Blockchain Dynamic and Macroeconomic Impact on The Stock Market

Amer M . Benarous[a]*, Ihsan T. Medeni[a], Tunç D. Medeni[a], Vildan Ateş[a]

[a]*Department of Management Information Systems, Ankara Yıldırım Beyazıt* Üniversitesi *Esenboğa Yerleşkesi Kızılca, Block C Dumlupinar Mahallesi 7, 06760,* Çubuk*, Ankara, Turkey*

ABSTRACT

This study sheds light on the achievements of digital financial technologies and blockchain technology in the stock market. This study aims to examine the relationship between blockchain technology and macroeconomic variables, as well as the impact these variables have on stock market performance. For this, authors used the methodology of correlation and regression analysis, analyzing data on cryptocurrencies, the stock market and key paper exchange rates. The study confirms a significant correlation between blockchain dynamics, particularly cryptocurrency price fluctuations, and stock market performance, indicating that movements in digital asset classes such as Bitcoin and Ethereum have measurable impacts on traditional financial markets. Traditional economic indicators continue to play a crucial role in stock market behavior, with variables like inflation rates and GDP growth showing strong correlations with market performance. The results suggest a complex interplay between blockchain technology and macroeconomic indicators, emphasizing a growing interconnectedness between emerging digital financial products and economic measures. In addition, the findings are particularly relevant for investors, financial analysts, and policymakers, highlighting the need for a holistic market analysis approach that integrates both new technological advancements in blockchain and economic indicators. The study underscores the evolving influence of blockchain technology on traditional stock markets that encompass both new digital assets and economic frameworks. Moreover, further studies could explore the impact of blockchain technology on specific sectors within the stock market, such as technology, finance, and consumer goods.

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*Corresponding author: Benarous M.A. – PhD, Department of Management Information Systems, Ankara Yıldırım Beyazıt Üniversitesi Esenboğa Yerleşkesi Kızılca, 06760 Çubuk, Ankara, email: 225217452@aybu.edu.tr

Макроэкономическое воздействие и динамика блокчейна на фондовый рынок

Бенарус А.М.[а]*, Медени И.Т.[а], Медени Т.Д.[а], Атеш В.[а]

[а]Факультет информационных систем управления, Университет Анкары Йылдырым Беязит, кампус Эсенбога, Блок С Думлупинар Махаллеси 7, 06760, Чубук, Анкара, Турция

АННОТАЦИЯ

Данное исследование освещает достижения цифровых финансовых технологий и технологии блокчейн на фондовом рынке. Целью данного исследования является изучение взаимосвязей между технологией блокчейна и макроэкономическими переменными, а также на анализ воздействия этих переменных на производительность фондового рынка. Для этого авторы использовали методы корреляционного и регрессионного анализа, анализируя данные о криптовалютах, фондовом рынке и ключевых бумажных обменных курсах. Исследование подтверждает значительную корреляцию между динамикой блокчейна, в частности, колебаниями цен на криптовалюты, и показателями фондового рынка, что указывает на то, что изменения в классах цифровых активов, таких как биткоин и Эфириум, оказывают ощутимое влияние на традиционные финансовые рынки. Экономические показатели продолжают играть решающую роль в поведении фондового рынка, а такие переменные, как уровень инфляции и рост ВВП, демонстрируют сильную корреляцию с показателями рынка. Результаты свидетельствуют о сложном взаимодействии между технологией блокчейн и макроэкономическими показателями, подчеркивая растущую взаимосвязь между появляющимися цифровыми финансовыми продуктами и экономическими мерами.Кроме того, полученные результаты особенно актуальны для инвесторов, финансовых аналитиков и политиков, подчеркивая необходимость целостного подхода к анализу рынка, который объединяет, как новые технологические достижения в блокчейне, так и экономические показатели. Исследование подчеркивает растущее влияние технологии блокчейн на традиционные фондовые рынки, которое охватывает как новые цифровые активы, так и экономические структуры. В целом, дальнейшие исследования могли бы изучить влияние технологии блокчейн на конкретные секторы фондового рынка, такие как технологии, финансы и потребительские товары.

КЛЮЧЕВЫЕ СЛОВА: динамика блокчейна, криптовалюта, макроэкономические показатели, показатели фондового рынка, финансовый анализ

КОНФЛИКТ ИНТЕРЕСОВ: авторы заявляют об отсутствии конфликта интересов

ФИНАНСИРОВАНИЕ: Исследование не спонсировалось (собственные ресурсы)

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*Корреспондирующий автор: Бенарус А.М. – PhD, факультет информационных систем управления, Университет Анкары Йылдырыма Беязыта Эсенбога Йерлешкеси Кызылджа, Блок С Думлупинар Махаллеси 7, 06760 Чубук, Анкара, Турция, email: 225217452@aybu.edu.tr

INTRODUCTION

A blockchain is a decentralized database or ledger that is distributed across nodes in a computer network. They are most known for their crucial role in cryptocurrency systems for maintaining a secure and decentralized record of transactions, but their uses go beyond cryptocurrencies. Blockchain may be used to make data in any industry immutable, ensuring that it remains unchangeable. It is a decentralized system that uses scripts to execute functions such as database management, retrieval, and storage. The system gathers transaction data, organizes it into blocks, and uses encryption to generate a hash. These hashes are then encrypted and linked together (Jiang et al., 2023).

In years blockchain technology has emerged as a ground-breaking innovation reshaping the landscape of transactions along with investment strategies. Serving as the foundation, for cryptocurrencies like Bitcoin blockchain has captured the attention of not only tech enthusiasts but economists as well as investors worldwide. This article explores the relationship between technology and the stock market a connection that plays a crucial role in shaping the future of finance as well as macroeconomics (Sáez, 2025). The study will conclude that macroeconomic conditions and the advancement of blockchain technology influence the performance of the stock market.

At its essence, blockchain is a ledger technology renowned for its security measures, transparency, as well as efficiency. These qualities have propelled it beyond the realm of cryptocurrencies to impact sectors, including the stock market. The incorporation of blockchain into stock market operations is not an upgrade in technology; it signifies a shift, in how financial assets are bought, and sold, moreover managed (Nehra & Sharma, 2021).

The importance of this study is highlighted by the potential that blockchain holds for the stock market. It offers to transform trading processes improve transparency levels, combat fraudulence, moreover streamline settlement procedures. Yet the influence of blockchain extends beyond enhancing aspects it carries significant macroeconomic implications ranging from altering money circulation speed to impacting monetary policies together with shaping global economic trends (Nehra & Sharma, 2021).

The significance of macroeconomic fundamentals and blockchain technology in influencing the stock market is emphasized in the findings. The correlation between cryptocurrencies, exchange rates, and stock prices demonstrates the intricate connection between digital asset classes and conventional economic indices (Jeris et al., 2022). The study highlights the need to implement a thorough market research approach that combines conventional economic indicators with blockchain-based asset characteristics.

Various industries, including cryptocurrencies, use blockchain, a decentralized database, to make data immutable. It uses scripts for database management, retrieval, and storage, and uses encryption to generate hashes. Blockchain's potential in the stock market is significant, as it can improve transparency, combat fraud, and streamline settlement procedures. It also has an impact on money circulation speed, monetary policy, and global economic trends. The correlation between cryptocurrencies, exchange rates, and stock prices demonstrates the complex relationship between digital asset classes and traditional economic indices.

Hence, it is imperative to carry out a comprehensive market research methodology, this study employed the Python programming language to examine the correlation between factors such as cryptocurrencies, exchange rates, and stock prices. It emphasized the impact of macroeconomic fundamentals and blockchain technology on the stock market. The study examines the influence of blockchain and cryptocurrency advancements on the dynamics of the stock market(Maleki et al., 2023).

LITERATURE REVIEW

Academics and financial experts are very curious about how blockchain dynamics and macroeconomic variables affect stock market performance. Several studies have investigated the influence of several factors on stock market behavior. These include macroeconomic indicators, blockchain technology, and their interplay (Wang et al., 2023).

The historical record of the correlation between macroeconomic indices, such as interest rates, inflation, GDP growth, and stock market success, is vast.NBER publications frequently illustrate a connection between the state of the economy and the performance of the market (Schwert, 1989). In his renowned work, Fama (1981) extensively examined the impact of anticipated and unanticipated shifts in economic activity on stock markets and argued that only unforeseen fluctuations in macroeconomic indicators have a substantial effect on stock prices (Bortis, 2023)

the price and the quantity equation, based on three constitutive principles: the classical labour value and surplus principles and the Keynesian principle of effective demand. Subsequently, two employment mechanisms implied in the super-multiplier relation, the classical-Keynesian quantity equation, are mentioned, the internal and the external employment mechanism. Section Seven provides an analysis of the actual situation on the basis of the external employment mechanism, associated with cumulative processes of increasing disequilibria and inequalities. Given this, it ought to be replaced by the internal employment mechanism, allowing for Keynesian employment and distribution policies (Section Eight.

Many studies have investigated the disruptive potential of blockchain technology since its emergence. Yermak (2017) asserts that blockchain technology can profoundly alter the organizational framework of financial institutions. Furthermore, Puri et al. (2017) present compelling data demonstrating the substantial influence of encrypted currencies on both financial markets and asset prices. Dyhrberg (2016) argues that cryptocurrencies possess attributes that resemble gold and the US dollar, suggesting their dual function as both a means of preserving wealth and a speculative financial instrument (Rudkin et al., 2023)high returns and comparative immaturity relative to equity and commodity markets. Topological Data Analysis (TDA.

Contemporary literature is now exploring the relationship between blockchain dynamics and conventional economic metrics. Corbet et al. (2019) discovered that cryptocurrency markets offer diversification advantages to investors in traditional stock markets, indicating a separation of blockchain assets from conventional economic cycles. Nevertheless, Gkillas and Katsiampa (2018) contend that noteworthy occurrences in the cryptocurrency market have the potential to affect stock markets, suggesting an intricate interplay between the two (Li, 2023).

There is a growing agreement that the dynamics of blockchain are interconnected with traditional financial markets. Instead, there exists a reciprocal interaction where one entity has an impact on the other. Auer (2019) proposes that cryptocurrencies, while influenced by the same market forces as traditional assets, also bring about novel dynamics in the financial equation. This is mostly seen through their impact on investor sentiment and perception of risk (Skinner, 2023).

By enabling the decentralized and safe movement of money, blockchain technology can link society in a way that has never been seen before. That helps to access massive amounts of publicly accessible data, such as the distribution of account balances and performed transactions, using blockchain techniques (States & Consciousn, 2023).

The impact of macroeconomic conditions on stock market performance in Malaysia. The findings indicate that the actual effective exchange rate has a moderately favorable impact on the KLCI index. Second, the inflation rate and overnight policy rate have a long-term beneficial impact on the KLCI index. The M2 money supply has a long-term negative impact on the KLCI index. This study builds on earlier research by studying the impact of macroeconomic factors on stock market performance in emerging economies (Siang & Rayappan, 2023).

The above literature provides insights into emphasizing the interconnected as well as the dynamic nature of blockchain technology, macroeconomic variables, also the stock market performance. Blockchain technology continues to improve so, more research is conducted, and a more nuanced understanding of these relationships is expected to emerge, which could have significant implications for investors, policymakers, as well as financial analysts alike.

Purpose of the Study

The fundamental purpose of this study is to investigate the direct impact that the dynamics of blockchain technology have on stock markets. The association between fluctuations and developments in cryptocurrency markets and the assessment and volatility of stock prices will be investigated in order to accomplish this goal. Specifically, the performance of certain stock indices and particular firms is the primary focus of attention.

A review of traditional economic indicators, including growth in gross domestic product (GDP), inflation rates, currency exchange rates, and interest rates, and an analysis of how effective these measures are in reducing competition in the stock market.

The purpose of evaluating the overall consequences is to explore whether the absence of the dynamic blockchain from macroeconomic metrics results in a synergistic or dampening effect. The investigation will focus on the relationship between these two factors and their combined impact on the stock market.

Research Hypotheses Hypotheses

H1: The dynamics of the blockchain and

cryptocurrency developments have a significant effect on the stock market.

H2: The macroeconomic indicators and the dynamics of blockchain technology have a significant impact on the performance of the stock market.

METHODOLOGY

The data were obtained from well-known financial databases as well as sources. The blockchain and cryptocurrency developments have a significant impact on the stock market, as evidenced by a curated dataset of financial data from january 1, 2003, to june 11, 2023. The data includes key features such as 'open', 'high', 'low', 'close', 'volume', 'year', and 'ytd gain'. The dataset provides valuable insights for market analysis, investment strategies, risk management, and academic research. It allows for thorough analysis of nasdaq stocks, currency markets, and cryptocurrencies, identifying potential investment opportunities, assessing portfolio risk, and testing hypotheses related to stock markets, currency markets, and cryptocurrencies. The dataset also aids in risk management by evaluating portfolio risk exposure and implementing appropriate risk management strategies. Overall, the dataset offers valuable insights for financial decision-making and analysis (Roeder et al., 2022).

The dataset employed in this study was collected by pune, maharashtra, india (financial data, 2023). The data covers the period from 2010 to 2023, enabling a comprehensive examination of trends and relationships throughout time. It includes an extensive compilation of financial information, comprising:

Cryptocurrencies: provides daily price and volume data for a range of cryptocurrencies, including bitcoin (btc), ethereum (eth), and others (seabe et al., 2023).

Currencies: provides exchange rate data for prominent fiat currencies such as the euro (eur), japanese yen (jpy), and other significant currencies (kumar m. & Arvind m., 2023).

Stocks: market statistics for multiple firms, such as apple inc. (Aapl), microsoft corp. (Msft), and others (sher et al., 2023).

The study used a quantitative research technique that is explanatory to scrutinize and elucidate the magnitude and orientation of the relationships between the independent variables (blockchain dynamics and macroeconomic indicators) and the dependent variable (stock market performance) (haynes-brown, 2023).

RESULTS AND DISCUSSION

Data analysis

Utilizing statistical approaches, such as correlation and regression analysis, to examine the relationships between variables. The research data was analyzed using python because of its exceptional skills and dominant position in the area. It improves productivity and efficiency, while also saving programmers a significant amount of time. Python's

Popularity stems from its natural language syntax, versatility, cost-effectiveness (being an open-source

And free language), active support community, and an extensive collection of modules and libraries. Python seamlessly interacts with a wide range of data science techniques (marikala, 2020).

Hypothesis testing

Involves the use of statistical tests to evaluate the accuracy of research hypotheses. This approach facilitates a methodical investigation of the cause-and-effect connections and offers a distinct structure for evaluating the outcomes of the statistical analyses.

Statistical analysis

Metadata of the dataset used to visually represent the attributes of the data that will be employed in this research attempt. This encompasses a diverse range of graphs illustrating many facets of the data, such as its distribution, central tendency, and volatility. Typical options include histograms, box plots, and bar charts (oh & pyrczak, 2023).

Histograms for distribution: histograms are an excellent tool for visually representing the spread of numerical data.

The histograms of apple inc.'S stock prices show the following:

Open-high-low-close histograms: a left-skewed graphic indicates that the stock regularly opened, reached its high, sank to its low, and closed at a lower price. It also suggests that greater stock prices were less common over the period in question (figure 1).

Volume Histogram: The significantly left-skewed signal indicates that on most trading days, the volume of stocks moved was on the low end. Days with unusually high trading volumes were few, indicating that huge trading volumes may be associated with significant corporate events or market news.
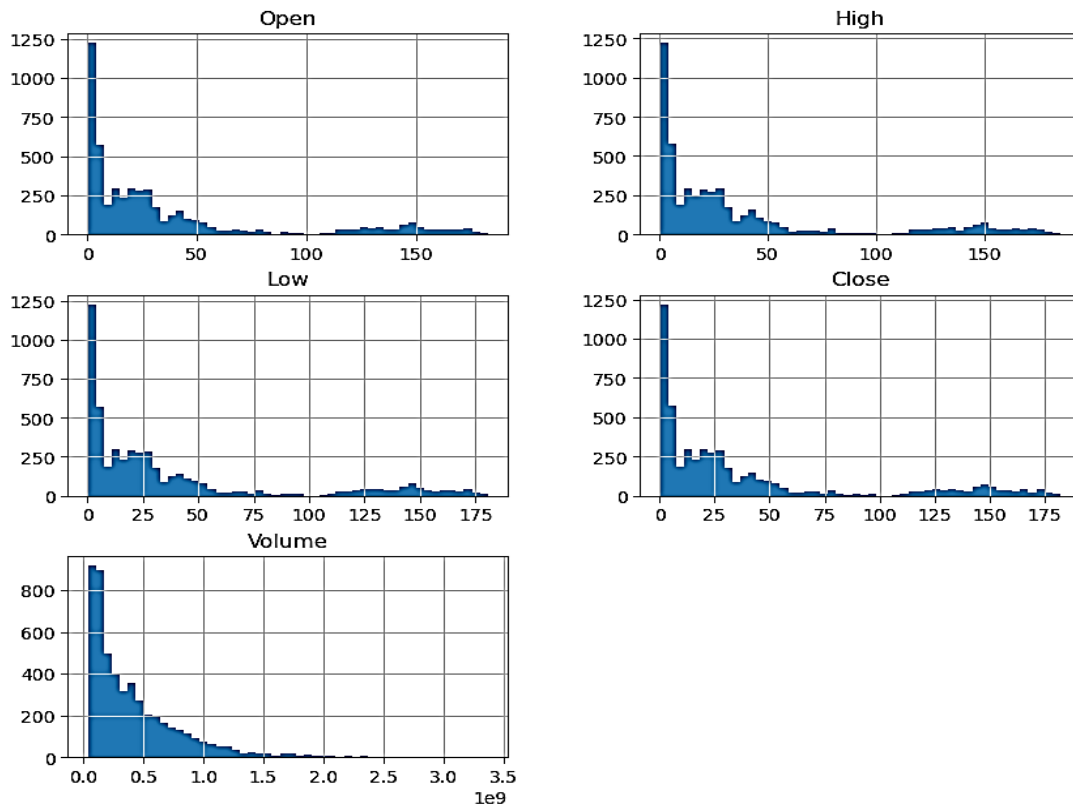
Figure 1. Distribution of Apple Inc. Stock Prices and volume

The skewness in these histograms demonstrates that Apple's stock prices tended to be lower for most of the recorded period, with rare peaks, and those high trade volumes.

Box Plots for Central Tendency and Variability: Box plots offer a reliable representation of the measures of central tendency, dispersion, and outliers (Figure 2).
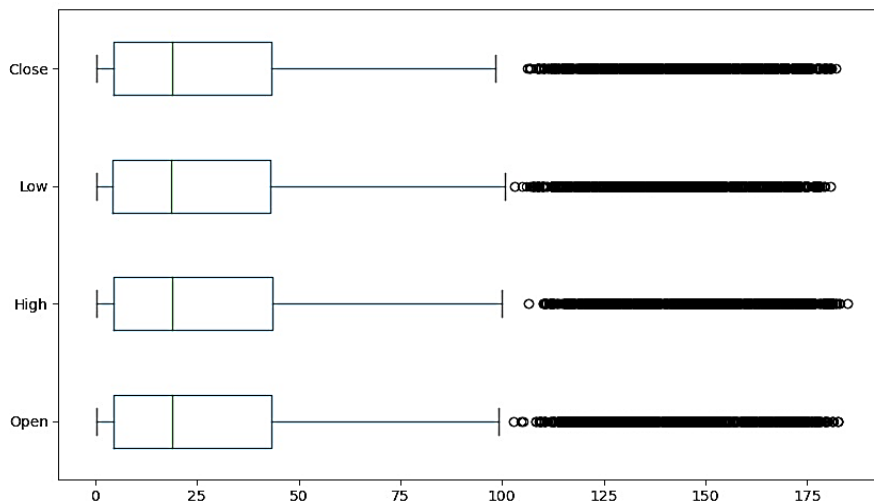

Figure 2. Box Plot of Apple Inc. Stock Price

As shown in Figure 2, these visualizations facilitate comprehension of data outliers and central tendencies, as well as the detection of any outliers that may be present. The figure illustrates

that 'Open' values vary more than the others and that all categories have several exceptional values that are significantly higher than the norm.

Correlation analysis

Correlation analysis examined the relationships between various financial variables in each dataset. This heatmap is used to visualize the degree of correlation between various financial metrics, particularly focusing on the Euro. The heatmap uses a color scale where red indicates a strong positive correlation (a relationship where both variables move in the same direction), and blue shows a weaker correlation. As illustrated in Figure 3 strong positive correlations with a P-value of 1 were found between the opening, closing, high, and low values of Bitcoin and Apple stocks, indicating synchronous price movements.
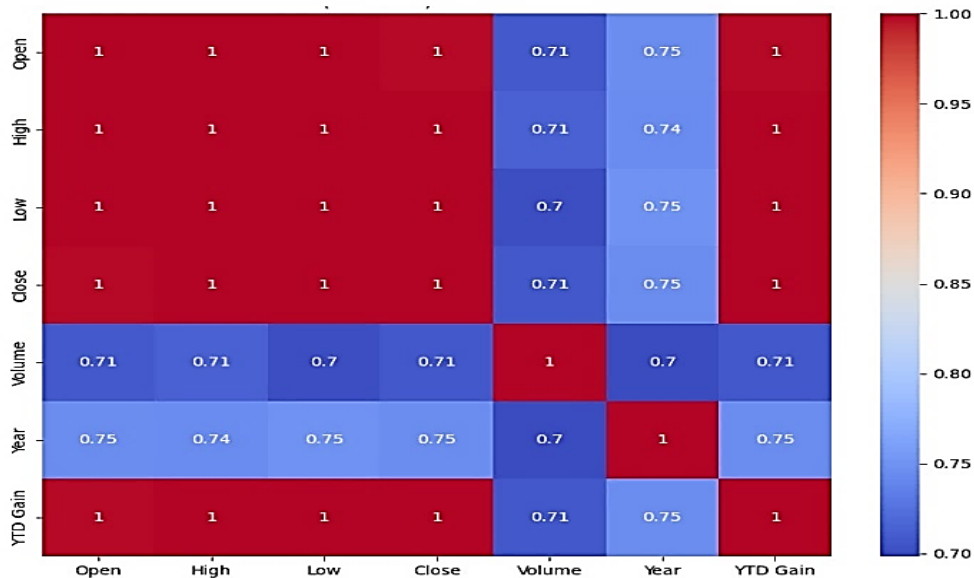

Figure 3. Euro (USD) correlation Matrix

Likewise, the Euro saw consistent swings in its price throughout the day. The statistics about Bitcoin and Apple stock demonstrated correlations between price indicators and trading volumes (Oh & Pyrczak, 2023). Figure 4 shows strong positive correlations with a P-value of 1 between the opening, closing, high, and low values of cryptocurrency.
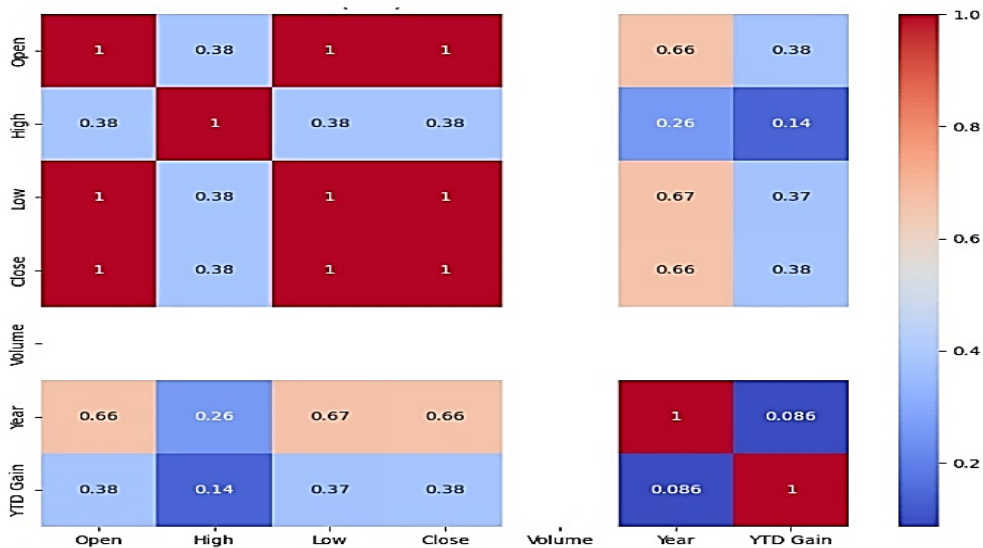

Figure 4. (Bitcoin. EUR) correlation Matrix

The diagrams presented depict a correlation matrix heatmap illustrating diverse financial measures of the Euro (EUR). Heatmap does not display any negative correlations, suggesting that the relationships are either positive or non-existent.

The color scale positioned on the right side of the heatmap indicates the extent of the association, with red denoting a strong positive correlation as well as blue indicating a lesser correlation. It is crucial to comprehend that correlations might vary between -1 and 1. Grade 1 signifies a perfect negative connection, step 0 signifies a complete absence of communication, and step 1 signifies a perfect positive correlation. Nevertheless, this heatmap does not exhibit any adverse associations.

Regression analysis

The represented values in Table 1 show the coefficient estimate for each variable in the regression model, the coefficient estimates provide information about the relation between the independent variables (BTC_Close and EUR_Close) and the dependent variable AAAPL_Close. P-values are very close to (0.0), which suggests that both variables (BTC_Close and EUR_Close) are highly significant to AAAPL_Close. They have a much greater influence based on the coefficient.

The model determines that both BTC_Close and EUR_Close are significant predictors of the dependent variable, with EUR_Close having a much greater effect based on the coefficients. The negative intercept shows a baseline level that has been modified upward by rises in BTC and EUR closing prices.

Table 1. Regression model

Variables	Coef.	Std err	t-value	p-value	0.025	0.975
const	-38.7	1.06	-36.7	0.0	-40.7	-36.6
BTC_Clos	0.0004	0.00005	74.90	0.0	0.00	0.00
EURClos	55.7	1.37	40.77	0.0	52.98	58.34

A regression study was undertaken to assess the impact of Bitcoin and Euro closing prices on the performance of Apple's shares. Figures show that the investigation revealed a significant correlation between the prices of Bitcoin and the Euro and Apple's stock price. Specifically, every increase in the prices of Bitcoin and Euro resulted in a proportional increase in Apple's stock price (Arkes, 2023). In Figure 6, the independent variable is the closing price of Bitcoin.
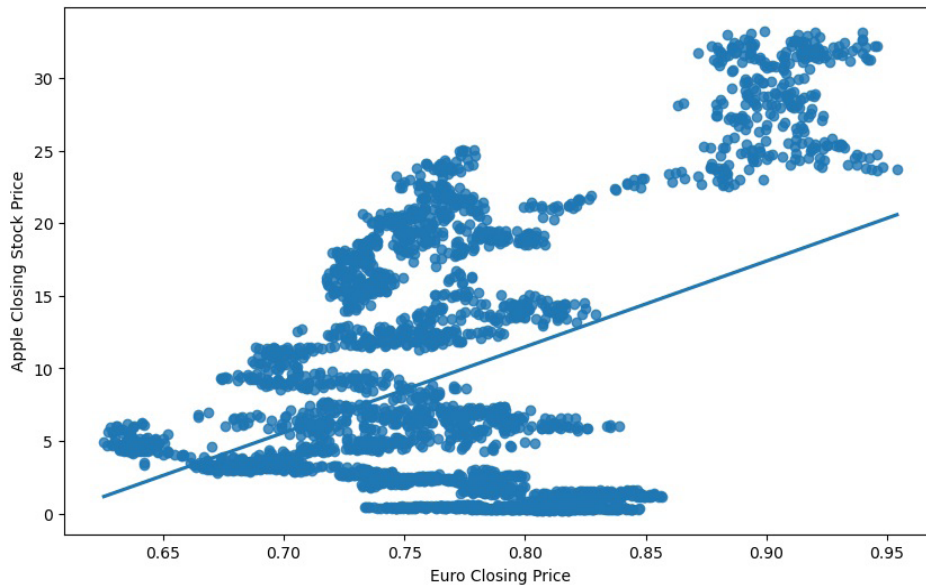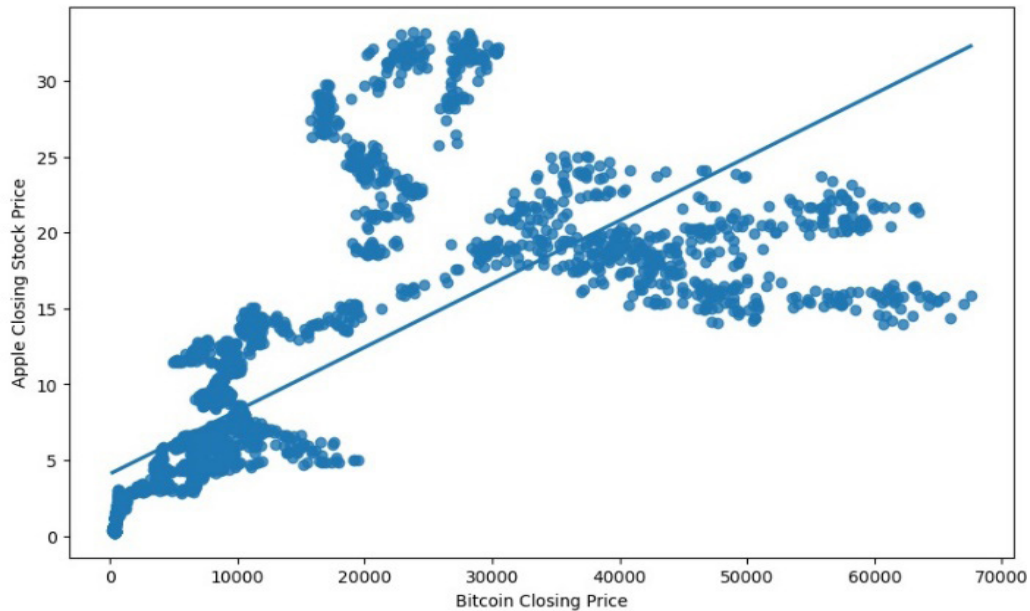

Figure 5. Regression Analysis: EUR_Close vs AAPL_Close

The slope of the line in each graph shows how strongly changes in the price of a currency (Bitcoin or Euro) are associated with changes in the price of Apple shares. In Figure 7, the independent variable is the Euro closing price.

Figure 6. Regression Analysis: BTC_Close vs AAPL_Close

Every data point on the scatter plot represents a distinct observation in your dataset. The x-coordinate indicates the independent variable, which may be either the closing price of Bitcoin or the closing price of Euro. The y-coordinate corresponds to the dependent variable, which is exactly the closing stock price of Apple.

The line is the ideal line obtained from the regression model.

The slope of the line indicates the strength and direction of the relationship between the independent and dependent variables. A steeper gradient would suggest a stronger association.

Hypothesis testing

The hypotheses were evaluated using regression analysis, and the following conclusions were derived:

Impact of Blockchain Dynamics:

The suggestion about the effects of blockchain dynamics has received approval. Bitcoin's significant influence illustrates that the mechanics of blockchain impact the stock market's performance.

The dynamics of the blockchain and cryptocurrency developments have a significant effect on the stock market.

Findings

The descriptive data provided useful insights into the volatility, dispersion, and trends in Bitcoin, Euro, and Apple's stock prices over the years. Bitcoin displayed substantial volatility, characterized by a wide range of values and trading volumes, indicating the inherent instability and speculative nature of cryptocurrency markets.

The Euro demonstrated a high level of stability with minimal significant fluctuations over time, consistent with the typical behavior of a major fiat currency.

Apple Inc. stocks showed a gradual upward trend over time, accompanied by the expected daily fluctuations that are typical of a heavily traded stock.

Bitcoin and Euro values affect Apple's stock price, with Bitcoin increasing somewhat and the Euro having a more pronounced effect. Correlation matrices indicate significant positive correlations between daily prices, suggesting a possible connection between increased transaction volumes and price volatility.

Bitcoin's correlations indicate a connection between increased transaction volumes and substantial price volatility. The Euro's volatility has decreased because of less trading activity. Apple's stock correlations exhibit standard stock market trends, with daily prices moving in harmony and showing some relationship to trade volume.

The data exhibited substantial fluctuations in the values of Bitcoin and the Euro, as well as the

stock prices of Apple over a period of time. Bitcoin exhibited volatility as a result of speculative markets, whereas the Euro demonstrated stability. The stock price of Apple had a moderate rising trajectory, while Bitcoin experienced a minor increase and the Euro had a more significant impact. The correlation matrices revealed positive associations between daily prices, indicating a rise in transaction volumes and price volatility.

Correlation analysis

The correlation matrices showed strong positive relationships between the daily Open, High, Low, and Close prices for both Bitcoin as well as Euro, which is a typical feature of financial time series data. The correlation between volume with price fluctuations in the case of Bitcoin shows varying degrees of linkage.

Bitcoin correlations suggest a potential link between higher transaction volumes as well as significant price volatility (Zenelgabdin, & Akhmetbek, 2020).

The Euro had reduced levels of volatility in correlations, mostly due to the constant lack of trading activity.

The stock correlations of Apple Inc. exhibited similarities to the typical patterns found in stock markets, where the daily prices moved in synchrony and also displayed some connection with the trading volume.

Regression Analysis

The regression study aimed to determine the influence of Bitcoin and Euro prices on Apple Inc.'s stock performance. The Bitcoin price had a statistically significant influence on the stock price of Apple, as shown by a positive coefficient. This indicates that when the value of Bitcoin increases, the stock price of Apple Inc increases, but this increase is rather small. The Euro price shows a significant positive association with the stock price of Apple, with a larger coefficient indicating a stronger impact.

Hypothesis Testing

According to the findings from the regression analysis, our hypothesizes were supported, which means:

The dynamics of the blockchain and crypto-currency developments significantly affect the stock market.

The macroeconomic indicators and the dynamics of blockchain technology significantly impact the stock market's performance.

Bitcoin and Euro values affect Apple's stock price, with Bitcoin increasing somewhat and the Euro having a more pronounced effect. Correlation matrices indicate significant positive correlations between daily prices, suggesting a possible connection between increased transaction volumes and price volatility. Bitcoin's correlations indicate a connection between increased transaction volumes and substantial price volatility. The Euro's volatility has decreased because of less trading activity. Apple's stock correlations exhibit standard stock market trends, with daily prices moving in harmony and showing some relationship to trade volume.

CONCLUSION

Results show that both the vagaries of the blockchain as well as macroeconomic data are fundamental aspects that affect the performance of the stock market. The study found that changes in Bitcoin prices had a proportionate effect on the Apple Arrow price, indicating that stock markets might respond to encrypted currency movements. furthermore, changes in the euro exchange rate had a direct impact on Apple's stock price, demonstrating the importance of traditional macroeconomic factors.

The results illustrate the complex relationship between the evolution of digital asset classes as well as traditional economic indicators. It also reveals a more inclusive market pattern in which traditional as well as emerging financial products are increasingly intertwined.

The results of the study will have an impact on investors, analysts, and regulators. They stress the importance of implementing a comprehensive market research strategy that combines traditional economic indicators with the constantly changing asset features of the blockchain.

Based on the findings, it seems that there is a complicated connection between the expansion of digital asset classes and the rise of conventional economic indicators. It is important to pay thorough consideration to this experience. Because the market pattern is characterized by a growing degree of interconnectedness between conventional and innovative financial products, further research and analysis on the overall market pattern are required.

The study's findings also point to the need to put into action a complete market research approach that incorporates the benefits of dynamic blockchain assets with conventional economic indicators that have been used in the past.

AUTHOR CONTRIBUTIONS

Conceptualization and theory: AB; research design: AB and IM; data collection: TM and VA; analysis and interpretation: AB, IM, TM and VA; writing draft preparation: AB, TM and VA; supervision: IM; correction of article: AB, IM, TM and VA; proofread and final approval of article: AB, IM, TM and VA. All authors have read and agreed to the published version of the manuscript.

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INFORMATION ABOUT THE AUTHORS

*Amer M. Benarous – PhD, Department of Management Information Systems, Ankara Yıldırım Beyazıt Üniversitesi Esenboğa Yerleşkesi Kızılca, Ankara, Turkey, ORCID ID https://orcid.org/0000-0001-6990-2561
Ihsan T.Medeni – PhD, Professor, Department of Management Information Systems, Ankara Yıldırım Beyazıt Üniversitesi Esenboğa Yerleşkesi Kızılca, Ankara, Turkey, ORCID ID: https://orcid.org/0000-0002-0642-7908
Tunç D. Medeni – PhD, Professor, Department of Management Information Systems, Ankara Yıldırım Beyazıt Üniversitesi Esenboğa Yerleşkesi Kızılca, Ankara, Turkey, ORCID ID: https://orcid.org/0000-0002-2964-3320
Vildan Ateş – PhD, Associate Professor, Department of Management Information Systems, Ankara Yıldırım Beyazıt Üniversitesi Esenboğa Yerleşkesi Kızılca, Ankara, Turkey, ORCID ID: https://orcid.org/0000-0002-8855-8556

АВТОРЛАР ТУРАЛЫ МӘЛІМЕТТЕР

*Бенарус А.М. – PhD, Басқару ақпараттық жүйелері бөлімі, Анкара Йылдырым Беязыт университеті Есенбога кампусы Кызылжа, Анкара, Түркия, ORCID ID: https://orcid.org/0000-0001-6990-2561.
Медени И.Т. – PhD, профессор, Басқару ақпараттық жүйелері департаменті, Анкара Йылдырым Беязыт университеті Есенбоға кампусы Кызылжа, Анкара, Түркия, ORCID ID: https://orcid.org/0000-0002-0642-7908.
Медени Т.Д. – PhD, профессор, Басқару ақпараттық жүйелері департаменті, Анкара Йылдырым Беязыт университеті Есенбоға кампусы Кызылжа, Анкара, Түркия, ORCID ID: https://orcid.org/0000-0002-2964-3320.
Атеш В. – PhD, қауымдастырылған профессор, Анкара Йылдырым Беязыт университетінің Есенбога кампусы Қызылжа, Анкара, Түркия, ORCID ID: https://orcid.org/0000-0002-8855-8556.

СВЕДЕНИЯ ОБ АВТОРАХ

*Бенарус А.М. – PhD, кафедра информационных систем управления, Университет Анкары Йылдирим Беязит, кампус Эсенбога, Кызылджа, Анкара, Турция, ORCID ID: https://orcid.org/0000-0001-6990-2561.
Медени И.Т. – PhD, профессор, Факультет информационных систем управления, Университет Анкары Йылдирим Беязит, кампус Эсенбога, Кызылджа, Анкара, Турция, ORCID ID: https://orcid.org/0000-0002-0642-7908.
Медени Т.Д. – PhD, профессор, Кафедра информационных систем управления, Университет Анкары Йилдирим Беязит, кампус Эсенбога, Кызылджа, Анкара, Турция, ORCID ID: https://orcid.org/0000-0002-2964-3320.
Атеш В. – PhD, ассоциированный профессор, Университет Анкары Йылдирим Беязит Кампус Есенбога Кызылджа, Анкара, Турция, ORCID ID: https://orcid.org/0000-0002-8855-8556