



ISSN: 2617-6548

URL: www.ijirss.com



CBDC news sentiment on the stock market and cryptocurrencies

 Endrizal Ridwan^{1*},  Mailinda Tri Wahyuni²,  Dwi Fitrizal Salim³

^{1,2}*Department of Economics, Universitas Andalas, Padang-Indonesia.*

³*School of Economics and Business, Telkom University, Bandung-Indonesia.*

Corresponding author: Endrizal Ridwan (Email: eridwan@eb.unand.ac.id)

Abstract

This study aims to analyze the impact of news related to Central Bank Digital Currency (CBDC) on the stock and cryptocurrency markets in the United States. Using the Time-Varying Parameter Vector Autoregression (TVP-VAR) method, this study examines the responses of the S&P 500 index, the CBOE Volatility Index (VIX), Bitcoin trading volume, and Ethereum trading volume to CBDC news from January 2020 to December 2023. The results indicate that CBDC news has a positive effect on stock market prices, but its impact on market volatility is negligible. Furthermore, Bitcoin and Ethereum trading volumes exhibit a declining trend in response to the rapid development of CBDC news. Although CBDC development is still in its early stages, these findings provide insights into the potential influence of CBDC news on financial market behavior, particularly in shaping investor sentiment and digital asset trading patterns. The study suggests that policymakers and investors should closely monitor CBDC developments, as they may gradually affect the financial ecosystem. Future research should further explore the long-term effects of CBDCs on financial market stability and cryptocurrency adoption.

Keywords: CBDC, Cryptocurrency, Stock market, United States, Volatility.

DOI: 10.53894/ijirss.v8i1.5043

Funding: This work is supported by Institute of Research and Community Service (LPPM) Universitas Andalas under Kontrak Penelitian Tesis Magister (PTM) Batch I with (Grant Number: 296/UN16.19/PT.01.03/PTM/2024).

History: Received: 22 January 2025 / Revised: 24 February 2025 / Accepted: 27 February 2025 / Published: 28 February 2025

Copyright: © 2025 by the authors. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

Competing Interests: The authors declare that they have no competing interests.

Authors' Contributions: All authors contributed equally to the conception and design of the study. All authors have read and agreed to the published version of the manuscript.

Transparency: The authors confirm that the manuscript is an honest, accurate, and transparent account of the study; that no vital features of the study have been omitted; and that any discrepancies from the study as planned have been explained. This study followed all ethical practices during writing.

Publisher: Innovative Research Publishing

1. Introduction

Central Bank Digital Currency (CBDC) is a form of digital currency issued by central banks, which aims to provide a secure and efficient medium of exchange in the digital age. Unlike cryptocurrencies like Bitcoin, CBDCs are issued and regulated by a central authority, thus guaranteeing their stability and status as legal tender. CBDC operates on blockchain or distributed ledger technology, enabling secure and transparent transactions. One of the main motivations behind the development of CBDCs is to modernize existing financial infrastructure and payment systems, making transactions faster, cheaper, and more accessible to the wider community. Additionally, CBDCs offer central banks greater control over monetary policy, allowing them to better manage factors such as inflation and financial stability [1].

The introduction of CBDCs has sparked discussions and pilot projects in many countries around the world [2]. Some see CBDCs as a potential solution to improve financial inclusion and reduce reliance on cash, but others have voiced concerns regarding privacy, cybersecurity, and their potential impact on the banking system. Nevertheless, CBDCs represent a significant evolution in the way we conceptualize and transact with currencies, with their adoption likely to reshape the financial and economic landscape in the digital age [3].

Despite previous research, understanding the impact of CBDC news on financial markets, particularly the stock market and cryptocurrencies, is still limited. The highly volatile financial markets, especially when there are CBDC-related announcements, demonstrate the need for in-depth analysis to help investors and policymakers make informed decisions [4]. The study aims to fill that void by investigating the impact of CBDC news on the stock and cryptocurrency markets in the United States, providing valuable insights into the growing relationship between traditional finance and digital currencies. The United States was chosen as the focus of this research due to its pivotal role in the global financial ecosystem. As the world's largest economy, the US financial market has a major influence on global trends, making it an ideal location to examine the relationship between traditional and digital financial systems [5]. Furthermore, the availability of comprehensive and reliable data from the US market allows this study to conduct an in-depth analysis of the impact of CBDC-related announcements. This ensures the robustness and relevance of the findings for investors, policymakers, and academics. On the other hand, the development of financial technology, including CBDC, is increasingly significant in the US, with various policies and initiatives that may affect the implementation of CBDC globally. Therefore, this research is not only relevant for the US market but also provides valuable insights for other countries that are considering or have piloted CBDCs [6].

2. Literature Review

Along with the times, technology is increasingly playing an important role in various aspects of life, including in the financial sector. Technological advances not only affect the way we interact with each other, but they also bring fundamental changes to the way we manage and utilize financial resources [7]. Technological innovations, such as blockchain and fintech, have transformed the operational models of conventional financial institutions, forcing them to adapt to stay competitive in the digital age [8]. These changes not only create new opportunities but also significant challenges, particularly in how the monetary system and financial transactions are conducted around the world.

Blockchain, as one of the most significant technological advancements, has become a major driver in transforming the global financial system [9]. Introducing cryptocurrencies like Bitcoin in 2009 was a turning point in how we view money and digital transactions [10]. On the other hand, the growing interest from central banks and national governments in Central Bank Digital Currency (CBDC) shows a push to digitize fiat currencies for better efficiency and security [11]. CBDCs have great potential to change the global financial landscape by providing a secure and efficient medium of exchange in the digital age while offering greater control over monetary policy [12].

Discussion about technology blockchain began with the publication of an official document by Satoshi Nakamoto in 2008, which led to the formation of Bitcoin in 2009. Observing the benefits associated with financial innovation-based blockchain, Central banks, and national governments are keen to explore the digitization of fiat currencies and develop a country's economic structure for greater efficiency and security. Central Bank Digital Currency (CBDC) is the result of this exploration effort [13]. Kristalina Georgieva, Managing Director of the IMF, highlighted the great interest in CBDCs by pointing out that more than half of global central banks are considering introducing CBDCs in their economic systems [14].

Regarding CBDC, the United States is represented by the Federal Reserve has not yet made a decision on whether to seek or implement a central bank digital currency, or CBDC. The Fed has explored the potential benefits and risks of CBDCs from various perspectives, including through research and technological experimentation. Currently, in the United States, banknotes Federal Reserve (i.e. physical currency) are the only type of central bank money available to the general public. Like existing forms of money, CBDCs will allow the general public to make digital payments. However, as an obligation Federal Reserve, CBDCs will be the safest digital assets available to the general public, with no associated credit or liquidity risk [15].

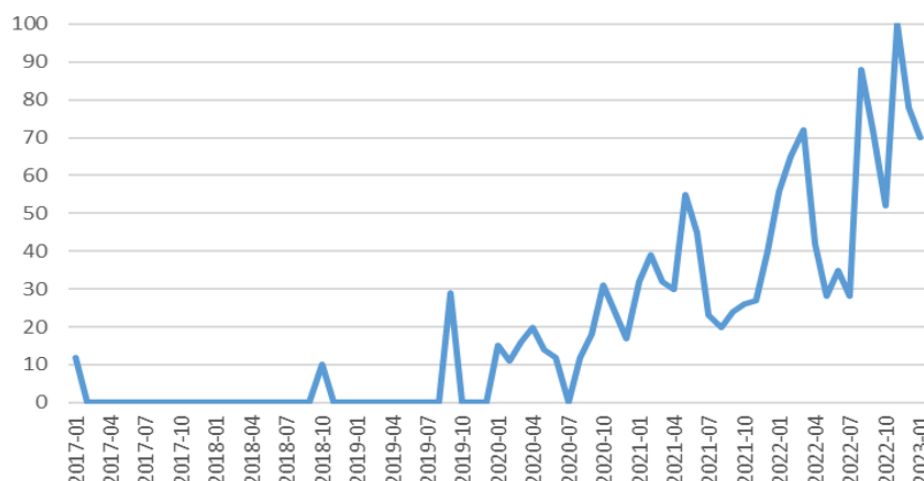


Figure 1.
CBDC Topic Popularity Index in the US 2017-2023.

In addition to the fact that there is still a lot of research and technological experiments related to CBDC in the United States, the interest of the public and media in the United States regarding the topic of CBDC is quite high during the period from 2017 to 2023. It can be seen in [Figure 1](#). The popularity of topics discussed and searched for related to CBDC is increasing from year to year, even though there are increases and decreases every year. In general, the popularity of CBDCs increased significantly around 2020 and continues to increase until 2023. 2020 is a period when central banks begin to seriously explore and announce CBDC-related projects. The COVID-19 pandemic has also accelerated interest in digital currencies as an alternative payment. Some central banks such as [The Fed \[15\]](#) began to announce conducting research and experiments related to

CBDC, this is also one of the reasons for the increasing popularity of CBDC among the public.

The significant public and media interest in CBDCs in the United States indicates a growing awareness of the potential for transformation in the financial and payment systems with the adoption of digital technology. This reflects the demand for innovation in financial infrastructure, as well as an increased understanding of the implications of CBDCs on the economic and financial life of society as a whole. The numerous in-depth studies, stakeholder consultations, and prototype developments reflect the government's commitment to take this public interest seriously and prepare a solid foundation for the potential future adoption of CBDCs.

Still in the stage of in-depth study and exploration related to CBDC, several studies state that news about CBDC can affect many financial sectors that are currently running. Research [Wang, et al. \[2\]](#) stated that financial markets are sensitive to the uncertainty of news related to CBDCs. CBDC news not only affects the financial market but also affects the cryptocurrency market [\[16\]](#). The reaction of the cryptocurrency market to the announcement of the Central Bank Digital Currency varies greatly from time to time. The impact of CBDC shocks on financial markets has been increasingly visible during the COVID-19 pandemic [\[17\]](#).

News about the initiation of Central Bank Digital Currency (CBDC) can have a significant impact on the stock market in a variety of ways. Positive announcements, such as central banks exploring or implementing CBDCs, can boost investor sentiment and generate speculation, especially benefiting stocks in financial technology, payment processing, and other sectors [\[18\]](#), blockchain. In contrast, traditional financial institutions may face challenges, impacting their stock prices, while companies that provide CBDC-related infrastructure and technology may benefit. Regulatory uncertainty and concerns about the impact of CBDCs on currency markets, monetary policy, and global trade can also affect stock prices, thus emphasizing the need for investors to closely monitor CBDC developments for informed decision-making [\[19\]](#).

Using the S&P 500 stock variable, the results of his research indicate a relationship of interdependence and mutual influence between the Central Bank Digital Currency market and the stock market. CBDC news can affect S&P 500 stocks by influencing investor sentiment, market volatility, regulatory dynamics, and the economic outlook. Positive announcements can increase investor confidence and stock prices, while uncertainty or unexpected developments can create volatility. Changes in interest rates and monetary policy, as well as global economic implications, also play an important role in influencing the performance of the S&P 500 in response to CBDC news [\[17\]](#).

In addition, CBDC news is also suspected to affect the VIX (CBOE Volatility Index) by shaping investor sentiment, regulatory dynamics, currency markets, financial sector impacts, and the global economic outlook. Using VIX, [\[20\]](#) found that changes in CBDC performance could affect the stability of the financial system as a whole. Positive CBDC developments can reduce market risk, lowering the VIX, while uncertainty or disruption can increase volatility and increase the VIX as a measure of market uncertainty.

In addition, there was a shock to the market of Cryptocurrencies because of the many media reports related to the existence of this CBDC [\[17\]](#). Cryptocurrencies Especially Bitcoin are an asset that has high fluctuations [\[21\]](#). Bitcoin and Ethereum are Cryptocurrencies which has a huge trading volume, making them two of the most liquid and influential digital assets on the market [Conlon, et al. \[22\]](#). [Choi and Shin \[23\]](#) stated that many factors cause high volatility. According to research by [Helmi, et al. \[17\]](#) there was a shock in the cryptocurrency market caused by CBDC news. However, research by [Bas, et al. \[20\]](#) stated a weak positive relationship between the CBDC index and Digital Assets in this case bitcoin.

Cryptocurrency sensitivity to news Central Bank Digital Currency (CBDC) is very significant, influenced by factors such as competition perception, regulatory impact, market sentiment, technological innovation, and market integration [\[24\]](#). Positive CBDC developments could boost sentiment and highlight the potential for blockchain, thus benefiting cryptocurrencies. However, concerns about regulatory crackdowns or CBDC competition could dampen sentiment and lower prices. Overall, cryptocurrencies reacted strongly to CBDC news due to the intricate interplay between regulatory dynamics, technology, and market sentiment.

The Efficient Market Hypothesis (EMH), introduced by Eugene F. Fama in the 1960s, stated that financial markets are "informationally efficient". This means that the price of an asset in the financial markets fully reflects all the information available at any given time. EMH states that market prices fully reflect all available information [\[25\]](#). According to [Fama \[26\]](#) it is impossible for investors to consistently achieve higher-than-average results both through technical analysis and fundamental analysis because any new in-formation that can affect the price of an asset is quickly and accurately fed into the market price.

Efficient Market Hypothesis (EMH) is not directly related to a particular mathematical equation, but rather a conceptual theory that states that the price of an asset reflects all available information. However, there are several models and equations in finance that are often associated with ideas that support or are related to EMH, one of which is the Capital Asset Pricing Model (CAPM) [\[27\]](#). The equation is as follows:

$$E(R_i) = R_f + \beta_i[E(R_m) - R_f]$$

Where $E(R_i)$ is the expected rate of return of security i that carries risk. R_f is the risk-free rate of return. β_i is a measure of the undiversifiable risk of security i . $E(R_m)$ is the expected market rate of return. In this study, $E(R_i)$ is the expected return of the stock or cryptocurrency market after the news related to CBDC. R_f is the risk-free return. β_i is the beta that measures the sensitivity to specific news about CBDCs. $E(R_m)$ is the stock and cryptocurrency market index return as a representation of market returns.

Announcements and developments Central Bank Digital Currency (CBDC) has the potential to significantly influence the dynamics of the stock market and the cryptocurrency market [17]. News of CBDC launches, policies, or implementations often have far-reaching impacts, as investors and market participants try to assess the implications of these changes on financial stability, market liquidity, and the growth prospects of fintech. In the context of the stock market, CBDC news can affect the stocks of companies involved in financial technology and digital payments, while in the crypto-currency market, this can affect the perception of decentralized digital currencies and their market value [28].

News about Central Bank Digital Currency (CBDC) can affect S&P 500 stocks in several ways. Positive news that CBDCs will improve monetary policy efficiency, improve financial stability, and provide better liquidity could boost investor confidence, leading to higher stock prices and an increase in S&P 500 shares [29]. Companies in the technology and financial sectors that are directly involved in the development of CBDC infrastructure can see their share prices rise, further supporting the index. Conversely, concerns about the disruptive impact of CBDCs on traditional banks or uncertainty about their implementation could negatively impact investor sentiment, causing stock prices to fall and drag down S&P 500 stocks. In addition, psychological and speculative reactions to significant financial innovations can lead to increased market volatility. Therefore, the overall effect on the S&P 500 depends on the market's interpretation of the news and the broader economic context.

Announcements regarding CBDCs could lead to an increase in the VIX by amplifying market uncertainty and expected volatility. These effects stem from doubts about the implementation and impact of CBDCs on existing financial frameworks, including potential disruptions to traditional banking and shifting monetary policy. Speculative trading and sharp market response to CBDC news further contribute to increased volatility [20]. Additionally, concerns about regulatory changes and broader economic consequences of CBDCs, such as their impact on global capital flows and currency stability, could increase investor anxiety. These combined factors pushed the VIX index higher, indicating an anticipated increase in market volatility.

News regarding CBDCs can significantly affect the volume of Bitcoin trading in the United States through several mechanisms. Positive developments in CBDC development could increase oversight of digital currencies, potentially leading to stricter regulation and negatively impacting Bitcoin trading volumes. Conversely, if CBDCs are considered to be valid against digital currencies, this could increase investor confidence and encourage an increase in Bitcoin trading volumes [29]. Additionally, the introduction of CBDCs could highlight the differences between centralized and decentralized digital currencies, thus attracting investor interest in Bitcoin as a de-centralized alternative [6]. Market speculation and shifts in investor sentiment, influenced by CBDC news, can lead to increased volatility and affect Bitcoin trading volumes.

As with Bitcoin, news regarding CBDCs can also affect Ethereum trading volumes. Positive developments in CBDC development could increase interest in blockchain technology, which benefits Ethereum due to its wide range of use cases [5]. However, increased regulatory scrutiny of the cryptocurrency market in general could negatively impact Ethereum's trading volume if investors anticipate stricter regulation. On the other hand, if CBDCs drive technological advancements or innovations in the digital currency space, Ethereum could see increased adoption and trading volume. Therefore, Ethereum's trading volume can be affected by market speculation and changes in investor sentiment driven by CBDC-related news.

According to Helmi, et al. [17] The different impacts of CBDC news on the stock and crypto markets can come from a variety of factors, especially market volatility, different investor sentiments, and the different characteristics of each financial instrument. The stock market, which is influenced by macroeconomic factors and company performance, can react differently to the crypto market, which is often more sensitive to technological innovations and regulatory news. Additionally, the higher volatility and risk tolerance in the crypto market compared to the stock market, as well as potential differences in market dependencies and correlations, could lead to different responses to CBDC news. External market shocks and political uncertainty can further exacerbate these differences, highlighting the need to consider the specific dynamics of each market when evaluating the impact of CBDC news.

Based on the theoretical description and problem formulation above, the hypotheses in this study are as follows:

- H₁: The CBDC News variable has a positive and significant effect on S&P 500 Stocks in the United States.*
- H₂: The CBDC News variable has a positive and significant effect on the volatility of the CBOE (VIX) in the United States.*
- H₃: The CBDC News variable has a negative and significant effect on Bitcoin Trading Volume in the United States.*
- H₄: The CBDC News variable has a negative and significant effect on Ethereum Trading Volume in the United States.*

3. Methodology

The data used in this analysis is secondary data of the weekly time series type. According to Das [30], time series data (Time Series) consists of observations on one variable or several variables collected over time. The data used are data on the CBDC news index (CBDC News), S&P 500 (S&P 500) stock price, CBOE volatility index (VIX), bitcoin trading volume (TVBTC), and Ethereum trading volume (TVETH) in the United States during the period from the first week of January 2020 to the last week of December 2023, obtained from web investing and CoinMarketCap platforms.

The CBDC News variable in this study was obtained from Google Trends, which provides a standardized index to measure the level of search popularity related to a particular topic. In this case, the data used is the frequency of searches for the keyword 'Central Bank Digital Currency' (CBDC) in the United States. The Google Trends index has a value range

between 0 and 100, where 0 indicates no significant search activity, while 100 indicates the peak of search popularity during the observation period. This index is used as a continuous variable that represents the level of public and media attention to CBDC development. This data is further processed as input in the analysis using the TVP-VAR model to measure its impact on the stock and cryptocurrency markets.

The method in this study uses Time-Varying Parameter Vector Autoregression (TVP-VAR) and the data processing uses Rstudio. The Time-Varying Parameter Vector Autoregression (TVP-VAR) model has gained significant traction in economic and financial research due to its ability to capture dynamic relationships between variables over time. The traditional VAR model, introduced by Sims [31] has been instrumental in understanding the interdependence between various time series. However, the model assumes constant parameters over the study period, which can become too restrictive in the presence of structural changes, policy shifts, or economic shocks that fundamentally alter the relationships between variables. TVP-VAR, which builds on the foundation of the VAR model, was developed to overcome these limitations by allowing parameters to evolve. These advancements provide a more flexible framework that can adapt to changes in economic and financial data.

Autoregressive Vector in TVP-VAR is a simultaneous equation modeling that has several endogenous variables simultaneously, but each endogenous variable is explained by the lag of its value and other endogenous variables in the model in the sense that in VAR all variables are considered endogenous [32]. However, the VAR model can be extended by including an exogenous variable called VARX [33]. In this study, VARX is represented by CBDC News.

The basic model of TVP-VAR regression can be written as follows [34]:

$$Y_t = B_t X_t + \epsilon_t$$

Where Y_t is the endogenous variable at time t . X_t is a vector of endogenous and exogenous variables at time t (including lag on endogenous and exogenous variables). B_t is a matrix of coefficients that changes over time. ϵ_t is an error term.

In this study, S&P 500 stocks, CBOE (VIX) volatility, bitcoin trading volume (TVBTC), and ethereum trading volume (TVETH) were endogenous variables and CBDC news (CBDC News) was an exogenous variable. So the TVP-VAR model equation can be written as follows:

$$Y_t = [S\&P\ 500_t, VIX_t, TVBTC_t, TVETH_t]^T$$

$$X_t = [S\&P\ 500_{t-1}, VIX_{t-1}, TVBTC_{t-1}, TVETH_{t-1}, CBDC\ news_t]$$

The model equation becomes:

$$\begin{pmatrix} S\&P\ 500_t \\ VIX_t \\ TVBTC_t \\ TVETH_t \end{pmatrix} = B_t \begin{pmatrix} S\&P\ 500_{t-1} \\ VIX_{t-1} \\ TVBTC_{t-1} \\ TVETH_{t-1} \\ CBDC\ news_t \end{pmatrix} + \begin{pmatrix} \epsilon_{SP500,t} \\ \epsilon_{VIX,t} \\ \epsilon_{TVBTC,t} \\ \epsilon_{TVETH,t} \end{pmatrix}$$

In the model above, the author only considers the effect of lag one ($t-1$), this is done for model simplification. The model is also estimated simultaneously, and the results will provide insight into how parameter changes over time affect the relationships between variables $t-1$

The use of TVP-VAR is very relevant in analyzing the impact of Central Bank Digital Currency (CBDC) on financial markets. Given the novelty and potential transformative effects of CBDCs, the relationship between major financial indicators such as the S&P 500 index, Bitcoin trading volume, and Ethereum is likely to vary as market participants adjust their expectations and strategies. Using TVP-VAR, researchers can uncover these changing dynamics and gain deeper insights into how CBDC-related news affects market behavior over different periods. This approach not only improves the accuracy of the analysis but also provides valuable information for policymakers and investors who need to understand the ever-evolving impact of CBDCs on financial markets.

4. Results

There are several stages carried out by researchers in obtaining research results.

Table 1.
Stationary Test Results Using Augmented Dickey-Fuller (ADF) Test Method.

Level			
Variable	Dicky-Fuller	P-value	Description
CBDC News	-2.4744	0.3772	Non-Stationary
S&P 500	-1.8011	0.6594	Non-Stationary
VIX	-4.5448	0.0100	Stationary
TVBTC	-2.3135	0.4447	Non-Stationary
TVETH	-2.2566	0.4685	Non-Stationary
First Difference			
Variable	Dicky-Fuller	P-value	Description
CBDC News	-8.0376	0.0100	Stationary
S&P 500	-6.7734	0.0100	Stationary
TVBTC	-5.8393	0.0100	Stationary
TVETH	-6.3671	0.0100	Stationary

Note: CBDC News – Central Bank Digital Currency News, S&P 500 – S&P 500 Stock Price, TVBTC- Bitcoin Trading Volume, TVETH- Ethereum Trading Volume.

The stationarity test, also known as the unit root test, is a statistical test used to determine whether the Time Series data is stationary or exhibits unit roots. Stationarity is an important concept in the analysis of Time Series because it ensures that the statistical nature of the data remains constant over time. In this study, the stationarity test uses the Dickey-Fuller test. Stationary variables show a probability below 0.05. If the variable is not stationary at the level, a stationary test will be carried out at the level of Difference 1 [35].

Table 1 presents the results of the Augmented Dickey-Fuller (ADF) test. At the data level, the results show that the variables CBDC News, S&P 500, TVBTC, and TVETH have a p-value greater than the general significance level of 0.05. Specifically, CBDC News has a Dickey-Fuller statistic of -2.4744 with a p-value of 0.3772; the S&P 500 has a statistic of -1.8011 with a p-value of 0.6594; TVBTC has a statistic of -2.3135 with a p-value of 0.4447; and TVETH has a statistic of -2.2566 with a p-value of 0.4685. These results indicate that these variables are not stationary at this level. In contrast, the VIX variable, with a Dickey-Fuller statistic of -4.5448 and a p-value of 0.0100, is stationary at its level, as the p-value is less than 0.05.

After making the first difference, the results of the ADF test showed that all variables that were previously not stationary became stationary. The first difference from CBDC News has a Dickey-Fuller statistic of -8.0376 and a p-value of 0.0100. The S&P 500 shows a statistic of -6.7734 and a p-value of 0.0100. TVBTC has a statistic of -5.8393 and a p-value of 0.0100, while TVETH has a statistic of -6.3671 with a p-value of 0.0100. These p-values, which are below the threshold of 0.05, indicate that the first difference data for these variables is stationary.

Table 2. summarizes the results of the optimal lag selection process for various time series variables, including CBDC News, S&P 500, VIX, TVBTC, and TVETH. The selection is based on several criteria: Akaike Information Criteria (AIC), Criteria Hannan-Quinn (Headquarters), Black Criteria (SC), and Final Prediction Errors (FPE). Each criterion indicates a different lag length, which helps determine the most appropriate amount of lag to incorporate into the model to balance complexity and accuracy [30].

Table 2.
Optimal Lag Selection Results Based on AIC, HQ, SC, and FPE Criteria.

Variable	AIC(n)	HQ(n)	SC(n)	FPE(n)	Selected Lag
CBDC News	9	4	1	9	1 (SC) or 4 (HQ) or 9 (AIC, FPE)
S&P 500	1	1	1	1	1
VIX	7	1	1	7	1 (HQ, SC) or 7 (AIC, FPE)
TVBTC	2	1	1	2	1 (HQ, SC) or 2 (AIC, FPE)
TVETH	1	1	1	1	1

Note: CBDC News – Central Bank Digital Currency News, S&P 500 – S&P 500 Stock Price, TVBTC- Bitcoin Trading Volume, TVETH- Ethereum Trading Volume, AIC - Akaike Information Criteria, HQ - Criteria Hannan-Quinn (Headquarters), SQ - Black Criteria, FPE - Final Prediction Errors.

For CBDC News, the AIC and FPE criteria recommend a lag length of 9, while the HQ criteria suggest a lag of 4, and the SC criteria suggest a lag of 1. This variation indicates that different criteria may prioritize different aspects of the model, such as compatibility or simplicity. The S&P 500 shows a unanimous recommendation across all criteria for a lag length of 1, which indicates that a simple model structure is sufficient for this variable. The VIX has split recommendations, with AIC and FPE suggesting lag 7, while HQ and SC both recommend lag 1. Similarly, TVBTC has a 2-lag recommendation from AIC and FPE, while HQ and SC suggest 1 lag. For TVETH, all criteria agree on a lag length of 1.

Based on the results of the optimal lag selection process, a lag length of 1 is selected for all variables, including CBDC News, S&P 500, VIX, TVBTC, and TVETH. This decision was made after considering recommendations from various criteria. The consistent recommendation of the 1-lag structure by the SC and HQ criteria for most variables, combined with the practical benefits of a simpler model, leads to the selection of a single lag. This option helps avoid the potential for overfitting associated with higher lag sequences and simplifies the model, making it easier to interpret and more robust, especially given the limited sample size or data frequency.

The test carried out in looking at the relationship between variables in the study is by using a model Variable Parameter Vector Autoregression (TVP-VAR), taking into account changes in effects over time [34].

Table 3.
Estimation Results of the TVP-VAR Model.

Variable	S&P 500 (-1)	VIX (-1)	TVBTC (-1)	TVETH (-1)	Intercept	CBDC News	F- Test	P-Value
S&P 500	0.9188	-0.01203	0.003097	0.001935	0.2489	0.003905	2.0461	0.154100
VIX	-0.03106	0.8354	0.01064	-0.01551	0.4019	-0.01991	14.1910	0.000216***
TVBTC	0.4885	0.04728	0.813	0.07829	-0.5400	-0.03216	3.8070	0.052410**
TVETH	0.8791	0.06042	0.2082	0.7047	-2.268	-0.08072	0.7095	0.400600

Note: CBDC News – Central Bank Digital Currency News, S&P 500 – S&P 500 Stock Price, TVBTC- Bitcoin Trading Volume, TVETH- Ethereum Trading Volume. Each asterisk indicates statistical significance where; *** p<1%, ** p<5%, * p<10%.

Table 4 presents the Granger causality test results, highlighting the significance of the relationship between the analyzed variables. This test is employed to assess whether changes in one variable can significantly predict changes in another variable. If the probability value (p-value) is smaller than the established significance level (e.g., 0.05), there is strong

evidence that the variable has Granger causality on the tested variable, indicating a statistically significant predictive relationship. Conversely, if the p-value exceeds the significance level, the causal relationship is not significant, suggesting that the variable lacks predictive ability over the other variables.

Table 4.
Granger causality test results.

Variable	F-Statistic
S&P 500	2.0461
VIX	14.1910
TVBTC	3.8070
TVETH	0.7095

Note: CBDC News – Central Bank Digital Currency News, S&P 500 – S&P 500 Stock Price, TVBTC- Bitcoin Trading Volume, TVETH- Ethereum Trading Volume. Each asterisk indicates statistical significance where; *** p<1%, ** p<5%, * p<10%.

In [Table 3](#). The S&P 500 lag 1 variable has a coefficient of 0.9188, which indicates that a 1 unit increase in the value of the previous period's stock price leads to a 0.9188 unit increase in the value of the current stock price. The small negative coefficient for VIX lag 1 (-0.01203) indicates that an increase in market volatility (represented by VIX) slightly decreases stock prices. TVBTC lag 1 (0.003097) and TVETH lag 1 (0.001935) indicate a small positive effect of bitcoin and Ethereum trading volume on stock prices. The intercept 0.2489 represents the constant value in the model, and the TVP-VAR model results show that CBDC News has a very small positive impact on the S&P 500 index, as reflected by the coefficient of 0.003905. The granger causality test results in [Table 4](#). show a p-value of 0.154100, meaning that CBDC News has a weak and insignificant positive impact on S&P 500 Stocks. Based on these results, there is not enough evidence to support H1.

VIX, which measures market volatility in [Table 3](#). The S&P 500 lag 1 coefficient (-0.03106) indicates that rising stock prices tend to lower market volatility. The VIX lag 1 coefficient of 0.8354 indicates that past volatility has a strong influence on current volatility. TVBTC lag 1 (0.01064) indicates that market volatility increases slightly with an increase in bitcoin trading volume, while TVETH lag 1 (-0.01551) indicates a small negative impact from changes in ethereum trading volume. The intercept is 0.4019 and the coefficient for CBDC News is -0.01991, based on these results H2 holds based on the analysis results showing a significant relationship. This negative coefficient indicates that an increase in CBDC News may slightly decrease market volatility, indicating a very weak but significant inverse relationship. This can be seen from the p-value in the granger causality test which is significant at the 1% level. CBDC News contributes significantly to changes in market volatility as measured by the VIX.

Bitcoin trading volume variable (TVBTC) in [Table 3](#). For the S&P 500 lag 1 coefficient (0.4885) indicates that changes in stock prices positively affect bitcoin trading volume. VIX lag 1 (0.04728) indicates a small positive impact of market volatility on bitcoin trading volume. The high coefficient of TVBTC lag 1 (0.813) indicates a strong dependence on the previous bitcoin trading volume. TVETH lag 1 (0.07829) indicates a positive effect of ethereum trading volume on Bitcoin. The intercept -0.5400 indicates a negative constant value, the coefficient for CBDC News with respect to Bitcoin trading volume (TVBTC) is -0.03216. This value indicates a small negative relationship between CBDC News and Bitcoin trading volume. Based on the granger causality test results the p-value of 0.052410 shows significance at the 5% level. The analysis confirms that H3 holds, as the results indicate a significant relationship.

In [Table 3](#). the S&P 500 lag 1 coefficient (0.8791) shows that stock price changes have a significant positive impact on ethereum trading volume. VIX lag 1 (0.06042) also shows the positive effect of market volatility. TVBTC lag 1 (0.2082) shows that bitcoin trading volume affects ethereum trading volume, and TVETH lag 1 (0.7047) shows a strong dependence on previous ethereum trading volume. The intercept is -2.268 and the co-efficient of CBDC News on Ethereum trading volume (TVETH) is -0.08072, indicating a negative relationship. This means that an increase in CBDC News is associated with a small decrease in Ethereum trading volume. As with Bitcoin, this effect is relatively small. The p-value on the granger causality test of 0.400600 indicates an insignificant result. Based on this, there is not enough evidence to support H4.

Overall, the findings suggest that CBDC News has no substantial direct impact on the S&P 500, VIX, TVBTC, or TVETH. In line with that, research by [Helmi, et al. \[17\]](#) also shows that the shock of the CBDC index is not statistically significant. The coefficients associated with CBDC News for these variables are relatively low, indicating that while CBDC developments are an emerging and important topic, they have not yet been the main drivers of market movements in this area. This may change as CBDCs become more integrated into the financial system, but current data suggests that traditional market factors and internal market dynamics play a more significant role in influencing these markets.

Table 5.
The Box-Ljung Test Results (Autocorrelation).

Variable	X-Squared	df	p-value
S&P 500	10.485	12	0.5735
VIX	19.214	12	0.0835
TVBTC	20.563	12	0.0572
TVETH	19.626	12	0.0745

Note: CBDC News – Central Bank Digital Currency News, S&P 500 – S&P 500 Stock Price, TVBTC- Bitcoin Trading Volume, TVETH- Ethereum Trading Volume.

The Box-Ljung test results for the S&P 500 dataset showed an X-squared value of 10.485 with 12 degrees of freedom and a p-value of 0.5735, indicating the absence of significant evidence of autocorrelation in the residuals. This suggests that the model has likely captured the patterns in the data adequately. The VIX data, with an X-squared value of 19.214, 12 degrees of freedom, and a p-value of less than 0.0835, shows evidence of no autocorrelation.

For TVBTC, with an X-squared value of 20.563, 12 degrees of freedom, and a p-value of 0.0572, there is no evidence of autocorrelation. Finally, the TVETH dataset has an X-squared value of 19.625, 12 degrees of freedom, and a p-value of 0.0745, which indicates the absence of significant autocorrelation, indicating that the model may be adequately capturing data patterns. Based on these results, no significant autocorrelation was detected in the time series.

Figure 2. Showing Function Respons Impuls Orthogonal (OIRF) of CBDC shocks (Central Bank Digital Currency) against various financial variables, including the S&P 500, VIX, TVBTC (Bitcoin trading volume), and TVETH (Ethereum trading volume). The impulse response function describes how the shock of a one-standard deviation on CBDC News impacts these variables throughout ten units of time, with 95% of the Bootstrap Confidence Interval (CI) indicated by the red dotted line [30].

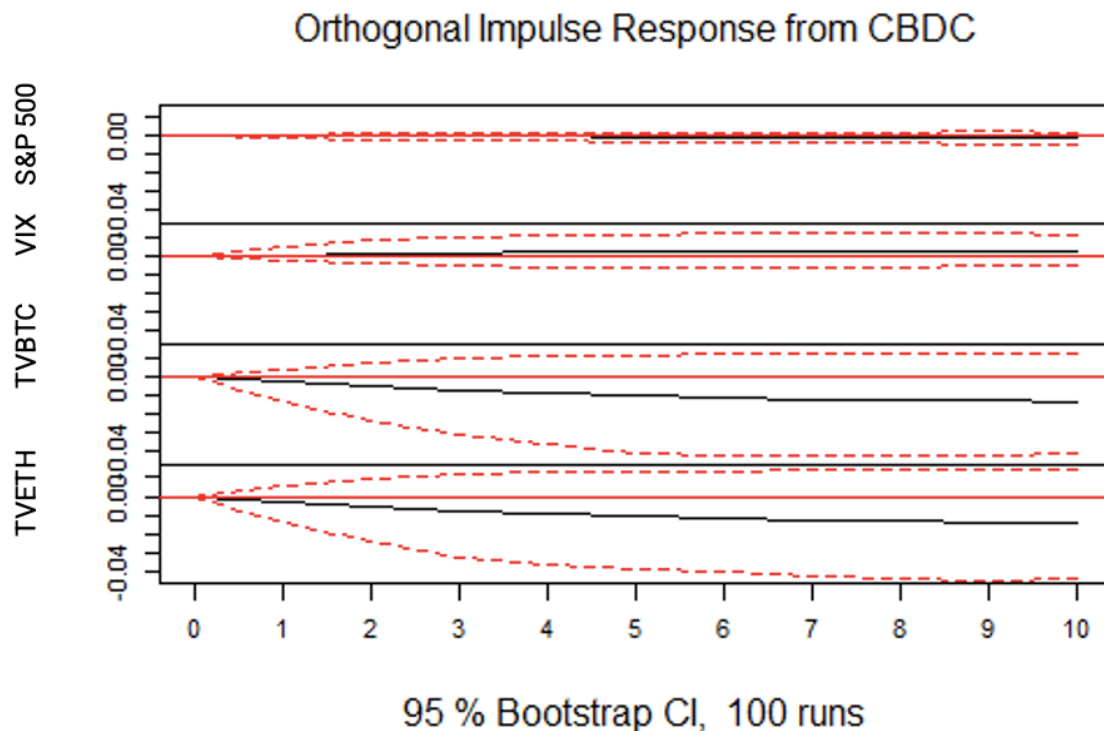


Figure 2.
Function of Impulse Response

The S&P 500's response to CBDC shocks is negligible, with the response line approaching zero during the period. This indicates that CBDC news has had minimal impact on the S&P 500 index, suggesting that the stock market's reaction to CBDC developments has been insubstantial. For the VIX, the response also remains close to zero, which suggests that CBDC shocks have not significantly affected market volatility. The minimal movement in the confidence interval indicates that perceived risk or uncertainty in the market, as measured by the VIX, is largely unaffected by CBDC-related news or events.

The response to TVBTC and TVETH showed a slight negative trend, suggesting that the shock from CBDC news could lead to a small decline in Bitcoin and Ethereum trading volumes. The downward response, albeit minimal, suggests a possible reallocation of interest or resources from these cryptocurrencies in reaction to CBDC developments. However, the change was small, and the confidence interval, which includes zero, suggests that this effect is not statistically significant.

Overall, the impulse response analysis shows that the CBDC news shock has a limited and statistically insignificant impact on the financial markets and major cryptocurrencies studied. The dynamics show that the response is generally stable and close to zero, indicating that CBDC-related events are not a strong driver of market change in these sectors. The results of the study show that, at least in the short term, the introduction or news about CBDCs has not led to significant disruption or shifts in these markets.

5. Discussion

The analysis shows that news related to Central Bank Digital Currency (CBDC) has a very small positive impact on the S&P 500 index, with a coefficient of 0.003905 (Table 3). From an economic perspective, this indicates that CBDC-related developments or announcements have not been significant drivers of investor sentiment or market movements in the US stock market. Although the introduction of CBDCs has the potential to revolutionize the financial system by providing a new form of digital money and changing the landscape of payment systems, the impact on stock prices appears minimal over the study period.

However, research by [Helmi, et al. \[17\]](#) shows that the CBDC news shock has a significant positive impact on SP stock returns. This limited effect may stem from the speculative nature of the news or the early stages of CBDC implementation, which have not yet translated into real changes in corporate earnings expectations or market risk assessments. Additionally, financial market reactions to CBDC news can be muted due to a lack of clarity on the regulatory framework, technological readiness, and broader economic implications of CBDC adoption at large. Thus, while CBDCs promise a future, their direct influence on equity markets is still small.

The previous analysis shows that news related to Central Bank Digital Currency (CBDC) has a very small negative impact on market volatility, as measured by VIX, as shown in [Table 3](#). with a coefficient of (-0.01991). From an economic perspective, this suggests that the development or announcement of CBDC can significantly reduce market volatility slightly. This small dampening effect may be due to the market perceiving CBDC as a stabilizing force in the financial system, potentially offering a more secure and efficient payment method.

In contrast to the author's findings, the results of the study by [Helmi, et al. \[17\]](#) show that CBDC news shocks have a positive but not significant impact on the VIX. The diversity of the research results can be attributed to the early stages of CBDC implementation and the speculative nature of the news, which has not yet resulted in concrete changes in economic conditions or financial stability. Additionally, the uncertain regulatory environment and technological challenges surrounding CBDCs could contribute to a relatively small response from the financial markets. Thus, while CBDCs have the potential for future financial system stability, their current influence on market volatility is negligible.

The analysis shows that Bitcoin trading volume (TVBTC) is slightly negatively impacted by news related to Central Bank Digital Currency (CBDC), with a coefficient of -0.03216 ([Table 3](#)). From an economic perspective, this suggests that CBDC-related developments or announcements can significantly dampen Bitcoin trading activity by a small amount. This small decrease could be because investors perceive CBDCs as a safer and potentially more stable alternative to cryptocurrencies, which could lead to a shift in interest away from more speculative assets such as Bitcoin.

However, [Akin, et al. \[36\]](#) revealed that CBDC news has a positive effect on Bitcoin yields. However, the findings of [Helmi, et al. \[17\]](#) revealed that CBDC news has a negative and significant impact on Bitcoin returns. In line with this study, [Bas, et al. \[20\]](#) stated that in the results of his research, there is a weak relationship between CBDC news and digital assets including bitcoin.

The very small impact in this study indicates that CBDC news significantly affects investor behavior or trading volume in the cryptocurrency market. This limited effect could be due to the early stage of CBDC implementation and the speculative nature of the news, which has not led to substantial changes in the financial landscape or regulatory environment. In addition, the technological and regulatory challenges associated with CBDCs may also contribute to the modest market response, as investors wait for more concrete developments before changing their trading strategies. Therefore, although CBDCs may affect the digital currency landscape in the future, their current impact on Bitcoin's trading volume is still negligible.

The analysis shows that news related to Central Bank Digital Currencies (CBDC) has a small negative impact on Ethereum (TVETH) trading volume, with a coefficient of -0.08072 ([Table 3](#)). From an economic perspective, this suggests that as CBDC-related news increases, there is a slight decrease in trading activity for Ethereum. This relationship suggests that investors may see CBDCs as a more secure or regulated alternative to cryptocurrencies like Ethereum, potentially reducing interest in more volatile and less regulated digital assets. However, the impact is very small, reflecting that the current stage of CBDC development and news does not substantially alter trading volumes in the cryptocurrency market.

This limited impact can be attributed to the new stage of CBDC implementation, where there are still regulatory and technological uncertainties. As a result, while CBDCs promise financial stability and integration in the future, their current influence on Ethereum's trading behavior is still relatively insignificant. In line with that [Bas, et al. \[20\]](#) show a weak connection between CBDC indices and digital assets, which shows that the movement of CBDC indices is not closely related to the performance of various digital assets and has a very small contribution to changes in digital asset returns.

6. Conclusion

The conclusions from the results of this study confirm several hypotheses that have been proposed previously. The results of hypothesis testing show that news related to Central Bank Digital Currency (CBDC) has a small but insignificant positive impact on S&P 500 stock prices, so there is not enough evidence to support the first hypothesis. In addition, the study also found that CBDC news had a very small and significant negative impact on the CBOE Volatility Index (VIX); based on the result, the second hypothesis holds. Furthermore, the study revealed that CBDC-related news had a significant negative effect on decreasing Bitcoin trading volume, thus the third hypothesis was accepted. CBDC news has a small and insignificant negative effect on Bitcoin trading volume, so there is not enough evidence to support the fourth hypothesis.

The implications of these findings suggest that although news related to the Central Bank Digital Currency (CBDC) has had little impact on stock prices, market volatility, and cryptocurrency trading volumes, there are still indications that announcements related to digital financial innovations could affect market behavior. This suggests that under certain conditions, information related to new financial technologies, such as CBDCs, may play a greater role in the future. The weaknesses of this study include limitations in the data and analysis methods used. In addition, the study does not consider external factors such as geopolitical developments or other technological innovations that may have an impact on stock and cryptocurrency prices. For further research, it is recommended to include additional variables such as trading volume or market sentiment to gain a more comprehensive understanding of the factors affecting the stock and cryptocurrency markets, especially in the United States.

References

- [1] T. C. Chiang, B. N. Jeon, and H. Li, "Dynamic correlation analysis of financial contagion: Evidence from Asian markets," *Journal of International Money and Finance*, vol. 26, no. 7, pp. 1206-1228, 2007. <https://doi.org/10.1016/j.jimonfin.2007.06.005>
- [2] Y. Wang, B. M. Lucey, S. A. Vigne, and L. Yarovaya, "The effects of central bank digital currencies news on financial markets," *Technological Forecasting and Social Change*, vol. 180, p. 121715, 2022. <https://doi.org/10.1016/j.techfore.2022.121715>
- [3] Y. Lee, B. Son, S. Park, J. Lee, and H. Jang, "A survey on security and privacy in blockchain-based central bank digital currencies," *Journal of Internet Services and Information Security*, vol. 11, no. 3, pp. 16-29, 2021. <https://doi.org/10.22667/JISIS.2021.08.31.016>
- [4] M. Martens, "Adoption and implications of CBDC: An agent-based modelling approach," Master's Thesis, University of Twente, 2021.
- [5] V. Sethaput and S. Innet, "Blockchain application for central bank digital currencies (CBDC)," *Cluster Computing*, vol. 26, no. 4, pp. 2183-2197, 2023. <https://doi.org/10.1007/s10586-022-03962-z>
- [6] H. Wang and S. Gao, "The future of the international financial system: The emerging CBDC network and its impact on regulation," *Regulation & Governance*, vol. 18, no. 1, pp. 288-306, 2024. <https://doi.org/10.1111/rego.12520>
- [7] P. K. Ozili, "Central bank digital currency research around the World: A review of literature," *Journal of Money Laundering Control*, vol. 26, no. 2, pp. 215-226, 2023. <https://doi.org/10.1108/JMLC-11-2021-0126>
- [8] K. Kim, R. J. Tetlow, S. Infante, A. Orlik, and A. F. Silva, "The macroeconomic implications of CBDC: A review of the literature," *Financial Economics Discussion Series*, vol. 2854, no. 2022-076, pp. 1-65, 2022. <https://doi.org/10.17016/feds.2022.076>
- [9] D. Likitrachoen, P. Chudasring, C. Pinmanee, and K. Wiwattanalamphong, "The efficiency of value-at-risk models during extreme market stress in cryptocurrencies," *Sustainability*, vol. 15, no. 5, p. 4395, 2023. <https://doi.org/10.3390/su15054395>
- [10] M. T. Wahyuni, E. Ridwan, and D. F. Salim, "US macroeconomic determinants of Bitcoin," *Investment Management & Financial Innovations*, vol. 21, no. 2, p. 240, 2024. [https://doi.org/10.21511/imfi.21\(2\).2024.19](https://doi.org/10.21511/imfi.21(2).2024.19)
- [11] L. Gąsiorkiewicz, J. Monkiewicz, and M. Monkiewicz, "Technology-driven innovations in financial services: The rise of alternative finance," *Foundations of Management*, vol. 12, no. 1, pp. 137-150, 2020. <https://doi.org/10.2478/fman-2020-0011>
- [12] H. M. A. Retha and G. D. D. P. Taslim, "A forecasting: Bitcoin price with the ARIMA method to help swing traders made decision," *Internasional Journal of Data Science, Engineering, and Analytics*, vol. 2, no. 1, pp. 17-24, 2022. <https://doi.org/10.33005/ijdasea.v2i1.19>
- [13] T. Zhang and Z. Huang, "Blockchain and central bank digital currency," *Ict Express*, vol. 8, no. 2, pp. 264-270, 2022. <https://doi.org/10.1016/j.ict.2021.09.014>
- [14] H. Gupta, "Cryptocurrency to CBDC: The transition of digital currency," *Focus*, vol. 23, no. 4, pp. 1-11, 2021.
- [15] The Fed, "Central bank digital currency (CBDC)," Retrieved: <https://www.federalreserve.gov/central-bank-digital-currency.htm>, 2022.
- [16] Y. Wang, Y. Wei, B. M. Lucey, and Su, Y., "Return spillover analysis across central bank digital currency attention and cryptocurrency markets," *Research in International Business and Finance*, 2023. <https://doi.org/10.1016/j.techfore.2022.121715>
- [17] M. H. Helmi, A. N. Çatık, and C. Akdeniz, "The impact of central bank digital currency news on the stock and cryptocurrency markets: Evidence from the TVP-VAR model," *Research in International Business and Finance*, vol. 65, p. 101968, 2023. <https://doi.org/10.1016/j.ribaf.2023.101968>
- [18] D. A. Bala and T. Takimoto, "Stock markets volatility spillovers during financial crises: A DCC-MGARCH with skewed-t density approach," *Borsa Istanbul Review*, vol. 17, no. 1, pp. 25-48, 2017. <https://doi.org/10.1016/j.bir.2017.02.002>
- [19] H. N. Luu, C. P. Nguyen, and M. A. Nasir, "Implications of central bank digital currency for financial stability: Evidence from the global banking sector," *Journal of International Financial Markets, Institutions and Money*, vol. 89, p. 101864, 2023. <https://doi.org/10.1016/j.intfin.2023.101864>
- [20] T. Bas, I. Malki, and S. Sivaprasad, "Connectedness between central bank digital currency index, financial stability and digital assets," *Journal of International Financial Markets, Institutions and Money*, vol. 92, p. 101981, 2024. <https://doi.org/10.1016/j.intfin.2024.101981>
- [21] K. H. Al-Yahyaee, M. U. Rehman, W. Mensi, and I. M. W. Al-Jarrah, "Can uncertainty indices predict Bitcoin prices? A revisited analysis using partial and multivariate wavelet approaches," *The North American Journal of Economics and Finance*, vol. 49, pp. 47-56, 2019. <https://doi.org/10.1016/j.najef.2019.03.019>
- [22] T. Conlon, S. Corbet, and R. J. McGee, "Inflation and cryptocurrencies revisited: A time-scale analysis," *Economics Letters*, vol. 206, p. 109996, 2021. <https://doi.org/10.1016/j.econlet.2021.109996>
- [23] S. Choi and J. Shin, "Bitcoin: An inflation hedge but not a safe haven," *Finance Research Letters*, vol. 46, p. 102379, 2022. <https://doi.org/10.1016/j.frl.2021.102379>
- [24] I. Yousaf and J. W. Goodell, "Linkages between CBDC and cryptocurrency uncertainties, and digital payment stocks," *Finance Research Letters*, vol. 54, p. 103765, 2023. <https://doi.org/10.1016/j.frl.2023.103765>
- [25] A. W. Lo, "Efficient markets hypothesis," *The New Palgrave Dictionary of Economics*, pp. 782-794, 2007. <https://doi.org/10.1057/9780230226203.0454>
- [26] E. F. Fama, "The behavior of stock-market prices," *The Journal of Business*, vol. 38, no. 1, pp. 34-105, 1965. <https://doi.org/10.2307/2277297>
- [27] Q. Ying, T. Yousaf, Q. u. Ain, Y. Akhtar, and M. S. Rasheed, "Stock investment and excess returns: A critical review in the light of the efficient market hypothesis," *Journal of Risk and Financial Management*, vol. 12, no. 2, p. 97, 2019. <https://doi.org/10.3390/jrfm12020097>
- [28] H. Becker, "Revolution or evolution? CBDC and its effects on the monetary financial system," Retrieved: <https://www.example.com>. [Accessed 2024].
- [29] J. Andersson and K. Fankl, "Correlation and causality between the S&P 500 and Bitcoin: A comparative study before and during the COVID-19 pandemic," Retrieved: <https://gupea.ub.gu.se/handle/2077/77488>, 2023.
- [30] P. Das, *Econometrics in theory and practice*. New York: Physica-Verlag Heidelberg, 1998.
- [31] C. A. Sims, "Macroeconomics and reality," *Econometrica*, vol. 48, no. 1, pp. 1-48, 1980. <https://doi.org/10.2307/1912017>
- [32] D. R. Febrianti, M. A. Tiro, and d. S. Sudarmin, "Vector autoregressive (VAR) method in analyzing the influence of exchange rates on exports and imports in Indonesia," *Jurnal Statistik*, vol. 2, no. 1, p. 23, 2021. <https://doi.org/10.35580/variansiumn14645>

- [33] G. Djurovic, V. Djurovic, and M. M. Bojaj, "The macroeconomic effects of COVID-19 in Montenegro: A Bayesian VARX approach," *Financial Innovation*, vol. 6, no. 1, p. 40, 2020. <https://doi.org/10.1186/s40854-020-00207-z>
- [34] G. Koop and D. Korobilis, "Bayesian multivariate time series methods for empirical macroeconomics," *Foundations and Trends® in Econometrics*, vol. 3, no. 4, pp. 267-358, 2010. <https://doi.org/10.1561/08000000013>
- [35] D. Gujarati, *Econometrics by example*, 2nd ed. London: Palgrave Macmillan, 2015.
- [36] I. Akin, M. Z. Khan, A. Hameed, K. Chebbi, and H. Satiroglu, "The ripple effects of CBDC-related news on Bitcoin returns: insights from the DCC-GARCH model," *Research in International Business and Finance*, vol. 66, p. 102060, 2023. <https://doi.org/10.1016/j.ribaf.2023.102060>