Bitcoin, which entered the futures market in December 2017. This research analyzes mid-price data in CBOE and Bitcoin market index of Bitcoin Futures, which applies VAR and VECM process methodologies, Hasbrouck's information sharing and Gonzalo-Granger component share measurements to examine price finding in Bitcoin markets. Results from intraday prices show that future contracts lead to price discovery at different frequencies, even with comparable future trading volumes.

Papafotis (2021) studied price behavior, fluctuations, potential peaks, minimum values of cryptocurrencies, and the existence of a coherence and link between price behavior of one and the other.

And then the author carried out a correlation analysis and Johansen's co-integration analysis of daily prices Bitcoin (BTC), Litecoin (LTC), Ethereum (ETH), Ripple (XRP) and Monero (XMR), from 2013 to 2020. The results of the analysis differ for pre- and post-2017. Research indicates that 5 cryptocurrencies prior to 2017 also had an unstable model, but a similar and stable model was observed among cryptocurrencies after 2017.

3. RESEARCH AND METHODOLOGY

This study is carried out to provide data to those who wish to assess their investments in blockchain-based cryptocurrencies. The results of this study are expected to be able to help investors understand the correlation between traditional and modern investment tools such as government treasury bonds or indexes or interest rates versus digital/crypto currencies.

Based on these explanations, the hypothesis proposed is as follows:

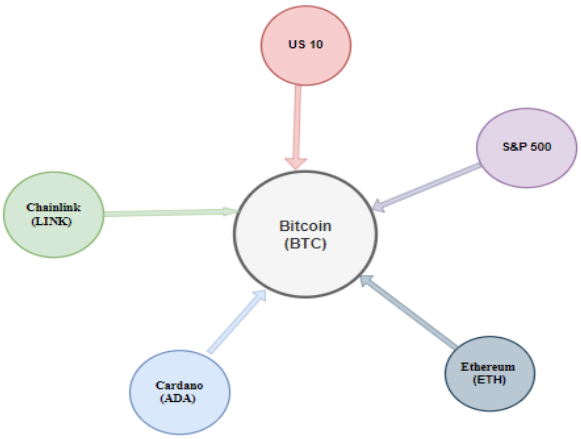
Research Hypotheses:

H_0: Bitcoin is not affected by S&P500 Index, US 10 Year Treasury, and altcoin values.

H_1: Bitcoin is affected by the S&P500 Index, US 10 Year Treasury, and altcoin values.

The research model assumes that an investor who is assumed to have savings of one hundred thousand dollars a year ago, would want to invest his/her savings in Bitcoin, Ethereum, Cardano and Chainlink, which were selected among the ten cryptocurrencies with the highest market value. If the investor in question includes defined cryptocurrencies in his portfolio, the causal relationship between these currencies, with the US 10-year Treasury, which is considered as a safe investment tool, and finally with the S&P 500 index, has been questioned. High volatility cryptocurrencies, US 10-year Treasury that can be considered as safe investment instruments, and often preferred stocks are included in the causality relationship, and the interaction level and direction of cryptocurrencies, which are assumed to form the investor's portfolio, with each other and other selected investment instruments are questioned.

Figure 1. Conceptual Framework



The research model assumes that the returns on the S&P 500 index and US 10-year Treasury and crypto money investments are affected by each other, and the altcoins among cryptocurrencies are affected by Bitcoin movements.

$$Y_t = c + \alpha_1 E_t + \alpha_2 A_t + \alpha_3 L_t + \alpha_4 S_t + \alpha_5 M_t + \epsilon_t \quad (1)$$

Y: Bitcoin (the dependent variable)

c: coefficient

E: Ethereum, A: Cardano, L: Chainlink, S: S&P500 Index, M: US 10 Year Treasury

ϵ: error term

In this study, the researcher aimed to understand the correlation between traditional and modern investment tools such as government treasury bonds or indexes or interest rates versus digital/crypto currencies. The research method used is causality analysis. Granger (1969) structured the events in the order they occurred, so that the previous event could be the cause of the next event, or in other words, to predict the values that the dependent variable might take in the future.

To test the research hypotheses, within 1-year (16.01.2020 – 16.01.2021) from the date of the analysis of the variables, Bitcoin (BTC), Ethereum (ETH), Cardano (ADA) and Chainlink (LINK) cryptocurrencies, US 10 Year Treasury weekly data of bonds and S&P 500 index were obtained from https://tr.investing.com/ website.

Weekly response rates were calculated starting with Data Week 19.01.2020. To be able to compare data with interest on deposits, FED decisions on interest rates were added according to the relevant dates. While the model was being built, the periodicity of the FED's interest rate decisions was not included in the model since there was no data set compatibility with other variables. But it was decided to present it as data and evaluation in the study regarding risk and return calculations.

Table 1. US Federal Reserve Interest Rate Decision

Date	*January 29*	*March 3*	*March 15*	*April 29*	*June 10*	*July 29*	*September 16*	*November 5*	*December 16*
Interest Rate	1,75%	1,25%	0,25%	0,25%	0,25%	0,25%	0,25%	0,25%	0,25%

Source: https://tr.investing.com/central-banks/

The value and rates of return of investing instruments are presented below.

Figure 2. Value and Rate of Return of Bitcoin in Tether (USDT)

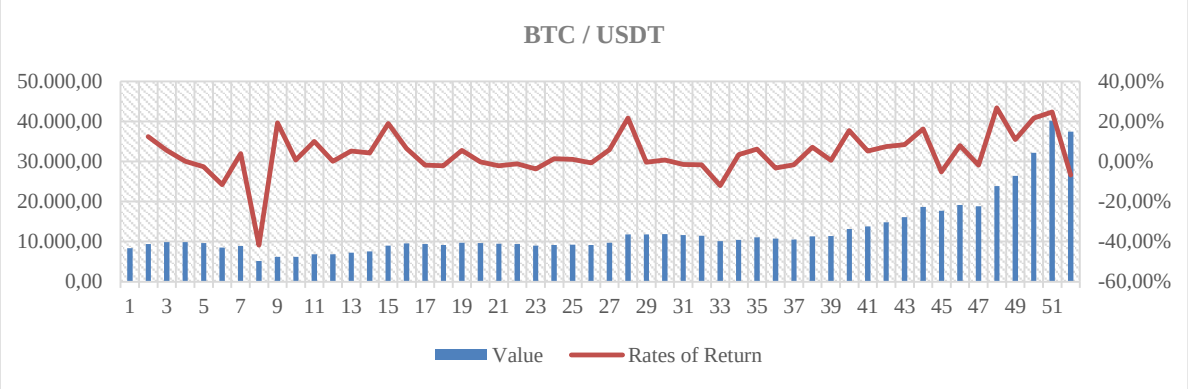


Figure 3. Ethereum Value and Rate of Return in Tether (USDT)

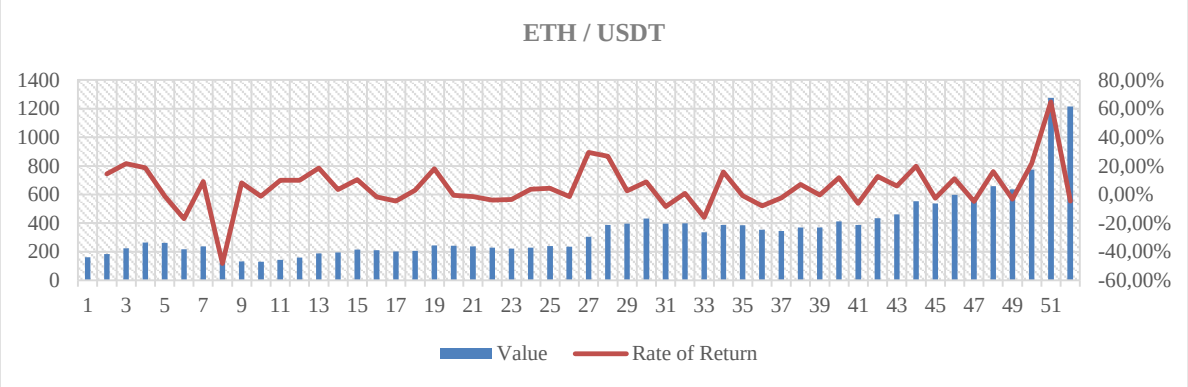


Figure 4. Value and Rate of Return of Cardano in Tether (USDT)

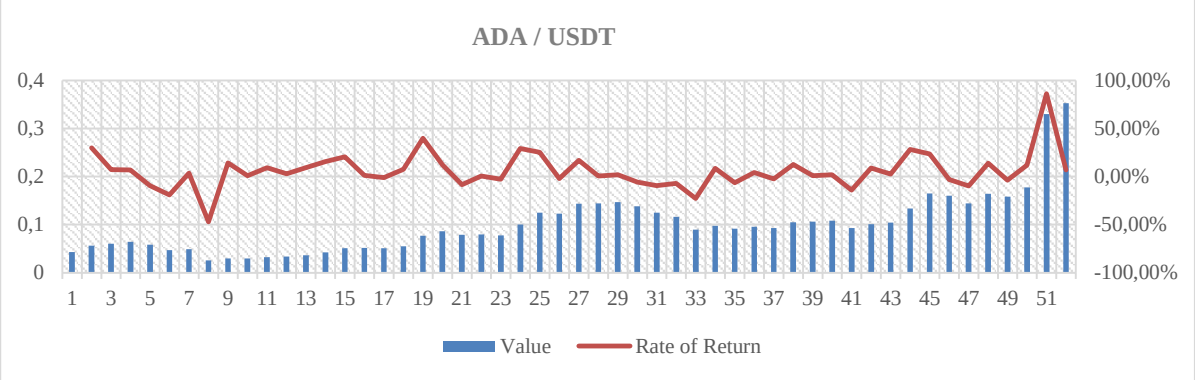


Figure 5. Value and Rate of Return of Chainlink in Tether (USDT)

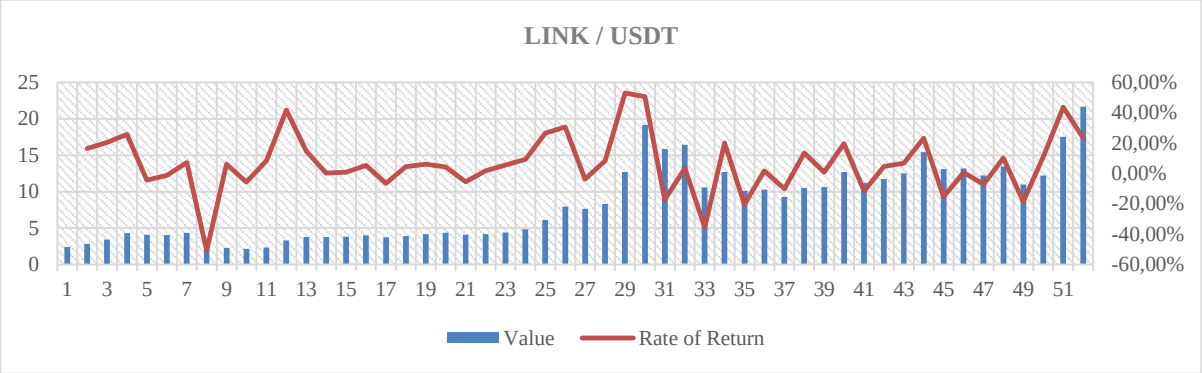


Figure 6. Value and Yield Rate of Tether (USDT) US 10 Year Treasury

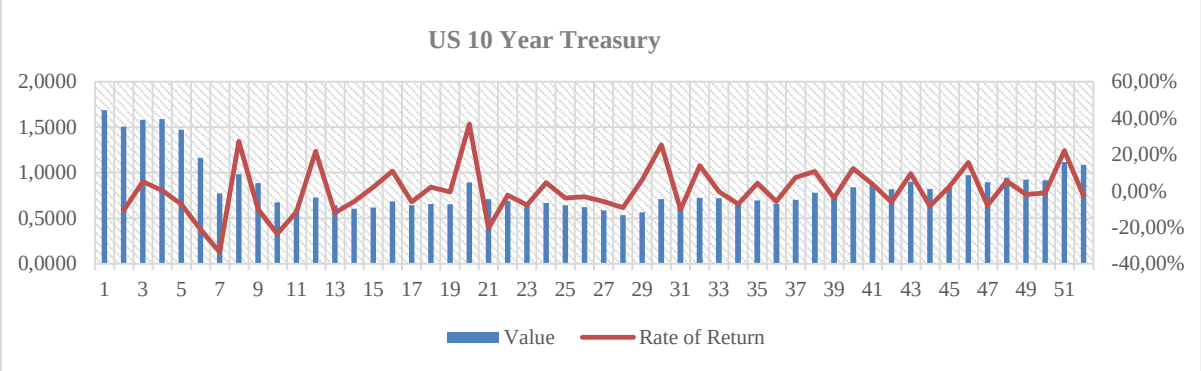
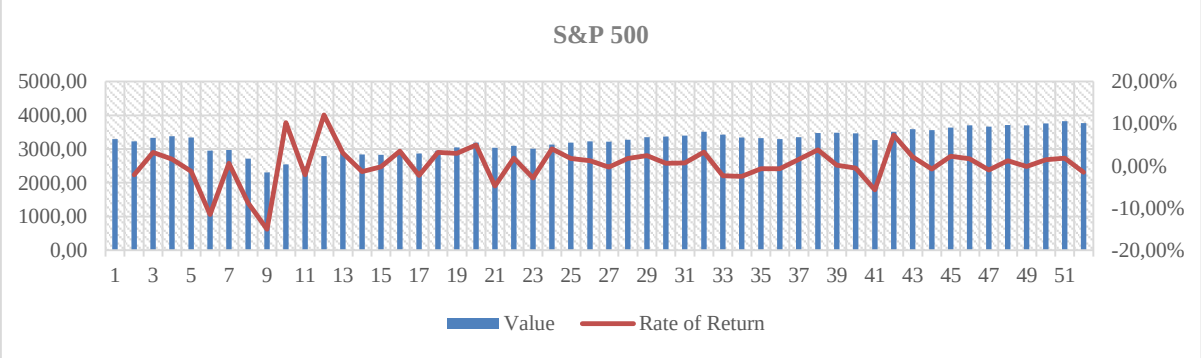


Figure 7. Value and Rate of Return of the S&P500 Index in Tether (USDT)



4. ANALYSIS AND FINDINGS

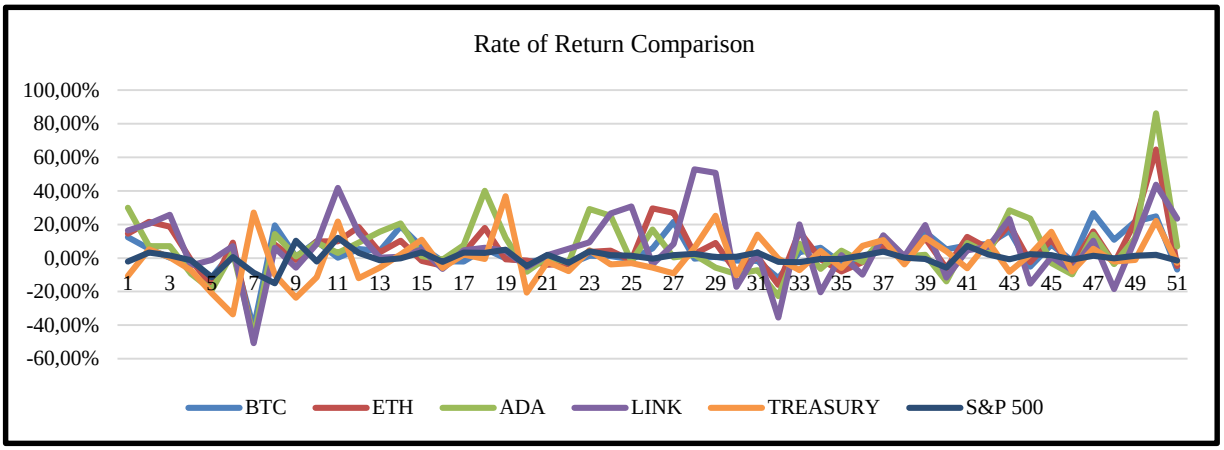
In the analysis, the data from which the logarithm was taken first, was transferred to the E-views 12 program. Graphs in this series were reviewed. Because there were significant jumps in the graphs, the data had to be adjusted from seasonal effects. As it is known that multiplication cannot be used because of negative values, the additive method has been used.

Table 2. Return and Risk Situations of Research Variables

	Average Return	Yield Ranking	Standard Deviation	Variance	Risk Ranking
BTC	3,61%	4	10,84%	1,18%	5
ETH	5,20%	3	15,31%	2,34%	3
ADA	5,74%	2	18,59%	3,46%	2
LINK	6,22%	1	19,31%	3,73%	1
FED	0,47%	5	0,51%	0,00%	7
TRESUARY	-0,02%	7	13,09%	1,71%	4
S&P 500	0,36%	6	4,45%	0,20%	6

The causal relationship between cryptocurrencies, the FED interest rate, the 10-year US Treasury and the S&P 500 Index was reviewed by performing a time series analysis using the data collected. Following the preparation of the dataset, the data were analyzed for causality using E-Views 12. As part of Granger's causal analysis, the causal relationship between the variables is determined by the occurrence of the events that will affect the relationship. Prior to starting the analysis, the log of the value data of all variables was taken.

Figure 8. Comparison of Research Variables with Rates of Return



The analysis process began with stability tests. Unit root tests (Dickey & Fuller ADF unit root test, Philips & Perron PP unit root test, Kwiatkowski et al. The KPSS root test and the Lee & Strazich root test) have been applied to measure the stationary level. In the stationary tests as part of Granger's causal analysis, all variables should be stationary regardless of their differences. The data were submitted for Correlogram surveillance. In stationary analysis, if a variable is affected by its past values, these data cannot have a constant variance and cannot show a common variance characteristic over the whole series. For this reason, it is recognized that there is a stationary problem with the data. Non-stationary data show a false regression problem. Figures can be inaccurate and unreliable. A correlation analysis was carried out to prevent that. The reason we chose 12 observations here is that we mean that an indicator can have an impact on up to 12 indicators afterwards. 12 were selected because 52 data were received for each variable in total per week.

All variables in the model have been determined to be stationary except the inflation variable. The process continued to consider the differences in the 1st stage. As the inflation data contain annual data, no difference could be found in the stagnation request. It was not stationary in the unit root tests, and no differences were found. The variable was therefore not included in the analysis. Then, standard unit root tests (Dickey & Fuller ADF unit root test, Philips & Perron PP unit root test, Kwiatkowski et al., KPSS unit root test and Lee & Strazich break unit root test) were performed for the variables. It was found that they are not stationary in option none without any difference. Because of the fractures, the root of the rupture unit was then tested. Radical unit failure tests have been evaluated and should be launched. Aberrant values of innovation are preferable because the types of fractures involve sudden shocks. In the ADA variable, stationarity was achieved in the trend and the fragile, in the constant, without any difference. When the 1st degree difference is taken in the variables BTC, ETH, LINK, S&P 500 and Treasury, stability are achieved in the tendency and fragile.

The research model has been revised as follows, since there are variables in the model that are stationary in the first-degree difference and the inflation data is not stationary without taking the difference.

$$\Delta Y_t = c + \alpha_1 \Delta E_t + \alpha_2 A_t + \alpha_3 \Delta L_t + \alpha_4 S_t + \alpha_5 M_t + \epsilon_t \quad (2)$$

ΔY: Bitcoin (The dependent variable),
c: coefficient
ΔE: Ethereum, A: Cardano, ΔL: Chainlink, S: S&P500 Index
M: US 10 Year Treasury
ϵ: Error term

While constructing the research model, Johansen's co-integration analysis was envisaged for altcoins, but while performing the stability tests, it was seen that Cardano (ADA) was stable without any difference, while Bitcoin (BTC), Ethereum (ETH) and Chainlink (LINK) variables were found to be stationary at the first differences. Since it is known that all the variables to be tested must be stationary at the 1st difference to perform the Johansen's co-integration analysis, the other stages of the causality analysis were started without cointegration. Added dummy variable. A dummy variable had to be added because of hopping out of the group. For the jump in the M12 period, the initiation of coronavirus vaccine administration is predicted as a dummy variable. The analysis was continued with the varying variance test. The variable variance issue (for the White option) could not be challenged because an inadequate compliance warning was received. At that stage, Breusch-Pagan-Godfrey was favored. Normality tests were subsequently conducted.

Table 3. Covariance Matrix of Research Variables

Dependent Variable: LNBTC				
Method: ARMA Maximum Likelihood (OPG - BHHH)				
Date: 01/22/21 Time: 17:33				
Sample: 1/19/2020 1/10/2021				
Included observations: 52				
Convergence achieved after 47 iterations				
Coefficient covariance computed using outer product of gradients				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
LNADA	0.031293	0.110190	0.283995	0.7778
LNETH	0.844851	0.136941	6.169440	0.0000
LNLINK	-0.142307	0.059015	-2.411374	0.0203
LNSP	-0.162560	0.239068	-0.679975	0.5003
LNTAHV	0.068286	0.056439	1.209913	0.2331
VACCINE	0.155460	0.037428	4.153579	0.0002
C	6.143598	2.355329	2.608382	0.0125
R-squared	0.983918	**Mean dependent var**		9.336331
Adjusted R-squared	0.980472	**S.D. dependent var**		0.435912
S.E. of regression	0.060915	**Akaike info criterion**		-2.570746
Sum squared resid	0.155848	**Schwarz criterion**		-2.195506
Log likelihood	76.83939	**Hannan-Quinn criter.**		-2.426888
F-statistic	285.5179	**Durbin-Watson stat**		1.977084
Prob(F-statistic)	0.000000			
Inverted AR Roots	.46-.38i	.46+.38i		

According to the data obtained, when the R^2 result is investigated, the search model may explain 98% of the changes in Bitcoin, which is the dependent variable. The F statistic does not support the H_0 hypothesis, and our model is important. Durbin-Watson value is convenient because it is close enough to ≈ 2. According to this, there was an important relationship between the dependent variable Bitcoin and Ethereum. Consequently, an increase of 1 unit in the BFR results in an increase of 0.85 in the BTC. There was no meaningful connection between Bitcoin and Cardano, Chainlink, S&P 500 and US 10-year Treasury. When the results of the "vaccine" variable added as a dummy variable are evaluated; During the periods when the vaccine was administered, BTC increased by 0.14 units more than the period when it was not administered.

5. CONCLUSION

Blockchain-based cryptocurrencies have continued to gain popularity with more and more people all over the world day by day, and cryptocurrency adaptation is exploding across a broad economic spectrum. The main purpose of this study is to provide data to those who wish to assess their investments in blockchain-based cryptocurrencies.

This study has provided an understanding of the correlation between traditional and modern investment tools such as government treasury bonds or indexes or interest rates versus digital/crypto currencies. This study has enriched the literature on portfolio theory and investment consultancy. It indicates the importance of cryptocurrencies as becoming a common investment tool.

Considering the 1-year average return rates, Chainlink as an investment tool has the highest return with 6.22%, although it is the riskiest investment tool because in the research Chainlink had the highest value on standard deviation and variance. Regarding average yield, Chainlink is followed by Cardano with 5.74%, Ethereum with 5.20% and ultimately Bitcoin with 3.61%. The highest return, but the riskiest investment tool among cryptocurrencies points to Chainlink. When cryptocurrency variables are assessed against each other, there is a direct proportional relationship between the higher average return and the high-risk classification. Compared to the return rates of selected cryptocurrencies, S&P500 Index and US 10-year Treasury, cryptocurrencies have the highest average rate of return. Cryptocurrencies are respectively, followed by interest rates and S&P500 Index. The US 10-year Treasury is the lowest average rate of return with a 10% loss.

Compared to the average return and risk values of selected investment tools, US 10-year Treasury offers not only the lowest rate of return but also a riskier tool than Bitcoin. The riskiest investment tools are altcoins, and they are followed by Treasury. S&P500 Index offers a lower rate of return and riskier in comparison with the FED interest rate. FED interest rates offer a higher rate of return and less risky than S&P500 Index. When the covariance values of the investment tools subject to the research are examined, it has been determined that Bitcoin has an increasing linear relationship with Ethereum, Cardano and Chainlink, and a decreasing linear relationship with the FED interest rates and US 10-year Treasury, while it is unrelated to the S&P500 Index.

On the other hand, Ethereum has proven to be linearly linked to Cardano and Chainlink, unrelated to the S&P 500 index and US 10-year Treasury, and linearly decreasing to Fed interest rates. The relationship between Ethereum and the FED interest rate is rather weak and can be considered independent. It has been determined that Chainlink is uncorrelated with the FED interest rate, US 10-year Treasury and S&P500 Index, the FED interest rate has a decreasing linear relationship with US 10-year Treasury and the S&P500 Index, but it can be considered unrelated because the values are quite low, and finally, US 10-year Treasury and the S&P500 Index are uncorrelated. Following the causality analysis, a meaningful relationship was found between the dependent variable Bitcoin and Ethereum. Consequently, an increase of 1 unit in the ETH, results in an increase of 0.85 in the BTC.

Blockchain technology and the digital currencies connected to these technologies broke all-time high (ATH) records because of the sudden and wide participation of institutional investors in the digitalization process of the global world, the broken records attracted new investors to the market, the prevalence and awareness of blockchain usage was at its highest since its emergence, reached several levels.

Because of the coronavirus pandemic over the last two years, the mutating virus, new living conditions, new ways of doing business, new public service areas and the new economic order;

governments, companies and also citizens, whose getting used to the new order will also prefer to resume the new lifestyle after coronavirus pandemic.

As a result, because of the transition to blockchain technology, the strengthening of technological development, the necessity of changing business and living conditions with the coronavirus pandemic, people will maintain the new normal lifestyle, the central banks of the countries will be tending to create national digital money by choosing blockchain technologies. And, the increasing interest, trust, and awareness of cryptocurrencies will increase progressively over the next few periods.

In this study, there are limitations which is only using 3 altcoins and US-10 Treasury, S&P 500 Index and FED interest rates variables to affect Bitcoin. Therefore, further researchers should be able to add other variables such as Gold, Silver, Oil, other global indexes, other growing altcoins and also exchange rates. Thus, further researchers might examine coronavirus effect on the different types of investment tools after the pandemic period is over. This research should also be repeatable in different periods.

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KATKI ORANI / *CONTRIBUTION RATE*	**AÇIKLAMA / *EXPLANATION***	**KATKIDA BULUNANLAR / *CONTRIBUTORS***
Fikir veya Kavram / *Idea or Notion*	Araştırma hipotezini veya fikrini oluşturmak / *Form the research hypothesis or idea*	Assoc. Prof. Cem KARTAL (Ph.D.) Ümran ÖZTÜRK CAN
Tasarım / *Design*	Yöntemi, ölçeği ve deseni tasarlamak / *Designing method, scale and pattern*	Assoc. Prof. Cem KARTAL (Ph.D.) Ümran ÖZTÜRK CAN
Veri Toplama ve İşleme / *Data Collecting and Processing*	Verileri toplamak, düzenlenmek ve raporlamak / *Collecting, organizing and reporting data*	Assoc. Prof. Cem KARTAL (Ph.D.) Ümran ÖZTÜRK CAN
Tartışma ve Yorum / *Discussion and Interpretation*	Bulguların değerlendirilmesinde ve sonuçlandırılmasında sorumluluk almak / *Taking responsibility in evaluating and finalizing the findings*	Assoc. Prof. Cem KARTAL (Ph.D.) Ümran ÖZTÜRK CAN
Literatür Taraması / *Literature Review*	Çalışma için gerekli literatürü taramak / *Review the literature required for the study*	Assoc. Prof. Cem KARTAL (Ph.D.) Ümran ÖZTÜRK CAN

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