# “US macroeconomic determinants of Bitcoin”


| | |
|---|---|
| **AUTHORS** | Mailinda Tri Wahyuni<br>Endrizal Ridwan<br>Dwi Fitrizal Salim |



| | |
|---|---|
| **ARTICLE INFO** | Mailinda Tri Wahyuni, Endrizal Ridwan and Dwi Fitrizal Salim (2024). US macroeconomic determinants of Bitcoin. *Investment Management and Financial Innovations*, *21*(2), 240-252. doi:10.21511/imfi.21(2).2024.19 |
| **DOI** | http://dx.doi.org/10.21511/imfi.21(2).2024.19 |
| **RELEASED ON** | Tuesday, 14 May 2024 |
| **RECEIVED ON** | Friday, 22 March 2024 |
| **ACCEPTED ON** | Wednesday, 08 May 2024 |





| | |
|---|---|
| **JOURNAL** | "Investment Management and Financial Innovations" |
| **ISSN PRINT** | 1810-4967 |
| **ISSN ONLINE** | 1812-9358 |
| **PUBLISHER** | LLC “Consulting Publishing Company “Business Perspectives” |
| **FOUNDER** | LLC “Consulting Publishing Company “Business Perspectives” |

| NUMBER OF REFERENCES | NUMBER OF FIGURES | NUMBER OF TABLES |
|---|---|---|
| 54 | 1 | 3 |

BUSINESS PERSPECTIVES

LLC "CPC "Business Perspectives"
Hryhorii Skovoroda lane, 10,
Sumy, 40022, Ukraine

www.businessperspectives.org

**Mailinda Tri Wahyuni** (Indonesia), **Endrizal Ridwan** (Indonesia), **Dwi Fitrizal Salim** (Indonesia)

# US MACROECONOMIC DETERMINANTS OF BITCOIN

## Abstract

This study aims to determine the impact of macroeconomic variables on bitcoin prices in the United States. Bitcoin is one of the cryptocurrencies that has the highest price and the most users in the United States in recent years. This study uses monthly data on inflation, interest rates, USD/EUR rates, gold prices, and bitcoin prices. To achieve the objectives of this study, Dynamic Conditional Correlation (DCC) and Multivariate Generalized Autoregressive Conditional Heteroscedasticity (MGARCH) were used. The results showed that there is a negative and significant relationship between the variables of inflation, interest rates, and USD/EUR rates affecting the price of Bitcoin in that period. Conversely, there is a positive and significant relationship between the price of gold and the price of Bitcoin in the United States during that period. An in-depth understanding of how macroeconomic factors such as inflation, interest rates and the USD/EUR rates affect Bitcoin price is key to making smart investment decisions in an increasingly complex crypto market. The findings of this analysis confirm that the significant relationship between macroeconomic variables and Bitcoin price provides deeper insights for investors to anticipate market movements and design adaptive investment strategies.

**Keywords** Bitcoin, currency, gold prices, inflation, interest rates, United States

**JEL Classification** E22, E44

**Received on:** 22nd of March, 2024
**Accepted on:** 8th of May, 2024
**Published on:** 14th of May, 2024



Mailinda Tri Wahyuni, Student, Department of Economics, Faculty of Economics and Business, Andalas University, Indonesia. (Corresponding author)

Endrizal Ridwan, Lecturer, Department of Economics, Faculty of Economics and Business, Andalas University, Indonesia.

Dwi Fitrizal Salim, Lecturer, School of Economics and Business, Telkom University, Indonesia.



**Conflict of interest statement:**
Author(s) reported no conflict of interest

## INTRODUCTION

The presence of Bitcoin as the first digital currency in Cryptocurrency raises many pros and cons in the wider community. In addition, Central Bank Digital Currency (CBDC) has also started to emerge as a digital currency to rival the Cryptocurrency market. The United States values economic freedom and individual liberty. Allowing the use and trading of Bitcoin is in line with the principles of free markets and personal choice. It gives individuals the freedom to transact and store value outside of the traditional financial system.

Bitcoin is referred to as an asset that has high price fluctuations. Bitcoin price fluctuations in the United States can be attributed to several factors, such as increased investor interest in Bitcoin, market sentiment, and speculative trading. In addition, the price of Bitcoin in the United States can be affected by macroeconomic factors, such as economic instability, inflation concerns, geopolitical events, or changes in monetary policy. Bitcoin price volatility over the 2017–2022 period was affected by various macroeconomic factors, including interest rates, exchange rates, and gold prices. These factors interact with inflationary dynamics, contributing to the overall price movement of Bitcoin.

This study is aimed more specifically at US investors and policymakers. Bitcoin is a highly volatile asset, and conducting research on its price can help investors make informed investment decisions. Additionally, research into the price of Bitcoin allows economists and financial re-



http://dx.doi.org/10.21511/imfi.21(2).2024.19

searchers to study its impact on monetary policy, financial stability, capital markets, and the broader economy. This provides an avenue to explore the implications of decentralized digital currencies and their relationship with the traditional financial system.

## 1. LITERATURE REVIEW, ANALYSIS, AND HYPOTHESES

In 1982, David Chaum, the originator of computerized cash, proposed an unused development for cryptography, specifically Blind Signature and a computerized cash framework with namelessness and based on dexterity, which is considered the most punctual computerized financial hypothesis (Astuti & Fazira, 2018). Chaum's discovery underlies the existence of Cryptocurrency as a product of innovation in the financial sector. Cryptocurrency is defined as a store of value and refers to digital money that operates on the Blockchain network. Cryptocurrency has emerged as a new type of currency in the United States since the last decade.

Since its initial launch by a group of programmers known by the anonymous name Satoshi Nakamoto, until now Cryptocurrency has one currency that always has more users and higher prices than other cryptocurrencies, namely Bitcoin (Astuti & Fazira, 2018). In line with Astuti and Fazira's (2018) study, in the United States Bitcoin is also a popular choice for most of its users. Data from the Triple-A website, a Cryptocurrency payment website that has been licensed by the Monetary Authority of Singapore (MAS), show that more than 73% of crypto owner respondents own Bitcoin. Ethereum follows in second place, followed by Ripple (XRP), Tether (USDT), and other Altcoins. People see Cryptocurrencies as a safe asset and an alternative to national currencies, with over 15% of crypto owners having crypto assets of more than US$10,000.

The downside of Bitcoin is price instability, as it is inherently speculative. The rapid rise of Bitcoin users as the leading digital currency by market capitalization since its launch in 2009 has attracted the attention of investors and policymakers. In recent years, the price of Bitcoin has fluctuated significantly (Al-Yahyaee et al., 2019).

Figure 1 shows the high volatility of the USD/BTC price. Based on the data, in 2015, the price of 1 Bitcoin was only USD 327, this value continues to increase every day. On December 15, 2017, the price of 1 Bitcoin had reached USD 19,650, but not even one year the price dropped considerably on March 16, 2018, to USD 7,857. Bitcoin reached its highest price on November 12, 2021,

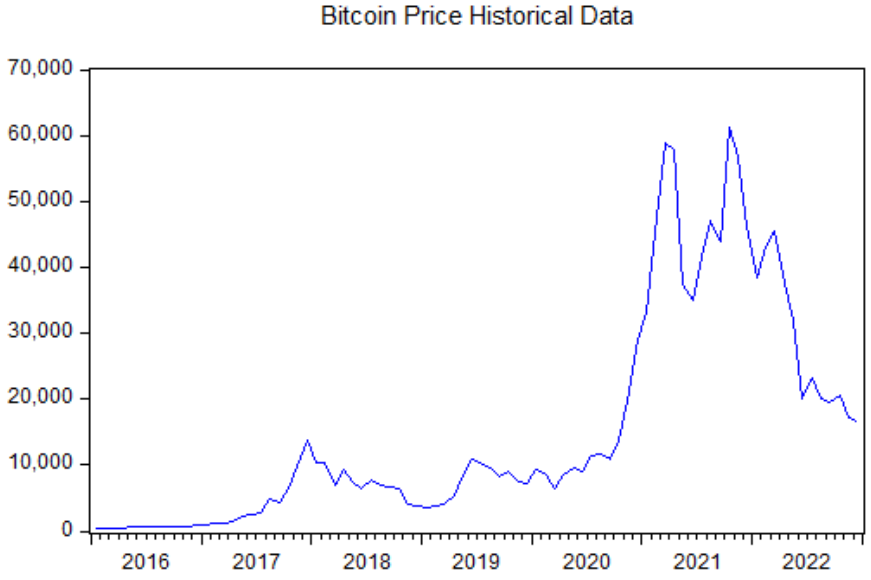


**Figure 1.** USD/BTC price fluctuations 2016–2022

at USD 64,400, but not even one month later, on December 3, 2021, the price of 1 Bitcoin dropped to USD 49,105.

Bitcoin price fluctuations in the United States can be attributed to several factors, such as increased investor interest in Bitcoin. In 2017, there was a surge in mainstream media coverage and public interest in Bitcoin. This led to a significant influx of new investors entering the market, increasing demand, and subsequently driving up the price (Havidz et al., 2021). In addition, the price of Bitcoin in the United States can be influenced by macroeconomic components, such as financial flimsiness, inflation concerns, geopolitical occasions, or changes in monetary policy. Amid times of financial vulnerability, investors often turn to alternative assets such as Bitcoin as a hedge against traditional financial markets, potentially driving up the price (Guizani & Nafti, 2019).

As explained in the previous paragraph, the price of Bitcoin is affected by several macroeconomic variables. Inflation is thought to affect the price of Bitcoin (Yang & Zhang, 2021; Sarker & Wang, 2022). Bitcoin is often touted as a potential hedge against inflation (Choi & Shin, 2022).

Based on data from the United States Bureau of Statistics and Labor, the inflation rate in March 2021 was 1.6 percent and rose dramatically in April 2021 to 3 percent; this was responded to by the price of Bitcoin, which in April 2021 was USD 57,637 and fell dramatically in May 2021 to USD 37,305. Inflation expectations can affect Bitcoin price volatility. According to the International Monetary Fund, central bank policies play an important role in shaping inflation expectations. Throughout the 2017–2022 period, central banks globally, including the United States, implemented a mix of monetary policies, including quantitative easing (QE) and low interest rates, to boost economic growth. These policies, aimed at combating deflationary pressures or promoting inflation, can affect investor sentiment and asset prices, including Bitcoin.

According to Zwick and Syed (2019) and Aboura (2022), inflation is just one component of broader macroeconomic variables. Bitcoin price volatility over the 2017–2022 period was influenced by various macroeconomic factors, including interest rates, exchange rates, and gold prices. These factors interacted with inflation dynamics, contributing to Bitcoin's overall price movements.

Based on data on the development of the United States interest rate, from 2021 to 2022, when the US economy began to recover from the pandemic-induced recession, the Federal Reserve maintained an accommodative monetary policy stance, keeping interest rates low to support economic growth and employment. At the same time, the price of bitcoin was at its highest in those years.

The US dollar started the year on a strong note against the euro but faced some fluctuations throughout 2019. The COVID-19 pandemic in 2020 had a substantial impact on global financial markets, including currency USD/EUR rates. Initially, there was volatility and strengthening of the US dollar as a safe-haven currency. However, as central banks implemented accommodative monetary policies and global economic conditions developed, the euro strengthened against the US dollar. The USD/Euro USD/EUR rate fluctuated throughout 2021 and continued into 2022. Based on the data, the strengthening and volatility that occurred in the US Dollar currency against the Euro were in line with fluctuations in the price of bitcoin in the same year; in 2019 the Bitcoin price began to increase and reached its highest price in 2021 and continued to fluctuate until 2022.

Based on data from 2017 to 2022, the price of gold in the United States is quite stable and has decreased from 2019 to 2020. In those years, the price of Bitcoin was in a period of high enough price increases. Until 2022, the price of United States gold tends to be stable, while the price of Bitcoin experiences high fluctuations and reaches its highest price in 2021.

Mishkin (2016) explains whether Bitcoin or other Cryptocurrencies can be the money of the future. In his writing, he mentions that Cryptocurrency works well as a medium of exchange. Cryptocurrency has two features that make it attractive for making transactions. First, the transaction fees are much lower than those associated with credit cards and debit cards. Second, transactions made with cryptocurrencies can be


http://dx.doi.org/10.21511/imfi.21(2).2024.19

done anonymously, which is very attractive to those who want to maintain their privacy.

However, the value of Cryptocurrencies is subject to huge fluctuations. The high volatility of the Cryptocurrency value means that it does not work well as a store of value because it is too risky. In addition, the huge changes in its price in dollar terms from day to day means that Cryptocurrency cannot serve as a unit of account because the prices of goods and services in cryptocurrency will also have massive fluctuations from day to day. Unsurprisingly, no Cryptocurrency has been a unit of account.

Bitcoin and other cryptocurrencies do not fulfill two of the three main functions of Money. Despite the hype, the understanding of the function of money strongly suggests that cryptocurrencies will not be the money of the future. However, some of the Cryptocurrency technologies, which allow users to conduct low-cost electronic transactions, may become a feature of electronic payment systems in the future. Indeed, central banks are considering issuing their own form of digital currency that would have many of the features of Cryptocurrencies but would be fixed in value to a unit of account, such as the US dollar.

The important role of money as a store of wealth has been explained by portfolio theory. This theory argues that people keep money in their portfolio as an asset. According to portfolio theory, the demand for money should be influenced by the risks and benefits offered by money and other assets besides. Moreover, the demand for money should be based on total wealth, as wealth represents the proportion of the portfolio that consists of traditional and unconventional assets. In portfolio theory, money demand is said to depend on real stock returns, anticipated real bond returns, anticipated inflation rate, and real wealth.

CAPM (Capital Asset Pricing Model) and APT (Arbitrage Pricing Theory) are two uncertainty models that are often used to determine the risk associated with and estimate the amount of risk arising from an asset (Afzal & Haiying, 2020). The CAPM model has been criticized by proponents of arbitrage pricing theory such as Chen, Roll, and Ross, and Chen noted the ability to estimate the expected outcome of the CAPM method for beta stability. Like the CAPM, APT describes the relationship between risk and return but uses different assumptions and procedures (Lai & Stohs, 2021).

This theory explains that asset returns can be carried out using a random process triggered by the risk factors included in the model, and it is expected that this process will be able to significantly worsen asset returns. Various risk factors can increase, such as inflation, changes in the market value of bonds, the production of domestically produced goods (GDP), or political and economic policies that are believed to have a significant impact on the functioning of all assets (Elbannan, 2014). The APT equation can be generalized to conditions where factor i is present so that it becomes:

$$\begin{aligned} E\left(R_i\right) &= R_F + \beta_{1,F1}\left[E\left(R_{F1}\right) - R_F\right] \\ &+ \beta_{2,F2}\left[E\left(R_{F2}\right) - R_F\right] \\ &+ \ldots \beta_{n,Fn}\left[E\left(R_{Fn}\right) - R_F\right] \end{aligned} \quad (1)$$

where $E(R_i)$ is the expected return of a particular financial asset, in this case, the price of bitcoin. $R_F$ is the return of the risk-free asset, $\beta_{1,F1}$, $\beta_{2,F2}$, ..., $\beta_{n,Fn}$ are sensitivity factors or beta weights to certain risk factors (e.g., interest rates or inflation) selected as the main factors in the APT model. Each factor has a beta weight corresponding to its effect on asset returns. $[E(R_{F1}) - R_F]$, $[E(R_{F2}) - R_F]$, ..., $[E(R_{Fn}) - R_F]$ is the expected return of each risk factor minus the risk-free asset return. It shows the expected risk premium for each risk factor (Priestley, 1996).

Current models suggest that investors want compensation for all factors that, mathematically speaking, affect the growth of financial markets. Compensation is the sum of the results of systematic risk and risk premium provided by factors in the foreign exchange market. According to the other risk compensation models described, investors do not receive compensation for the unsystematic risk they know about.

Kusumastuty et al. (2019) state that there is no significant relationship between inflation and bitcoin prices in the first period of their research. Andrean (2020) stated that in the short term and

long term, inflation has a negative and significant effect on bitcoin prices. In contrast to the two previous studies, Sarker and Wang (2022) stated that in the short term, inflation affects Bitcoin prices positively. Harooni and Alvan (2023) state that inflation has a long-term effect on the cost of Bitcoin.

In reaction to inflationary pressures, central banks may execute financial arrangements such as bringing down intrigued rates or locks in quantitative facilitating (QE) to invigorate the economy. These actions may increase the money supply, potentially raising concerns about future inflation. In such cases, investors may turn to Bitcoin as a perceived hedge against the potential devaluation of fiat currencies. Inflation expectations due to central bank actions may affect the price of Bitcoin.

Interest rates can be influenced by central bank monetary policy, which is executed to manage expansion and financial development. Central banks frequently alter intrigued rates to control expansion or invigorate financial movement. Interest rate changes driven by monetary policy decisions can affect inflation expectations and market sentiment. If investors anticipate higher inflation due to accommodative monetary policy and lower interest rates, they may turn to Bitcoin as a potential inflation hedge, leading to increased demand and potentially influencing its price. Evidence is provided that the Fed Funds Rate has a non-linear effect and a strong temporary spillover effect on Bitcoin (Aboura, 2022). The results of Yang and Zhang's (2021) study show that the US interest rate significantly affects the price of Bitcoin.

Bitcoin is traded on various Cryptocurrency exchanges around the world, and its price is determined by the supply and demand dynamics in these markets. The USD/EUR rate between different fiat currencies and Bitcoin can affect the attractiveness and purchasing power of Bitcoin for investors and traders in different countries. If the USD/EUR rate of a particular currency strengthens against Bitcoin, it can make Bitcoin relatively more expensive and potentially reduce demand in that market. Conversely, a weaker USD/EUR rate could make Bitcoin more affordable and potentially increase demand. Georgoula et al. (2015) stated that there is a negative relationship between Bitcoin and USD/EUR.

Investor sentiment can be affected by gold prices as an indicator of economic uncertainty. If gold prices rise, investors feel that there is uncertainty or risk in conventional markets, and in response, they may be inclined to seek safety in crypto assets including Bitcoin. Su et al. (2020) stated that the price of gold has a negative and significant effect on the price of bitcoin.

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

*H1: The Inflation variable is suspected to have a positive and significant impact on the cost of Bitcoin in the United States.*

*H2: The Interest Rate variable is suspected to have a negative and significant impact on the cost of Bitcoin in the United States.*

*H3: The USD/EUR Rate variable is suspected to have a negative and significant impact on the cost of Bitcoin in the United States.*

*H4: The Product Cost variable (Gold) is suspected to have a negative and significant impact on the cost of Bitcoin in the United States.*

## 2. METHODOLOGY

The data utilized in this examination are auxiliary information of the month-to-month time arrangement sort. Time arrangement information is information collected in the shape of time-ordered perceptions on one or more factors (Wooldridge, 2013). The data used are monthly data on bitcoin prices, inflation, interest rates, USD/EUR rates, and gold prices (troy ounces) in the United States from 2017 to 2022 obtained from Yahoo Finance and Investing websites.

The methods used in this study are Dynamic Conditional Correlation (DCC) and Multivariate Generalized Autoregressive Conditionally Heteroscedastic (MGARCH). Data from recent years, especially financial data such as Bitcoin prices, show increased volatility. A method to handle data with high time volatility is heteroscedasticity. The most common mod-


http://dx.doi.org/10.21511/imfi.21(2).2024.19

el to deal with heteroscedasticity is called the Autoregressive Conditional Heteroscedasticity (ARCH) model, which was first proposed by Engle in 1982. Later, in 1986, Tim Bollerslev developed the Generalized Autoregressive Conditional Heteroscedasticity (GARCH) model to address more obvious shortcomings in the ARCH model.

Engle and Sheppard presented the DCC model as the latest multivariate model to examine the dynamic correlation between assets in financial markets. Correlation is the easiest way to assess the development of financial markets. High correlations mean high and increasingly integrated movements.

The DCC GARCH model proposed by Engle in Das (2019) can be written as follows:

$$y_t = Cx_t + \varepsilon_t, \tag{2}$$

$$\varepsilon_t = H_t^{1/2} v_t, \tag{3}$$

$$H_t = D_t^{1/2} R_t D_t^{1/2}, \tag{4}$$

$$R_t = diag\left(Q_t\right)^{-1/2} Q_t diag\left(Q_t\right)^{-1/2}, \tag{5}$$

$$Q_t = \left(1-\lambda_1-\lambda_2\right)R + \lambda_1 \tilde{\varepsilon}_t - 1\tilde{\varepsilon}_{t-1} + \lambda_2 Q_{t-1}, \tag{6}$$

where $y_t$ is an $m \times 1$ vector of subordinate components; $C$ is an $m \times k$ parameter lattice; $x_t$ is a $k \times 1$ vector of independent components, which may contain slacks $y_t$; $H_t^{1/2}$ is the Cholesky figure of the time-varying conditional covariance cross-section $H_t$; $\mathbf{v}_t$ is an $m \times 1$ vector of conventional, free, unclearly passed on progressions; $D_t$ is the slanting arrange of conditional changes,

$$D_t = \begin{pmatrix} \sigma_{1,t}^2 & 0 & \cdots & 0 \\ 0 & \sigma_{2,t}^2 & \cdots & 0 \\ \vdots & \vdots & \ddots & \vdots \\ 0 & 0 & \cdots & \sigma_{m,t}^2 \end{pmatrix}. \tag{7}$$

In which each $\sigma_{i,t}^2$ advances concurring to a univariate GARCH show of the frame

$$\sigma_{i,t}^2 = s_i + \sum_{j=1}^{p_i} \alpha_j \int_{i,t-j}^2 + \sum_{j=1}^{q_i} \beta_j \sigma_{i,t-j}^2. \tag{8}$$

By default, or

$$\sigma_{i,t}^2 = \exp\left(\gamma_i z_{i,t}\right) + \sum_{j=1}^{p_i} \alpha_j \int_{i,t-j}^2 + \sum_{j=1}^{q_i} \beta_j \sigma_{i,t-j}^2, \tag{9}$$

when the alternative is indicated, where $\gamma_i$ it is $1 \times p$ vector of parameters, $z_i$ could be a $p \times 1$ vector of autonomous factors counting a steady term, the $\alpha_j$ are ARCH parameters, and the $\beta_j$ are GARCH parameters;

$R_t$ is a matrix of conditional quasi correlation

$$R_t = \begin{pmatrix} 1 & \rho_{12,t} & \cdots & \rho_{1m,t} \\ \rho_{12,t} & 1 & \cdots & \rho_{2m,t} \\ \vdots & \vdots & \ddots & \vdots \\ \rho_{1m,t} & \rho_{2m,t} & \cdots & 1 \end{pmatrix}, \tag{10}$$

where $\tilde{\varepsilon}_t$ it is an $m \times 1$ vector of standardized residuals, $D_t^{-1/2}\varepsilon_t$; and $\lambda_1$ and $\lambda_2$ are parameters that supervise the components of conditional quasicorrelation. $\lambda_1$ and $\lambda_2$ are nonnegative and fulfill $0 \leq \lambda_1 + \lambda_2 < 1$.

When $Q_t$ is stationary, the $R$ framework could be a weighted normal of unlimited covariance framework of the standardized residuals $\tilde{\varepsilon}_t$, signified by $\bar{\mathrm{R}}$, and the unrestricted cruel of $Q_t$, signified by $\bar{\mathrm{Q}}$. Since $\bar{\mathrm{R}} \neq \bar{\mathrm{Q}}$, as appeared by Aielli (2009), $R$ is not one or the other the unrestricted relationship lattice nor the unlimited cruel of $Q_t$. For this reason, the parameters in $R$ are known as quasicorrelation.

In this study, the dependent variable (Bitcoin price) will be part of the $y_t$ vector. Meanwhile, the independent variables (inflation, interest rate, USD/EUR rate, and gold price) will be part of vector $x_t$. The independent variables will likely be included in the parameter matrix $C$, which shows the relationship between the independent variable and the dependent variable. The dependent variable will also affect the residual vector $\varepsilon_t$ through the $H_t^{1/2}$ matrix. The independent variables will have an impact on the diagonal matrix $D_t$, which governs the conditional change in residual volatility. The correlation between the residuals will be governed by the quasi-conditional correlation matrix $R_t$, which may be affected by the independent variables through the matrix $Q_t$. So, in general, the dependent variable (Bitcoin price) will be included

in the equation as $y_t$, while the independent variables (inflation, interest rate, USD/EUR rate, and gold price) will be included in the parameter matrix and will affect the volatility and correlation of the residuals.

An imperative advantage of utilizing this method is that it realizes the plausibility of conditional relationship changes over time, taking into consideration the location of energetic speculator behavior in reaction to news and advancements (Celik, 2012). In expansion, the strategy of measuring energetic conditional relationships is reasonable for investigating conceivable disease impacts within the improvement of grouping behavior in monetary markets in times of emergency. In expansion, utilizing the DCC-GARCH show can be valuable to degree the relationship coefficient of the standardized residuals, hence straightforwardly clarifying heteroscedasticity (Chiang et al., 2007). Due to the procedural alteration for instability, time-varying conditional redresses (DCCs) are not one-sided by instability. Since they do not resemble the volatility-adjusted cross-market correlations used, time-varying volatility correlations are continuously examined according to the DCC-GARCH approach (Forbes & Rigobon, 2002).

## 3. RESULT

Researchers perform several stages in obtaining research results. The stationarity test, also known as the unit root test, is a statistical test used to determine whether time series data are stationary or show unit roots. 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, then a stationary test will be carried out at the 1st Difference level.

Based on the results of the data stationarity test in Table 1, only the bitcoin price variable is stationary at the level level, with a probability of <0.05. Therefore, it is necessary to conduct a 1st Difference level stationarity test. Based on the test results, the inflation, interest rate, USD/EUR rate, and gold price variables are stationary at the 1st Difference level with a probability of <0.05.

The multicollinearity test is a statistical method used to detect the presence and severity of multicollinearity in a regression model. This test helps assess the correlation and interdependence between independent variables. In this study, the multicollinearity test was carried out by observing the correlation coefficient value between independent variables. Based on the multicollinearity test results, there is no correlation between the independent variables whose value is >0.8. So, it can be concluded that there are no symptoms of multicollinearity in the data (Shrestha, 2020).

The heteroscedasticity test could be a measurable test utilized to test for the nearness of heteroscedasticity in a relapse demonstration. Heteroscedasticity alludes to a circumstance where the inconstancy of errors (residuals) in a relapse demonstration is not consistent over the extent of indicator factors. There are several methods or tests that are usually used in detecting the occurrence of this heteroscedasticity problem.

**Table 1.** Data stationarity test (Augmented Dickey-Fuller)

Source: Data processed.

| Variable | t-statistic | Critical Value | | | | Description |
|---|---|---|---|---|---|---|
| | | 1% | 5% | 10% | p-value | |
| **Level** | | | | | | |
| Inflation | 0.122 | –3.551 | –2.913 | –2.592 | 0.9675 | Non-stationary |
| Interest Rate | 1.364 | –3.551 | –2.913 | –2.592 | 0.9969 | Non-stationary |
| USD/EUR rate | –1.539 | –3.551 | –2.913 | –2.592 | 0.5142 | Non-stationary |
| Gold Price | –0.605 | –3.551 | –2.913 | –2.592 | 0.8699 | Non-stationary |
| Bitcoin Price | –4.453 | –3.551 | –2.913 | –2.592 | 0.0002 | Stationary |
| **First Difference** | | | | | | |
| Inflation | –4.415 | –3.551 | –2.914 | –2.592 | 0.0003 | Stationary |
| Interest Rate | –3.727 | –3.552 | –2.914 | –2.592 | 0.0037 | Stationary |
| USD/EUR rate | –6.849 | –3.552 | –2.914 | –2.592 | 0.0000 | Stationary |
| Gold Price | –7.736 | –3.552 | –2.914 | –2.592 | 0.0000 | Stationary |


http://dx.doi.org/10.21511/imfi.21(2).2024.19

**Table 2.** Multicollinearity test

Source: Data processed.

| | Bitcoin Price | Inflation | Interest Rate | USD/EUR rate | Gold Price |
|---|---|---|---|---|---|
| Bitcoin Price | 1.0000 | | | | |
| Δ Inflation | 0.7422 | 1.0000 | | | |
| Δ Interest Rate | –0.1431 | 0.0903 | 1.0000 | | |
| Δ USD/EUR rate | 0.3499 | 0.5688 | 0.4074 | 1.0000 | |
| Δ Gold Price | –0.8841 | –0.5973 | 0.4210 | –0.1953 | 1.0000 |

In this study, the method used was the Breusch-Pagan test. If the Chi-square probability result is less than the alpha value, usually 1 percent, 5 percent, and 10 percent, it is concluded that there is a heteroscedasticity problem in the data.

Based on the test results, at an alpha level of 1 percent with a probability result of 0.0005, it can be concluded that the data have a heteroscedasticity problem. Due to this problem, this study can be continued with the DCC-MGARCH method.

Based on Table 3, simultaneously the p-value result is 0.0479. This figure shows that the p-value is smaller than the alpha of 0.05 or 5%, so it can be concluded that with a significance level of 5%, it can be stated that the variables of inflation, interest rates, USD/EUR rates, and gold prices simultaneously have a significant effect on the bitcoin price variable.

Based on the t-test results in Table 3, it can be concluded that the inflation variable at lag 1 has a negative and significant effect on the price of bitcoin; this is evidenced by the coefficient value of –3.56e-08 contained in the table. So, based on these results, *H1* is rejected. Correspondingly, the interest rate and USD/EUR rates variables in lag 1 also have a negative and significant effect on the price of Bitcoin with a coefficient value of –9.90e-08 and –3.86e-07. Based on these results, *H2* and *H3* are accepted. Unlike the previous variables, the gold price variable in lag 1 has a positive and significant effect on the price of Bitcoin with a coefficient value of 5.89e-06, so *H4* is rejected.

Hypothesis testing results show that there is a significant relationship between the studied macroeconomic variables (such as inflation, interest rates, and the USD/EUR rates) and Bitcoin price. Specifically, it was found that inflation, interest rates, and the USD/EUR exchange rate have a significant relationship with Bitcoin price, while gold price shows a positive and significant relationship with Bitcoin price during the studied period.

**Table 3.** DCC-MGARCH

Source: Data processed.

| Dependent Variable: Log Bitcoin Price | | | | | |
|---|---|---|---|---|---|
| **Variabel Independen** | **(1)** | **(2)** | **(3)** | **(4)** | **(5)** |
| Δ Inflation (–1) | –2.01e–07*** | | | | –3.56e–08*** |
| | (5.94e–08) | | | | (8.56e–08) |
| Δ Interest Rate (–1) | | 1.31e–07*** | | | –9.90e–08*** |
| | | (1.10e–07) | | | (1.38e–07) |
| Δ USD/EUR Rate (–1) | | | –3.51e–06*** | | –3.86e–07*** |
| | | | (2.26e–06) | | (2.66e–06) |
| Δ Log Gold Price (–1) | | | | 5.75e–06*** | 5.89e–06*** |
| | | | | (1.24e–06)) | (1.99e–06) |
| Log Bitcoin Price (–1) | 1.0000*** | 1.0000*** | 1.0000*** | 1.0000*** | 1.0000*** |
| | (2.97e–07) | (2.46e–07) | (2.99e–06) | (5.91e–06) | (0.0000) |
| Cons | 0.1737 | 0.0816 | 0.0007 | 0.0000 | 5.92e–13 |
| | (0.0182) | (0.0136) | (0.0001) | (0.0000) | (9.94e–14) |
| Prob>Chi² | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| | | | | | |
| Number of Obs | 71 | 71 | 71 | 71 | 71 |

*Note:* Standard errors are in parentheses. Each asterisk indicates statistical significance, *** p < 1%, ** p < 5%, and * p < 10%.

An in-depth statistical analysis was conducted to test these hypotheses, and the results confirmed the significance of the relationship between these variables. In addition, it was also found that the Bitcoin price variable at lag 1 has a positive and significant impact on the current Bitcoin price, meaning that a one-point increase in Bitcoin price in the previous month will increase the current month's Bitcoin price by one point. Overall, all independent variables in this study have a significant impact at the 1 percent confidence level.

## 4. DISCUSSION

Using the DCC-MGARCH method allows for modeling time-varying correlations between variables. This is particularly useful in financial analysis as correlations between assets often change over time. By capturing these dynamics, DCC-MGARCH can provide more accurate estimates of correlations compared to models that assume constant correlations (Chevallier, 2012). In expansion, DCC-MGARCH is well suited to capture instability clustering, which alludes to the wonder where periods of tall instability tend to cluster together. By permitting the conditional fluctuation to be time-varying, the demonstration can capture this clustering behavior, which is commonly watched in money-related information (Ko et al., 2024).

DCC-MGARCH is also capable of modeling asymmetric and heteroskedastic data, which is commonly observed in financial time series. It allows the estimation of both positive and negative shocks to volatility and can capture various magnitudes of volatility over time (Bala & Takimoto, 2017).

This study is taken from the latest US data and tested with independent variables representing inflation, interest rates, USD/EUR rates, and gold prices. This study aims to see the relationship of these independent variables with the dependent variable, namely the price of Bitcoin. Similar research has been done before, but using the DCC-MGARCH method has not been done on US data. Inflation may be a term used to depict the common increment within the costs of products and administrations in an economy over time, coming about in a diminish in people's acquiring control. In this study, inflation was found to have a negative and significant relationship with the price of Bitcoin in the United States. In contrast to the author's findings, Sarker and Wang (2022) stated that in the short term, inflation affects Bitcoin prices positively.

Kusumastuty et al. (2019) stated differently that there was no significant relationship between inflation and Bitcoin prices. Supporting the author's findings, Andrean (2020) states that in the short and long term, inflation has a negative and significant effect on the price of Bitcoin. Inflation has a long-term impact on Bitcoin prices (Harooni & Alvan, 2023). As a decentralized digital currency, Bitcoin offers an alternative to traditional fiat currencies that are impacted by inflationary pressures. High inflation in fiat currencies can reduce the purchasing power of consumers in general. This can lead to people having less resources to invest or even buy Bitcoin. As a result, demand for Bitcoin may decrease, which in turn may affect its price (Krakower, 2023). In addition, high inflation in fiat currencies may trigger government responses, including tighter monetary policies or heavier regulations against cryptocurrencies like Bitcoin. Such measures could create uncertainty and depress the price of Bitcoin (Bas et al., 2024).

In this study, interest rates were found to have a negative and significant relationship with Bitcoin prices. When interest rates are low, it can reduce the potential returns from fixed income investments such as bonds or savings accounts. This may cause some investors to seek higher-yielding assets such as Bitcoin, increasing its demand and potentially increasing its price (Wang & Gao, 2024). In addition, lower interest rates may result in an increase in money supply as central banks implement expansionary monetary policies to stimulate economic growth. This can lead to concerns about inflation and a decline in the value of fiat currencies, causing investors to turn to Bitcoin as a potential store of value or inflation hedge. Interest rates have a negative short-term relationship with bitcoin prices (Georgoula et al., 2015). An increment in interest rates will reduce investors' intrigue in contributing to Bitcoin as a theoretical resource, and gold may supplant Bitcoin as a substitute resource (Havidz et al., 2021). Interest rates have a long-term impact on the price of Bitcoin (Harooni & Alvan, 2023).


http://dx.doi.org/10.21511/imfi.21(2).2024.19

The USD/EUR rate variable in this study was found to have a negative and significant relationship with the price of bitcoin in the United States. In contrast to these findings, Guizani and Nafti (2019) found that the exchange rate does not determine the price of Bitcoin in both the short and long term. However, Oad Rajput et al. (2020) found that the exchange rate has a negative and statistically significant effect on the price of Bitcoin, and vice versa. When the US exchange rate weakens, investors look for alternative investments to protect the value of their wealth. One option is to turn to assets that are considered more potentially profitable, such as Bitcoin. As a result, demand for Bitcoin may increase when the fiat currency exchange rate weakens, which could push the price up (Benetton & Compiani, 2024).

In this study, it was found that the price of gold has a positive and significant effect on the price of Bitcoin in the United States, this is in line with Jareño et al. (2020). Both gold and Bitcoin are often considered safe-haven assets, which means investors tend to shift their investments to these two assets when there is economic uncertainty or geopolitical tension. When gold prices increase, it can reinforce the belief that hedge assets as a whole are being sought after. This could encourage investors to also buy Bitcoin, which in turn increases demand and supports Bitcoin's price. Harooni and Alvan (2023) state that many of the differences in research results are due to the highly volatile cryptocurrency market; some cryptocurrencies have collapsed quickly, while others have experienced tremendous gains. Cryptocurrencies are experiencing tremendous growth while some other macroeconomic variables are facing a bear market.

This study of the impact of inflation on Bitcoin prices is a study that uses United States data with independent variables of inflation, interest rates, USD/EUR rates, and Bitcoin prices and the dependent variable of Bitcoin prices. This study was tested with the DCC-MGARCH method. The results of this study indicate that there is a positive and significant relationship between the variables of inflation, interest rates, and USD/EUR rates on the price of Bitcoin in the United States in the period January 2017 to December 2022. Conversely, there is a negative and significant relationship between the price of gold and the price of Bitcoin in the United States in the period January 2017 to December 2022.

The presence of Bitcoin as the first digital currency in Cryptocurrency raises many pros and cons in the wider community. Its high price fluctuations cause Bitcoin users to be a lot more careful in using it. The United States values economic freedom and individual liberty. Allowing the use and trading of Bitcoin is in line with the principles of free markets and personal choice. In line with that, this study aims to analyze the relationship between macroeconomic variables and Bitcoin prices. Researchers found that there is a negative and substantial relationship between inflation, interest rates, and USD/EUR rates with Bitcoin prices in the US. While the gold price variable has a positive and significant effect on the price of Bitcoin in the US. This finding is particularly relevant in the current context of the digital economy. The findings confirm that, although Bitcoin is considered a decentralized and independent digital asset, it is not independent of macroeconomic factors that affect the value and demand of the asset. Therefore, it is important for market participants to pay attention to and analyze macroeconomic conditions thoroughly to understand Bitcoin's price behavior. This also points to the need for prudent regulatory oversight and appropriate monetary policies to manage their impact on the crypto market.

In addition, the significant positive relationship between gold and Bitcoin prices highlights Bitcoin's role as a form of alternative investment or hedge, particularly in times of economic uncertainty or when traditional assets such as gold are rising in price. This implication encourages diversification of investment portfolios by considering both assets, which can help reduce risk and increase potential returns in the long run. Thus, understanding the implications of the relationship between macroeconomic factors and Bitcoin price is key to making smart and strategic investment decisions in an increasingly complex crypto market.

## CONCLUSION

The conclusion of the results of this study confirms several hypotheses proposed earlier. Hypothesis testing results show that inflation has a negative and significant relationship with Bitcoin prices in the United States. This result is different from the hypothesis proposed earlier, so based on the results, *H1* is rejected. Interest rates and the USD/EUR rates have a significant negative relationship with the price of Bitcoin in the cryptocurrency market in the United States, in accordance with the proposed hypothesis, so *H2* and *H3* are accepted. However, there is a rejection of the gold price hypothesis, where the findings show that the price of gold has a positive and significant impact on the price of Bitcoin; this is different from the previously proposed hypothesis, so *H4* is rejected.

The implication of these findings is that macroeconomic variables such as inflation, interest rates, currency exchange rates, and gold prices can be important factors in predicting Bitcoin price movements in the US market. The highly volatile cryptocurrency market can result in significant price fluctuations, and the risks associated with these investments should be carefully calculated. The weaknesses of this study include limitations in the data and analysis methods used. In addition, this study did not consider external factors such as geopolitical events or technological developments that could affect the price of Bitcoin. For future 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 Bitcoin price in the US market.

## AUTHOR CONTRIBUTIONS

Conceptualization: Mailinda Tri Wahyuni, Endrizal Ridwan, Dwi Fitrizal Salim.
Data Curation: Mailinda Tri Wahyuni, Dwi Fitrizal Salim.
Formal Analysis: Mailinda Tri Wahyuni, Endrizal Ridwan.
Funding acquisition: Endrizal Ridwan, Dwi Fitrizal Salim.
Investigation: Mailinda Tri Wahyuni, Endrizal Ridwan, Dwi Fitrizal Salim.
Methodology: Mailinda Tri Wahyuni.
Project Administration: Mailinda Tri Wahyuni.
Resources: Mailinda Tri Wahyuni, Dwi Fitrizal Salim.
Software: Mailinda Tri Wahyuni, Endrizal Ridwan.
Supervision: Endrizal Ridwan, Dwi Fitrizal Salim.
Validation: Mailinda Tri Wahyuni, Endrizal Ridwan.
Visualization: Mailinda Tri Wahyuni, Dwi Fitrizal Salim.
Writing Original draft: Mailinda Tri Wahyuni, Endrizal Ridwan, Dwi Fitrizal Salim.
Writing : review & editing: Endrizal Ridwan, Dwi Fitrizal Salim.

## REFERENCES


1. Aboura, S. (2022). A Note on the Bitcoin and Fed Funds Rate. *Empirical Economics, 63*(5), 2577-2603. https://doi.org/10.1007/S00181-022-02207-7
2. Afzal, F. J. & Haiying, P. (2020). Evaluating The Effectiveness of Capm and Apt for Risk Measuring and Assets Pricing. *Financial Risk and Management Reviews*. https://doi.org/10.18488/Journal.89.2020.61.14.21
3. Aielli, G. P. (2011). Dynamic conditional correlation: On properties and estimation. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.1507743
4. Al-Yahyaee, K. H., Rehman, M. U., Mensi, W., & Al-Jarrah, I. M. W. (2019). Can Uncertainty Indices Predict Bitcoin Prices? A Revisited Analysis Using Partial and Multivariate Wavelet Approaches. *North American Journal of Economics and Finance*. https://doi.org/10.1016/J.Najef.2019.03.019
5. Andrean, G. (2020). Determinant of the Bitcoin Prices as Alternative Invesment in Indonesia. *Indicators: Journal of Economic and Business, 1*(1), 22-29. https://doi.org/10.47729/Indicators.V1i1.48
6. Astuti, R. D., & Fazira, N. (2018). The Effect of Cryptocurrency on Exchange Rate of China: Case Study of Bitcoin. *Munich Personal*



http://dx.doi.org/10.21511/imfi.21(2).2024.19

*Repec Archive, 93052*. Retrieved from https://ideas.repec.org/p/pra/mprapa/93052.html

7. Bala, D. A., & Takimoto, T. (2017). Stock Markets Volatility Spillovers During Financial Crises: A DCC-MGARCH With Skewed-T Density Approach. *Borsa Istanbul Review*. https://doi.org/10.1016/J.Bir.2017.02.002
8. Bas, T., Malki, I., & Sivaprasad, S. (2024). Connectedness between central bank digital currency index, financial stability and digital assets. *Journal of International Financial Markets, Institutions and Money, 92*(July 2023), 101981. https://doi.org/10.1016/j.intfin.2024.101981
9. Baur, D. G., Dimpfl, T., & Kuck, K. (2018). Bitcoin, gold, and the US dollar – A replication and extension. *Finance Research Letters, 25,* 103-10. https://doi.org/10.1016/j.frl.2017.10.012
10. Benetton, M., & Compiani, G. (2024). Investors' beliefs and cryptocurrency prices. *The Review of Asset Pricing Studies*, raad015. https://doi.org/10.1093/rapstu/raad015
11. Brière, M., Oosterlinck, K., & Szafarz, A. (2015). Virtual currency, tangible return: portfolio diversification with bitcoin. *Journal of Asset Management, 16,* 365-73. https://doi.org/10.1057/jam.2015.5
12. Celik, S. (2012). The More Contagion Effect on Emerging Markets: The Evidence of DCC-GARCH Model. *Economic Modelling, 29*(5), 1946-1959. https://doi.org/10.1016/J.Econmod.2012.06.011
13. Chevallier, J. (2012). Time-Varying Correlations in Oil, Gas and CO2 Prices: An Application Using BEKK, CCC and DCC-MGARCH Models. *Applied Economics*. https://doi.org/10.1080/00036846.2011.589809
14. Chiang, T. C., Jeon, B. N., & Li, H. (2007). Dynamic Correlation Analysis of Financial Contagion: Evidence from Asian Markets. *Journal of International Money and Finance, 26*(7), 1206-1228. https://doi.org/10.1016/J.Jimonfin.2007.06.005
15. Choi, S., & Shin, J. (2022). Bitcoin: An Inflation Hedge But Not A Safe Haven. *Finance Research Letters*. https://doi.org/10.1016/J.Frl.2021.102379
16. Chu, J., Chan, S., Nadarajah, S., & Osterrieder, J. (2017). GARCH modelling of cryptocurrencies. *Journal of Risk and Financial Management, 10,* 17. https://doi.org/10.3390/jrfm10040017
17. Das, P. (2019). Econometrics in Theory and Practice: Analysis of Cross Section, Time Series and Panel Data with Stata 15.1. In *Econometrics in Theory and Practice: Analysis of Cross Section, Time Series and Panel Data with Stata 15.1*. https://doi.org/10.1007/978-981-32-9019-8
18. Dyhrberg, A. H. (2016). Hedging capabilities of bitcoin. Is it the virtual gold? *Finance Research Letters, 16,* 139-44. https://doi.org/10.1016/j.frl.2015.10.025
19. Elbannan, M. A. (2014). The Capital Asset Pricing Model: An Overview of the Theory. *International Journal of Economics and Finance, 7*(1), 216-228. Https://doi.org/10.5539/Ijef.V7n1p216
20. Farhi, E., & Maggiori, M. (2018). A model of the international monetary system. *The Quarterly Journal of Economics, 133*(1), 295-355. Retrieved from https://scholar.harvard.edu/files/farhi/files/ims.pdf
21. Forbes, K. J., & Rigobon, R. (2002). No Contagion, Only Interdependence: Measuring Stock Market Comovements. *Journal of Finance, 57*(5), 2223-2261. https://doi.org/10.1111/0022-1082.00494
22. Ge, Z., & Zhou, C. (2019). Bitcoin Price Trends and Influencing Factors. *Hmeet,* 122-128. Retrieved from https://www.clausiuspress.com/conference/article/artId/3952.html
23. Giudici, G., Milne, A., & Vinogradov, D. (2020). Cryptocurrencies: market analysis and perspectives. *Journal of Industrial and Business Economics, 47*(1), 1-18. Retrieved from https://ideas.repec.org/a/spr/epolin/v47y2020i1d10.1007_s40812-019-00138-6.html
24. Guizani, S., & Nafti, I. K. (2019). The Determinants of Bitcoin Price Volatility: An Investigation with ARDL Model. *Procedia Computer Science, 164,* 233-238. https://doi.org/10.1016/J.Procs.2019.12.177
25. Harooni, M. U., & Alvan, A. (2023). The Relationship Between Bitcoin Price and Macroeconomic. Retrieved from https://www.researchgate.net/publication/370872683_THE_RELATIONSHIP_BETWEEN_BITCOIN_PRICE_AND_MACROECONOMIC_VARIABLES
26. Havidz, S. A. H., Karman, V. E., & Mambea, I. Y. (2021). Is Bitcoin Price Driven by Macro-Financial Factors and Liquidity? A Global Consumer Survey Empirical Study. *Vilniaus Universiteto Leidykla, 24*. Retrieved from https://www.redalyc.org/journal/6923/692372872007/html/
27. International Monetary Fund. (2022). The Money Revolution. *Finance & Development IMF, September,* 42-54.
28. Jareño, F., González, M. de la O., Tolentino, M., & Sierra, K. (2020). Bitcoin and gold price returns: A quantile regression and NARDL analysis. *Resources Policy, 67*(March). https://doi.org/10.1016/j.resourpol.2020.101666
29. Katsiampa, P. (2017). Volatility estimation for bitcoin: a comparison of GARCH models. *Economics Letters, 158,* 3-6. https://doi.org/10.1016/j.econlet.2017.06.023
30. Ko, H., Son, B., & Lee, J. (2024). Portfolio insurance strategy in the cryptocurrency market. *Research in International Business and Finance, 67,* 102135. https://doi.org/10.1016/j.ribaf.2023.102135
31. Krakower, R. H. (2023). *Exploring The Relationship Between Bitcoin and Inflation Expectations: An Empirical Analysis*. Retrieved from https://repository.upenn.edu/entities/publication/59bd2073-2ce6-4c70-838c-513fd638e066
32. Kusumastuty, C., Wulandari, D., Narmaditya, B., & Kamaludin, M.

(2019). Do Monetary Variables Affect to Cryptocurrency Price? Lesson From Indonesia. *Jurnal Ekonomi Dan Studi Pembangunan, 11*(2), 131-142. Https://doi.org/10.17977/Um002v11i22019p131

33. Lai, T., & Stohs, M. H. (2021). CAPM And Asset Pricing. *International Journal of Business, November*. Retrieved from https://ijb.cyut.edu.tw/var/file/10/1010/img/838/V26N4-6.pdf

34. Li, J.-P., Naqvi, B., Rizvi, S. K. A., & Chang, H.-L. (2021). Bitcoin: The Biggest Financial Innovation of Fourth Industrial Revolution and a Portfolio's Efficiency Booster. *Technological Forecasting & Social Change*. https://doi.org/10.1016/J.Techfore.2020.120383

35. Li X, & Wang, C. A. (2017). The technology and economic determinants of cryptocurrency exchange rates: the case of bitcoin. *Decision Support Systems, 95,* 49-60. https://doi.org/10.1016/j.dss.2016.12.001

36. Mirzayi, S., & Mehrzad, M. (2017). Bitcoin, An SWOT Analysis. *2017 7th International Conference on Computer and Knowledge Engineering, ICCKE*. https://doi.org/10.1109/ICCKE.2017.8167876

37. Mishkin, F. S. (2016). *The Economics of Money, Banking, and Financial Markets*. Columbia University. Retrieved from http://bibliotheque.pssfp.net/livres/THE_ECONOMICS_OF_MONEYS_BAMKING_AND_FINANCIAL_MARKETS.pdf

38. Nguyen, T., Nguyen Thanh, B., Nguyen, K., & Pham, H. (2019). Asymmetric monetary policy effects on cryptocurrency markets. *Research in International Business and Finance, 48*(C), 335-339. https://doi.org/10.1016/j.ribaf.2019.01.011

39. Oad Rajput, S. K., Soomro, I. A., & Soomro, N. A. (2020). Bitcoin sentiment index, Bitcoin performance and US Dollar Exchange Rate. *Journal of Behavioral Finance, 23*(2), 150-165. https://doi.org/10.1080/15427560.2020.1864735

40. Parino, F., Beiró, M. G., & Gauvin, L. (2018). Analysis of the Bitcoin Blockchain: Socio-Economic Factors Behind yhe Adoption. *EPJ Data Science*. https://doi.org/10.1140/Epjds/S13688-018-0170-8

41. Priestley, R. (1996). The arbitrage pricing theory, macroeconomic and financial factors, and expectations generating processes. *Journal of Banking and Finance, 20*(5), 869-890. https://doi.org/10.1016/0378-4266(95)00035-6

42. Rahman, A., & Dawood, A. K. (2019). Bitcoin and future of cryptocurrency. *Ushus Journal of Business Management, 18*(1), 61-66. http://dx.doi.org/10.12725/ujbm.46.5

43. Sadraoui, T., Nasr, A., & Mgadmi, N. (2022). Studding Relationship Between Bitcoin, Exchange Rate and Financial Development: A Panel Data Analysis. *International Journal of Managerial and Financial Accounting*, *January*. https://doi.org/10.1504/IJMFA.2021.120519

44. Sarker, P. K., & Wang, L. (2022). Co-Movement and Granger Causality Between Bitcoin and M2, Inflation and Economic Policy Uncertainty: Evidence from the U.K. and Japan. *Heliyon, 8*(October), E11178. https://doi.org/10.1016/J.Heliyon.2022.E11178

45. Sinha, K., Gurung, B., Paul, R. K., Kumar, A., Panwar, S., Alam, W., Ray, M., & Rathod, S. (2012). *Volatility spillover using multivariate GARCH model: an application in futures and spot market price of black pepper.* Retrieved from http://isas.org.in/jisas/volume/vol71/issue1/4-Kanchan.pdf

46. Shrestha, N. (2020). Detecting Multicollinearity in Regression Analysis. *American Journal of Applied Mathematics and Statistics, 8*(2), 39-42. https://doi.org/10.12691/ajams-8-2-1

47. Shuai, Z., Xinyu, H., & Shusong, B. (2021). What Determines Interest Rates for Bitcoin Lending? *Research in International Business and Finance, 58*(March), 101443. https://doi.org/10.1016/J.Ribaf.2021.101443

48. Su, C., Qin, M., Tao, R., & Zhang, X. (2020). Is the Status of Gold Threatened by Bitcoin ? *Economic Research-Ekonomska Istraživanja, 33*(1), 420-437. https://doi.org/10.1080/1331677X.2020.1718524

49. Sukamulja, S., & Sikora, C. O. (2018). The New Era of Financial Innovation: The Determinants of Bitcoin'S Price. *Journal of Indonesian Economy and Business, 33*(1), 46. https://doi.org/10.22146/Jieb.30646

50. Wang, H., & Gao, S. (2024). The future of the international financial system: The emerging CBDC network and its impact on regulation. *Regulation and Governance, 18*(1), 288-306. https://doi.org/10.1111/rego.12520

51. Wooldridge, J. M. (2013). Econometrics: A Modern Approach 5th Edition. In *Introductory Econometrics: A Practical Approach*. Retrieved from https://economics.ut.ac.ir/documents/3030266/14100645/Jeffrey_M._Wooldridge_Introductory_Econometrics_A_Modern_Approach__2012.pdf

52. Yang, K., & Zhang, Z. (2021). What are the Potential Factors That Will Affect the Value of Bitcoin in The U.S.? *Proceedings of the 2021 International Conference On Financial Management And Economic Transition (FMET 2021), 190*(Fmet), 436-441. https://doi.org/10.2991/Aebmr.K.210917.067

53. Yuneline, M. H. (2019). Analysis of cryptocurrency's characteristics in four perspectives. *Journal of Asian Business and Economic Studies, 26*(2), 206-219. https://doi.org/10.1108/JABES-12-2018-0107

54. Zwick, H. S., & Syed, S. A. S. (2019). Bitcoin And Gold Prices: A Fledging Long-Term Relationship. *Theoretical Economics Letters,* 2516-2525. https://doi.org/10.4236/Tel.2019.97159



http://dx.doi.org/10.21511/imfi.21(2).2024.19