International Journal of Economics and Financial Issues

ISSN: 2146-4138

available at http: www.econjournals.com

International Journal of Economics and Financial Issues, 2023, 13(6), 91-100.

An Empirical Investigation of Bitcoin Hedging Capabilities against Inflation using VECM: The Case of United States, Eurozone, Philippines, Ukraine, Canada, India, and Nigeria

Kolawole Ibrahim Gbolahan*

Vilnius Gediminas Technical University, Lithuania. *Email: kolawole-ibrahim.gbolahan@stud.vilniustech.lt

Received: 18 July 2023 **Accepted:** 27 October 2023 **DOI:** https://doi.org/10.32479/ijefi.14956

ABSTRACT

This study examines Bitcoin's potential as an inflation hedge in different countries, including the United States, the Eurozone, the Philippines, Ukraine, Canada, India, and Nigeria. The study reveals varying results across countries using the vector error correlation model (VECM) with secondary monthly data from January 2012 to June 2023 for Bitcoin prices and inflation rates. Bitcoin exhibits an insignificant short-term relationship in the United States but a significant long-term negative correlation, suggesting it may not be a reliable inflation hedge. Similarly, no significant relationship was found in the Eurozone, the Philippines, Ukraine and Nigeria, indicating Bitcoin's limited effectiveness as an inflation hedge. Contrastingly, the study identifies a significant positive relationship between Bitcoin and inflation in Canada and India, indicating potential hedging against inflation within these economies. Therefore, investors, portfolio managers, and policymakers should consider these country-specific findings when evaluating Bitcoin's role as an inflation hedge. Furthermore, this study contributes valuable insights into cryptocurrencies and their potential in financial risk management.

Keywords: Bitcoin, Hedge, Inflation, Vector Error Correction Model, Cryptocurrencies, VCEM
JEL Classifications: G12, G14, G17

1. INTRODUCTION

Inflation is regarded as one of "the three economical evils" facing humanity (Rehman et al., 2022) because of its contribution toward a continuous rise in the price of goods and services. Potentially reducing the purchasing power of individuals over a given period. Post Covid-19 inflation has become a problem that is facing most countries of the world because of the quantitative easing carried out in many countries by the governments to provide support to the citizen and companies during the pandemic, meaning a huge amount of money was pumped into the economy, thereby causing a high rate of inflation. However, the value of fiat currencies decreases during high inflation rates (Egbe et al., 2021). Consequently, investors and individuals seek an alternative way of protecting their money against inflation (Allor, 2020).

Moreover, after the financial crisis in 2008 and the creation of Bitcoin, the first cryptocurrency in 2008 by Satoshi and launched in 2009, many investors and individuals saw Bitcoin as "digital gold," which has the same hedging capabilities against inflation as traditional gold. Additionally, Bitcoin is regarded as the best innovative digital currency created by humanity, and it has been called "peer-to-peer digital money" with a high level of transparency, decentralization, and anonymity (Ismail et al., 2020). The cryptocurrency market has attracted significant attention in recent years because of the high rate of return compared to traditional financial instruments (Jeribi and Masmoudi, 2021). Furthermore, the decentralization characteristics of Bitcoin created better privacy and security than traditional banking systems (Longo et al., 2020). In highly cryptocurrency adoption countries such as the United States, Eurozone, the Philippines, Nigeria, Ukraine, and India, many institutional investors like hedge funds and pension funds have well-diversified risk-mitigation portfolios to hedge against inflation. A study of the "Global alternative fund survey" was carried out by (Ernst and Young, 2021) with 138 firms from North America, 45 from Europe and 27 from Asia. Stated that about 7% of private equity and hedge funds firms are investing in digital assets, and this makes it very enticing to investigate the possibilities of using Bitcoin as a potential hedge against inflation by providing empirical evidence that will help investors, portfolio managers and policymakers make informed decisions regarding the relationship between Bitcoin as an alternative hedging instrument against inflation. In conclusion, the continuous worldwide adoption of cryptocurrency as an alternative asset that can be used to diversify risk has caught the attention of many researchers, especially where there is a high adoption rate. Furthermore, the author's selection of these particular countries in this study is based on the top 20 cryptocurrency adoption countries (Chainalysis, 2022). However, some countries like Canada and the Eurozone are missing from the list but are of great interest to the author because of their geographical locations and economic robustness among the world's countries.

1.1. The Research Problem

There is a lack of comprehensive empirical evidence using the vector error correction model (VECM) to answer the following questions;
Can Bitcoin hedge against inflation in the United States?
Can Bitcoin hedge against inflation in the Eurozone?
Can Bitcoin hedge against inflation in the Philippines?
Can Bitcoin hedge against inflation in Ukraine?
Can Bitcoin hedge against inflation in Canada?
Can Bitcoin hedge against inflation in India?
Can Bitcoin hedge against inflation in Nigeria?

1.2. Main Purpose

To investigate if Bitcoin can be used as a hedge against inflation in the United States, Eurozone, Philippines, Ukraine, Canada, India, and Nigeria.

The paper is organized as follows:
1. Section one presents the introduction.
2. Section two depicts the Literature review.
3. Section three presents the research methodology.
4. Section four deals with the results and discussion.
5. Section five depicts the model diagnoses tests.
6. Section six deals with the conclusion.

2. LITERATURE REVIEW

2.1. Bitcoin as a Potential Hedge against Inflation

For many decades, gold has been the only asset considered by many investors and portfolio managers to be a "safe haven" or have hedging capabilities against inflation; however, since the creation of Bitcoin in 2008, scholars have been researching its hedging capabilities against inflation because of the high return and no central authority controlling the ecosystem. Furthermore, Bitcoins' ability to hedge against inflation can be attributed to several key factors (Phochanachan et al., 2022), such as having a fixed supply, unlike conventional fiat currencies that are prone to inflationary monetary policies (Ashimbayev and Tashenova, 2018). For Bitcoin to be called a "safe haven" or considered to have the hedging ability against inflation, it is important to understand the full definition of this strategy (Phochanachan et al., 2022). A safe haven asset refers to a financial instrument that is not impacted or is inversely affected by the general state of the economy. These assets are anticipated to retain or even appreciate when economic downturns occur (Baur and Lucey, 2010), and according to (Bodie, 1976), assets that can be used to hedge against inflation must have three properties:
1. An asset can hedge inflation if the return on the asset is at least equal to the inflation rate.
2. The asset can reduce the uncertainty or variance of the future return of alternative assets.
3. An asset could be used to hedge inflation if there is a positive linear relationship between the asset return and inflation.

The last strategy is popularly used by researchers to empirically examine hedging against inflation (Phochanachan et al., 2022). Likewise, (Fama and Schwert, 1977) stated that an asset could fully or partially hedge inflation if the correlation between the asset returns and the expected inflation rate is positive; otherwise, it cannot hedge inflation if the correlation is negative. If the correlation is one, the asset is a perfect hedge against inflation.

Bitcoin is a digital asset known by many as a speculative asset with no intrinsic value. However, (Daho, 2021) highlights that Bitcoin offers a significant diversification benefit for many investors. Adding Bitcoin to an investment portfolio can "reduce risk by spreading investments across different asset classes." A study by (Urquhart, 2016) suggests that the returns on Bitcoin are not merely a random occurrence. This indicates that there might be underlying factors or patterns influencing the performance of Bitcoin rather than pure chance. A study by (Balcilar et al., 2017) reveals that the circulating supply of Bitcoin can be utilized to predict its returns. This implies that monitoring the quantity of Bitcoins in circulation can provide insights into future returns on this digital currency. Although, according to (Rothman, 2019), the monthly average volatility of Bitcoin is significantly higher compared to foreign currencies and gold. Even the lowest monthly volatility of Bitcoin remains higher than that of foreign currencies and gold. This demonstrates that Bitcoin exhibits greater unpredictability in its price movements; therefore, it possesses the instability feature and should not be considered a hedge against inflation or financial crisis (Qin et al., 2021). Additionally, market sentiment plays a greater role in the price composition of Bitcoin, which can invalidate the hedging claims against inflation and economic policy uncertainty (Chen and Dong, 2020). For the past years, many authors have assessed the hedging properties of Bitcoin against inflation and other traditional asset. (Dyhrberg, 2016) reveal that Bitcoin and gold have similar hedging properties. (Choi and Shin, 2021) Investigates the hedging properties of Bitcoin in the United States using the vector autoregressive model (VAR), and the result shows that Bitcoin does not decline during high inflation, thereby confirming its hedge properties against inflation. However, they rejected some investors' "save heaven" claims because the price negatively responds to financial uncertainty shocks. Furthermore, the study of (Plakandaras et al., 2021) highlights the presents of shocks in the price of Bitcoin during economic policy uncertainty. A study carried out by (Matkovskyy and Jalan, 2021) using a quantile-on quantile regression model to investigate the hedging ability of Bitcoin against inflation in the UK, United States, Eurozone, and Japan shows that Bitcoin cannot hedge inflation in the United States; however, it can hedge inflation in the UK and Japan. (Smales, 2022) examined the cryptocurrencies against inflation in the United States using ordinary least squares (OLS) regression, the findings show a positive relationship with inflation, meaning Bitcoin can be used as hedging against inflation in the United States in the short run, and also find no significant evidence of hedging against inflation in the long run. (Conlon et al., 2021) Uses wavelet time-scale techniques to investigate the relationship between cryptocurrency prices and expected inflation. The study reveals a positive relationship between Bitcoin and expected inflation in the short run; furthermore, other authors, such as (Blau et al., 2021) and (Choi and Shin, 2021), uses the vector autoregressive (VAR) model. Found significant evidence to support the hedging capabilities of Bitcoin against inflation in the United States. (Phochanachan et al., 2022) Adopted the MS-VAR model to investigate the hedging properties of Bitcoin in Ukraine, Russia, Singapore, Kenya, the United States, India, South Africa, Nigeria, Columbia, and Vietnam. The study stated that Bitcoin could hedge inflation in the United States and Vietnam when the market is stable and found insignificant evidence to support Bitcoin hedging properties in the other countries; however, during unstable market situations, it found a significant hedging ability of Bitcoin against inflation in Nigeria, Ukraine, Kenya, and India. Additionally, a study conducted by (Habtai and Urbye, 2021) on the hedging ability of Bitcoin against inflation in the United States, Eurozone, Japan, South Korea and Norway using the GARCH model with monthly data spanning from 2010 to June 2021. The result stated that Bitcoin does not hedge inflation in these countries. However, he found significant evidence of the hedging properties of Bitcoin on the producer price index of South Korea and Japan. The study conducted by (Wissmann, 2022) on the hedging properties of Bitcoin against inflation in the United States, Eurozone, India, Kenya, South Korea, and Norway using the Fisher coefficient and its extension by Fama and Schwert. He found no significant evidence of the hedging ability of Bitcoin against inflation in these countries. (Arshad et al., 2023) Examined the claims of hedging properties against inflation in ASEAN countries using the student-t EGARCH (1,1) model. They found significant evidence to support the claims of Bitcoin hedging against inflation in these countries. However, they noted no significant evidence of the "safe haven" claims of Bitcoin in these countries. A study conducted by (Kinkyo, 2022) using the stochastic volatility (SV) model with decomposed series and daily returns of Bitcoin, Gold, oil, and exchange rate of 13 countries, revealed that Bitcoin performs better than gold and oil in risk reduction over the medium and long run. Furthermore, Bitcoin has been perceived as a way of protecting savings during times of high inflation and economic uncertainty; hence, used by investors to diversify risk in their portfolios (Paule-Vianezet al., 2020). In conclusion, numerous authors have tried to estimate the hedging properties of Bitcoin against inflation using different methodologies, most especially in the United States and Eurozone.

Nevertheless, there exists a disparity in the outcomes of these research findings. The analysis of various scholarly articles reveals that certain studies propose that Bitcoin may need to be more effectively hedging against inflation or that its capacity to act as a hedge is restricted to the short run of particular economic disruptions in specific nations. Furthermore, there needs to be a more comprehensive understanding of using Bitcoin to hedge inflation in the countries chosen for this study. More importantly, using a vector error correction model (VECM) methodology to determine the short and long-run relationship between Bitcoin and inflation.

3. METHODOLOGY

3.1. Research Design and Literature Review

This study uses quantitative research design to examine the Bitcoin hedging properties against inflation in the United States, Eurozone, Philippines, Ukraine, Canada, India, and Nigeria by testing and quantifying the relationship between Bitcoin and inflation rates to determine whether Bitcoin can effectively hedge against inflation in these regions. A comprehensive literature review was conducted using logical and comparative analysis of existing scientific articles related to Bitcoin hedging against inflation in different countries. This provides a better understanding of the current state of knowledge on this topic and identifies the gaps in existing research.

3.2. Data Collection and Processing

Bitcoin data was obtained from data.nasdaq.com from January 2012 to June 2023 monthly, while inflation data, the monthly percent change in the consumer price index (CPI), was downloaded from the theglobaleconomy.com. However, according to the website, the data sources are "Central Bank of Nigeria, Eurostat, Ministry of Statistics and Program Implementation of India, Philippine Statistics Authority, State Statistics Service of Ukraine, Statistics Canada, U.S. Bureau of Labor Statistics." Utilizing extensive Bitcoin and inflation data from January 2012 to June 2023, encompassing a considerable timeframe, ensure the opportunity to conduct a thorough analysis of trends and patterns. Additionally, adopting a monthly perspective enable the researchers to perceive the fluctuations in price and gain valuable insights into the short- and long-term correlations between Bitcoin and inflation (Lee and Rhee, 2022), providing a more comprehensive understanding of their relationship. The data was converted to monthly time series with no missing values or outliers for statistical modeling.

3.3. Model Identification and Assumptions Testing

Researchers have applied various methodologies to examine how Bitcoin can serve as a hedge against inflation in economies. However, there needs to be more current literature regarding scientific articles investigating the hedging properties of Bitcoin against inflation using the vector error correction model (VECM). The VECM framework is particularly valuable as it captures both short-term dynamics and term equilibrium relationships making it highly suitable for studying the dynamic interplay between Bitcoin and inflation (Rahman et al., 2020). Therefore, conducting research that utilizes VECM would fill the gap by offering valuable insights into the potential role of Bitcoin as a hedge against inflation in diverse economies. Specifically, this study aims to investigate if Bitcoin can be used to hedge against inflation using VECM specifications. The variables included in the VECM must exhibit co-integration (Miyan and Biplob, 2019). Co-integration signifies a long-term equilibrium relationship (Tian and Dong, 2023). Guarantees that the variables move together over the long term (Miyan and Biplob, 2019).

$$\Delta y_t = \alpha\beta^{'} y_{t-1} + \sum_{i=1}^{p-1} \Gamma_i \Delta y_{t-i} + \varepsilon_t \quad (1)$$

Where:
Δy_t: This represents the first-differenced value of the dependent variable at time t. First differencing involves taking the difference between the current value of the variable and its value at the previous time step. First differencing is often used to make a time series stationary, which can simplify analysis.

$\alpha\beta' y_{t-1}$: This term involves the lagged value of the dependent variable y at time $t-1$, multiplied by a coefficient $\alpha\beta'$. The term β' represents the transpose of a vector β. The vector β represents coefficients associated with the lagged values of the dependent variable.

$\sum_{i=1}^{p-1} \Gamma_i \Delta y_{t-i}$: This part of the equation involves a summation ($\sum$) from $i = 1$ to $p - 1$, where p is the maximum lag order. In each term of the summation, Γ_i represents a coefficient matrix associated with the lagged first-differenced values of the dependent variable Δy. $\Delta y(t-i)$ represents the first-differenced value of the dependent variable at earlier time steps.

ε_t: This term represents the error term or residual at time t. It captures the part of the dependent variable's value that is not explained by the lagged values of the dependent variable and other terms in the equation.

3.4. Significant Level and Empirical Results

This study selected a significance level of 0.05% or 5%, a commonly used threshold in statistical hypothesis testing. When performing tests like regression analysis or hypothesis testing, researchers calculate the P-value. The P-value signifies the likelihood of obtaining the observed data or extreme outcomes, assuming the null hypothesis holds false (Graaf and Sack, 2018). In this research, it is deemed significant if the computed P-value is below 0.05% or 5%. This indicates that the observed results are improbable to have arisen by chance. Hence, the null hypothesis will be rejected in favour of the alternative hypothesis suggesting a meaningful relationship or effect. Alternatively, it lacks significance when the calculated P-value exceeds 0.05% or 5%. This implies that the observed outcomes could reasonably occur by chance, so researchers would fail to reject the null hypothesis. The empirical research thoughtfully presented its findings, including concise introductions, to each test, explanations of the results and implications drawn from them. This method allows readers to comprehend the statistical analysis performed, the significance of the results and the potential implications for the research subject (Liu et al., 2022). It promotes transparency (Simanjuntak et al., 2023). Helps establish the credibility and relevance of the empirical findings (Mutambo et al., 2021).

3.5. Model Diagnoses and Conclusion

The model's validity was assessed through tests, including examinations for serial correlation, heteroskedasticity, normal distribution of residuals and model stability. These tests were conducted to ensure the reliability of the model's estimates and the robustness of its assumptions. The serial correlation analysis aimed to determine any correlation among the model's residuals or errors. Such correlations could indicate misspecification or omitted variables within the model. Heteroskedasticity tests were performed to evaluate whether the variance assumption was violated in the model residuals. Such violations could impact the accuracy and efficiency of the estimates derived from the model. The normal distribution test aimed to ascertain if the residuals adhered to a distribution commonly assumed in statistical models. Finally, stability tests were conducted to assess whether the relationships between variables remained consistent over time. Upon a review of existing literature and analysing the results obtained from these tests, several significant conclusions about the relationship between Bitcoin and inflation were made. These conclusions contribute insights to the existing knowledge on this subject matter, offering a deeper understanding of Bitcoin's effectiveness as an inflation hedge.

4. RESULTS AND DISCUSSION

4.1. Descriptive Statistics Analysis

Descriptive statistics, a branch of statistics, focuses on presenting concise and understandable data summaries (Ali, 2021). Its primary goal is to describe the characteristics of a dataset that allows researchers, analysts, and decision-makers to extract insights without necessarily making inferences or drawing conclusions about a larger population (Opusunju and Opusunju, 2021). Using statistics, researchers can delve deeper into the data by examining various measures of central tendency and dispersion, such as the mean, median, and standard deviation (Zimon and Tarighi, 2021). Moreover, descriptive statistics offer opportunities to explore distributions that provide insights into the distribution of values within a dataset. These distributions often reveal patterns or trends that may not immediately be obvious (Herman et al., 2022).

In Table 1, the properties of the data are analyzed. The mean values varied across variables. For example, BTC has a value of 0.05, whereas the Philippines, Canada, and Nigeria have a mean value of 0.01. In contrast, Ukraine had a mean value of −0.01. This indicated that there were differences in the mean values of these variables. Standard deviation measures the spread or variability of the data. Variations in deviations across variables were observed. For instance, "United States" has a standard deviation (of 0.32) compared to "Ukraine" (0.16), suggesting that the data for "United States" is more dispersed. The median

Table 1: Descriptive statistics

Variables	n	Mean	SD	Median	Trimmed	Mad	Min	Max	Range	Skew	Kurtosis	SE
BTC	101	0.05	0.21	0.05	0.05	0.2	−0.47	0.53	1	−0.08	−0.13	0.02
Philippines	101	0.01	0.28	0	0.01	0.15	−1.45	0.97	2.42	−0.68	7.71	0.03
United States	101	0.03	0.32	0.02	0.02	0.14	−1.54	1.69	3.23	0.29	12.91	0.03
Eurozone	101	0.04	0.35	0.01	0.04	0.18	−1.24	1.22	2.46	−0.09	4.22	0.03
Ukraine	101	−0.01	0.16	−0.01	−0.01	0.1	−0.76	0.45	1.21	−0.67	4.1	0.02
Canada	101	0.01	0.28	0.02	0.02	0.18	−1.48	1.22	2.71	−0.87	10.08	0.03
India	101	0	0.16	0.01	0	0.13	−0.42	0.48	0.9	−0.13	0.85	0.02
Nigeria	101	0.01	0.04	0.01	0.01	0.02	−0.07	0.17	0.24	1	4.01	0

represents the intermediate value of the dataset. We can see that some variables have a median of 0.01, whereas others have a median of 0.05. This implies differences in the values within the data. Skewness measures the symmetrically distributed data; positive skewness (>0) indicates a skewed distribution, and negative skewness (<0) indicates a left-skewed distribution. Skewness can be observed among variables, with some, such as the United States and Nigeria, being positively skewed and others negatively skewed. Kurtosis measures how peaked or flatly distributed the data is. Positive kurtosis, indicated by values >3, suggests a more peaked or heavy-tailed distribution. In contrast, negative kurtosis (values <3) signifies a flatter or light-tailed distribution. The variables in this analysis exhibited variations in kurtosis values, indicating differences in the shapes of their distributions. In addition, we observed discrepancies in the ranges of these variables. For instance, the range for the United States is 3.23, whereas India has a range of 0.9. These distinct variations highlight the characteristics of each variable and offer valuable insights into how they relate to Bitcoin hedging capabilities against inflation in empirical investigation.

4.2. Stationary Testing

When dealing with time-series analysis, it is important to determine whether the data are stationary or non-stationary (Yi et al., 2023). Additionally, when working with co-integration analysis and vector error correction models (VECM), it is crucial to conduct stationary tests. These tests help validate the assumptions (İlhan et al., 2021). Ensuring the reliability of the model. In the VECM, one of the assumptions is that the all-time series should have the same level of integration, denoted as I(d). Here "d" represents the degree of integration (Fseifes and Warrad, 2020). This means that all the variables used in the model should either be stable (d=0) or require a single differencing step to become stable (d=1) (Duan et al., 2021). To determine this integration order (d) and check for stability, the Augmented Dickey-Fuller (ADF) test was utilized.

The outcomes of the Augmented Dickey-Fuller test on individual time series data from countries are shown in Table 2. These tests aim to determine whether a time series is stationary or non-stationary by examining the presence of unit roots. The test statistic for the Dickey-Fuller test represents the t-statistic, which indicates how strongly we can reject the hypothesis of a unit root. A negative value provides evidence against the presence of a unit root. Analyzing the results in Table 2, it is evident that most countries and the BTC variable have P-values below 0.05. This suggests that the time series data for these countries exhibit stationarity, which is crucial for results in time series analysis. However, Ukraine's

Table 2: Augmented Dickey-Fuller test results for stationarity

Variables	Dickey-Fuller	Lag order	P-value	Conclusion
Nigeria	−3.4762	4	0.04766	Stationarity
United States	−4.9135	4	0.01	Stationarity
Canada	−3.831	4	0.02011	Stationarity
India	−4.4397	4	0.01	Stationarity
Ukraine	−3.3784	4	0.06193	Non- Stationarity
Philippines	−5.0278	4	0.01	Stationarity
Eurozone	−4.2272	4	0.01	Stationarity
BTC	−4.11	4	0.01	Stationarity

Source: Summarized from R-programming Augmented Dickey-Fuller (ADF) test result

P-value is above 0.05. Still relatively close. This implies the need for more evidence to conclude that it is stationary.

4.3. Co-integration Analysis

Co-integration analysis helps understand the enduring connections between variables (Wahyudi and Palupi, 2023). Using co-integration techniques, researchers can effectively address the challenges posed by short-term time series data (Belinsky, 2019). This analysis method is useful for studying models that involve non-stationary variables (Priyadi et al., 2021). Moreover, Johansen's co-integration methodology is widely used to determine the relationship between these variables (Lupekesa et al., 2022). The Johansen co-integration test checks for co-integration among time series variables. Co-integration suggests that a combination of these variables, when linearly combined remains stable over time, indicating a lasting connection between them (Ahmet et al., 2022).

The test statistics provided in Table 3 correspond to the values of "r" (rank), which indicate the number of cointegrating vectors tested in the model with a lag order of 2 based on AIC lag selection. The table displays the values at different significance levels (10%, 5%, and 1%) used to evaluate the test statistics. To conclude the Johansen co-integration (trace) test, it was necessary to compare the calculated test statistics with the critical values in the table. If, for a given "r" the calculated test statistic exceeds the value at a 5% significance level, we can reject the null hypothesis and conclude that there is co-integration at that specific "r" value. Table 3 demonstrates this scenario, where the test.

Statistic surpasses the 5% significance level threshold for a seven rank, indicating seven or fewer integration properties among these variables. The results obtained from this test will allow the use of the vector error correction model (VCEM) because it requires co-integration.

4.4. Long-run Relationship

Calculating the error correction term (ECT) is a part of analyzing the long-term connection between variables in time series analysis. The ECT plays a role in the vector error correction model (VECM), widely used to examine the relationship among multiple non-stationary variables over an extended period.

Table 4 contains crucial information for assessing the study countries' long-term relationship between BTC and inflation. The estimated coefficient value of 0.0139 in the Philippines indicates that there might be a positive relationship between BTC and inflation; however, this relationship is not considered statistically significant at common levels of significance (0.5). Therefore, we do not have evidence to support the idea that BTC can effectively hedge against inflation in the long term in the Philippines. The coefficient estimate of −0.1178 in the United States suggests an inverse association between BTC and inflation; Hence, as inflation increases, the price of Bitcoin decreases and vice versa. However, it is important to note that the significance level for this relationship is denoted by a weak asterisk (*), indicating only marginal significance. According to (Bodie, 1976; Fama and Schwert, 1977), an asset can only hedge against inflation if there is a positive relationship; therefore, this implies that BTC cannot hedge against inflation in the United States. A coefficient estimate of −0.0211 in the Eurozone implies a negative correlation between BTC and inflation. Furthermore, this association is not statistically significant. Hence, the author does not find evidence to support the notion that BTC can be used as an effective long-term hedge against inflation in the Eurozone. The estimated coefficient value of −0.0420 in Ukraine suggests a negative relationship between BTC and inflation; additionally, it has a statistically insignificant of more than 0.5. Therefore, BTC cannot be used as a long-term hedge against inflation in Ukraine. An estimated value of 0.2980 in Canada shows a strong positive and highly significant (*** denotes high significance) relationship between BTC and inflation in Canada. These findings indicate that Bitcoin can serve as a long-term hedge against inflation in Canada. The calculated coefficient of 0.1099 in India indicates a statistically significant relationship between BTC and inflation (***). This finding implies that BTC has the potential to be used as a long-term hedge against inflation in India. However, in Nigeria, the coefficient estimates of 0.0048 suggests a positive relationship between BTC and inflation but lack statistical significance. Therefore, no evidence supports BTC as a long-term hedge against inflation in Nigeria. Based on these findings, BTC may function as a long-term hedge against inflation in Canada and India; however, the evidence in the United States is inverse. Therefore, Investors, portfolio managers, and policymakers should consider these findings when evaluating BTC as an inflation hedge in these countries.

Table 3: Johansen Co-integration (trace) test

Rank	Test-statistics	10pct	5pct	1pct	Decision
r≤7	10.31	7.52	9.24	12.97	Rejected
r≤6	26.56	17.85	19.96	24.60	Rejected
r≤5	53.44	32.00	34.91	41.07	Rejected
r≤4	82.75	49.65	53.12	60.16	Rejected
r≤3	122.78	71.86	76.07	84.45	Rejected
r≤2	187.63	97.18	102.14	111.01	Rejected
r≤1	271.36	126.58	131.70	143.09	Rejected
r≤0	372.07	159.48	165.58	177.20	Rejected

Source: Summarized from R-programming Johansen Co-integration (trace) test result, Note: 1pct-10pct are critical values, Null hypotheses: No co-integration

4.5. Short-term Relationship

In a vector error correction model (VECM), the short-term relationship pertains to how the variables in the system adjust after experiencing a shock or deviation from their long-term equilibrium. While the error correction term (ECT) captures the long-run relationship, the short-term relationship focuses on how the variables respond to changes in their values and other variables' values.

Table 5 shows the short-term relationship that exists among the variables; however, the main focus is to identify the short-term hedging capabilities of Bitcoin against inflation in these countries. Two optimal lags were used for the modeling based on the optimal lags test conducted, and three were considered optimal. However, since one lag is lost when estimating the vector error correction model, the author used two lags instead of three to determine the relationship. For Bitcoin to be considered a hedge against inflation in the short run, the coefficient should be statistically significant with at least one asterisk (*), which indicates that the P< 0.05, the commonly adopted significant level. The Philippines coefficient of 0.1143 (0.1325) and 0.1211 (0.1320) for lag one and two show a positive relationship between BTC in the short run; however, since it is not statistically significant, there is no short-run hedging ability of Bitcoin against inflation in the Philippines. The short-run relationship between Bitcoin and inflation in the United States shows a coefficient of 0.2307 (0.1533) and 0.2983 (0.1527) in both lags, respectively. Since the coefficients are not statistically significant, it concluded that Bitcoin could not hedge inflation in the short run in the United States. The estimated coefficient for the short-term relationship between Bitcoin and inflation in Eurozone for both lags is 0.1026 (0.1635) and 0.0103 (0.1628); this implies that Bitcoin does not possess the hedging capability against rising inflation in the Eurozone, although the relationship between Bitcoin and inflation in the countries above shows a

Table 4: Estimation of error correction term (ECT)

Country	Estimates	Std. Error	Significance	Long-run relationship with BTC	Lag order	Co-integration method
Philippines	0.0139	0.0493		No	2	Johansen
United States	−0.1178	0.0570	*	No	2	Johansen
Euro-zone	−0.0211	0.0608		No	2	Johansen
Ukraine	−0.0420	0.0235	.	No	2	Johansen
Canada	0.2980	0.0380	***	Yes	2	Johansen
India	0.1099	0.0309	***	Yes	2	Johansen
Nigeria	0.0048	0.0042		No	2	Johansen

Source: Summarized from R-programming Vector error correction model test result, Note: Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1"

Table 5: Short-term relationship analysis

Variables	BTC-1	Philippines-1	BTC -2	Philippines -2
BTC	−0.5803 (0.1099)***	−0.0243 (0.0817)	−0.2670 (0.1094)*	−0.0346 (0.0814)
Philippines	0.1143 (0.1325)	−0.3680 (0.0985)***	0.1211 (0.1320)	−0.5496 (0.0982)***
United States	0.2307 (0.1533)	0.1909 (0.1140)	0.2983 (0.1527)	0.1635 (0.1136)
Eurozone	0.1026 (0.1635)	0.0135 (0.1215)	0.0103 (0.1628)	0.0542 (0.1211)
Ukraine	0.1143 (0.0633)	0.0034 (0.0470)	0.0957 (0.0630)	−0.1135 (0.0469)*
Canada	0.1141 (0.1021)*	0.0846 (0.0759)	−0.0562 (0.1017)	0.1371 (0.0757)
India	0.2008 (0.0832)*	0.0522 (0.0618)	−0.0969 (0.0829)	−0.0559 (0.0616)
Nigeria	0.0022 (0.0113)	−0.0243 (0.0084)**	0.0074 (0.0113)	−0.0236 (0.0084)**
Variables	**United States-1**	**Euro-zone-1**	**United States -2**	**Eurozone -2**
BTC	0.0474 (0.0998)	0.0099 (0.0775)	−0.0631 (0.0975)	0.0451 (0.0772)
Philippines	0.0194 (0.1204)	0.1487 (0.0934)	−0.4333 (0.1175)***	0.3196 (0.0931)***
United States	−0.1509 (0.1393)	0.1007 (0.1081)	−0.2250 (0.1360)	0.0302 (0.1078)
Eurozone	0.5414 (0.1485)***	−0.8943 (0.1153)***	0.0263 (0.1450)	−0.3614 (0.1149)**
Ukraine	0.0858 (0.0575)	−0.0374 (0.0446)	0.0896 (0.0561)	−0.0642 (0.0445)
Canada	−0.6564 (0.0928)***	0.0646 (0.0720)	−0.4165 (0.0906)***	0.0707 (0.0718)
India	−0.1114 (0.0756)	−0.0505 (0.0587)	−0.0861 (0.0738)	−0.1317 (0.0585)*
Nigeria	0.0006 (0.0103)	0.0024 (0.0080)	−0.0096 (0.0100)	0.0117 (0.0079)
Variables	**Ukraine -1**	**Canada -1**	**Ukraine -2**	**Canada -2**
BTC	−0.0146 (0.1796)	−0.1762 (0.1133)	−0.1209 (0.1804)	−0.0491 (0.0907)
Philippines	0.0872 (0.2165)	−0.0736 (0.1366)	0.0528 (0.2175)	0.1007 (0.1094)
United States	−0.4784 (0.2506)	−0.2351 (0.1581)	0.0860 (0.2518)	−0.0174 (0.1266)
Eurozone	0.1953 (0.2671)	−0.0426 (0.1685)	0.4962 (0.2684)	0.2213 (0.1349)
Ukraine	−0.3536 (0.1034)***	−0.1095 (0.0652)	−0.1308 (0.1039)	0.0144 (0.0522)
Canada	−0.6891 (0.1669)***	0.1482 (0.1053)	−0.5863 (0.1677)***	0.0518 (0.0843)
India	−0.0946 (0.1359)	0.1149 (0.0858)	−0.0570 (0.1366)	0.2029 (0.0687)**
Nigeria	−0.0051 (0.0185)	0.0097 (0.0117)	−0.0021 (0.0186)	0.0136 (0.0093)
Variables	**India -1**	**Nigeria -1**	**India -2**	**Nigeria -2**
BTC	0.2401 (0.1289)	1.3316 (1.1206)	−0.0318 (0.1303)	0.2524 (1.1241)
Philippines	0.0878 (0.1554)	−2.0640 (1.3511)	0.2094 (0.1571)	1.7207 (1.3553)
United States	0.1196 (0.1798)	−0.7708 (1.5637)	0.4283 (0.1819)*	−1.2801 (1.5686)
Eurozone	0.1593 (0.1917)	0.0913 (1.6671)	0.4001 (0.1939)*	0.9063 (1.6723)
Ukraine	−0.0422 (0.0742)	−1.6439 (0.6452)*	0.0270 (0.0750)	−0.2533 (0.6472)
Canada	0.1985 (0.1198)	−1.5021 (1.0417)	0.3983 (0.1211)**	−1.4442 (1.0449)
India	−0.2888 (0.0976)**	0.8481 (0.8484)	−0.3085 (0.0987)**	0.4554 (0.8510)
Nigeria	0.0114 (0.0133)	−0.1765 (0.1153)	−0.0058 (0.0134)	−0.0755 (0.1156)

Asterisk (*) signif significance, Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1"

positive association which means in a short period increase in inflation does not have much impact on Bitcoin price. The short-run relationship in Ukraine also exhibited a positive coefficient. Still, since it is not statistically significant, the author concluded a lack of a short-term hedge of Bitcoin against inflation in Ukraine. The positive relationship in these countries may be due to factors such as Bullish sentiment and positive news about adoption. The short-run relationship between Bitcoin and inflation in Canada shows that a percentage change in the inflation rate leads to an increase of 0.1141 in Bitcoin price, with a statistical significance at the significant level of 5%. Likewise, India also exhibited a positive coefficient with Bitcoin statistically significant, meaning that Bitcoin can be used as a hedge against inflation in both countries and Nigeria, showing a positive coefficient with Bitcoin. However, it is not statistically significant to support the hedging capabilities of Bitcoin in Nigeria. In conclusion, the results from Table 5 reveal that Bitcoin can only be used as a hedge against inflation in Canada and India.

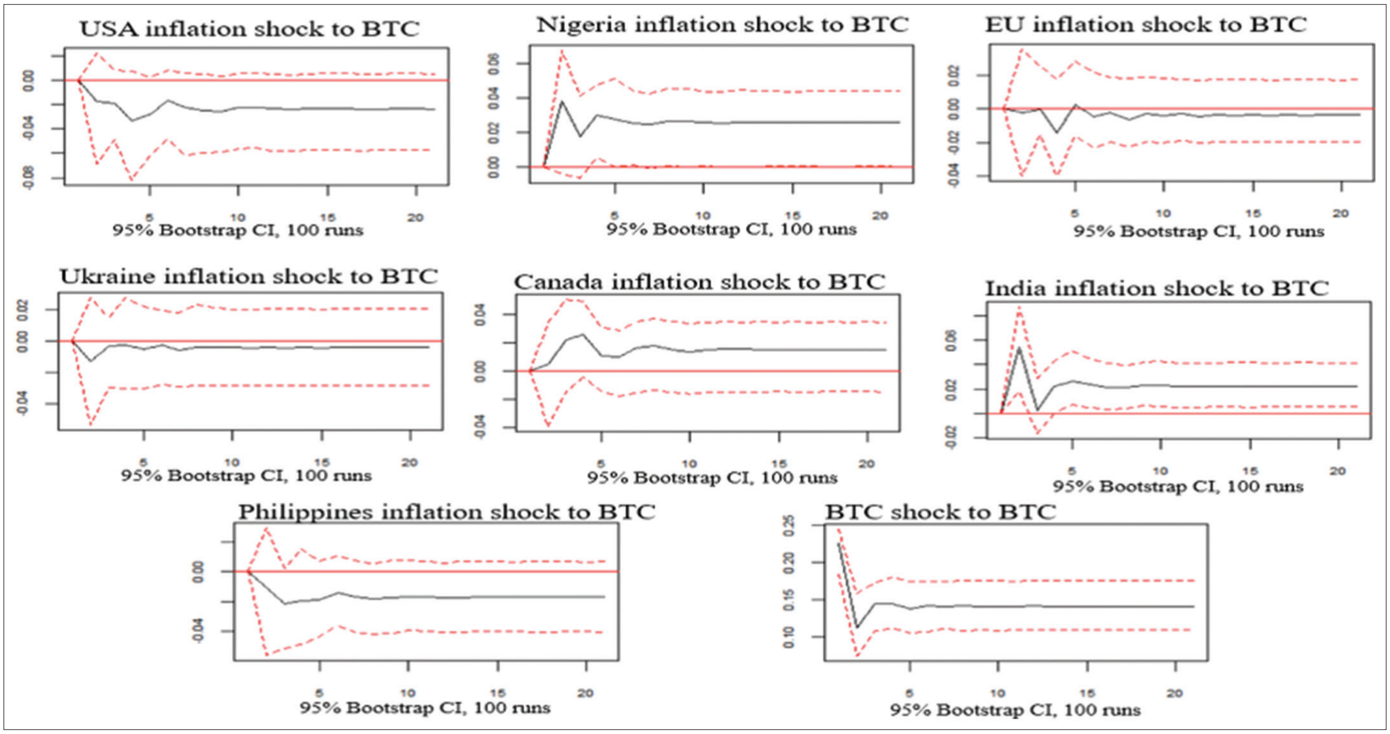
4.6. Impulse-response Function Analysis

Impulse response analysis plays a role in econometrics and time series analysis (Allen and McAleer, 2020). It helps researchers explore the connections between variables in a model shedding light on how changes or surprises in one variable can impact other variables as time progresses (Anu and Elampari, 2022). This analytical approach finds application across multiple disciplines, such as economics, finance, engineering, and environmental sciences, and its primary purpose is to deepen the understanding of systems behavior (Simchenko et al., 2021).

The analysis of response helps to understand the short-term dynamic relationship between variables in a vector error correction model (VECM). It reveals how a sudden change in one variable affects all the variables in the system over time. In this case, the author examined the response functions for Bitcoin hedging against inflation in different countries. Figure 1 illustrates how Bitcoin responds when there is a one-unit shock in the inflation rate of each country. In the United States, it can be observed that inflation has a negative and statistically significant impact on Bitcoin. However, this impact diminishes over time. Becomes statistically insignificant.

Conversely, inflation in the Philippines has a positive and statistically significant impact on Bitcoin in the short run. As time

Figure 1: Impulse-response plots



goes by, this effect weakens and becomes statistically insignificant. Interestingly, European Union (Eurozone) inflation does not impact Bitcoin significantly. This lack of influence persists over time. In Ukraine, similar to what we observed in the United States, inflation initially has a statistically significant impact on Bitcoin. However, like cases mentioned earlier, this impact weakens over time and becomes statistically insignificant. In Canada, it was seen that inflation has a statistically significant impact on Bitcoin in the short run. Remarkably this positive effect remains significant even as time progresses. India experienced statistically significant impacts from its inflation rate on Bitcoin initially. The positive impact remains statistically significant over time. In Nigeria, inflation has a statistically insignificant influence on the price of Bitcoin in the short term. This lack of impact remains consistent as time goes on.

Based on the analysis of the response, it can be observed that inflation has varying effects on the price of Bitcoin in different countries in the short term. While some countries initially experience impacts, these effects tend to diminish over time for most countries. However, Canada and India stand out as countries where Bitcoins price consistently and significantly benefit from inflation, suggesting that BTC may serve as a hedge against inflation in these economies.

5. MODEL DIAGNOSES TESTING

5.1. Serial Correlation

The presence of serial correlation was evaluated by conducting the Portmanteau test (asymptotic), and the obtained p-value was 1. This outcome suggests that there is no serial correlation, which is a positive indication of the reliability of the VECM results. Serial correlation, in the VECM model, can introduce biases. Affect the outcomes, but since we do not observe any such correlation, it strengthens the credibility of the findings.

5.2. Heteroskedasticity Testing

To investigate heteroskedasticity, the ARCH (Multivariate) test was performed. The obtained p-value is 1. This outcome suggests that the model does not exhibit heteroskedasticity, which is vital for its effectiveness. Heteroskedasticity can cause inaccuracies in the estimates of the model. In this scenario, its absence guarantees the dependability and precision of the findings.

5.3. Normal Distribution of the Residuals Test

The data distribution was assessed using the Kolmogorov-Smirnov test. Based on the test results, it can be concluded that the data does not follow a normal distribution. The small p-value (p-value < 2.2e 16) provides evidence against the null hypothesis, which suggests that the data is normally distributed. Since the null hypothesis has been rejected, the data significantly deviates from a normal distribution.

5.4. Model Stability

The model stability test was conducted using eigenvalues, and the results indicate that all the eigenvalues are within the unit circle on the complex plane. Therefore, the model is stable.

6. CONCLUSION

Based on the findings of this study, Bitcoin's ability to hedge against inflation differs across countries. This research explored whether Bitcoin can be used as a hedge against inflation in the selected countries. The study addressed the following research questions; Can Bitcoin hedge against inflation in the United States? The findings indicate a non-significant short-term and significant long-term negative relationship between Bitcoin and inflation hedging in the United States. This suggests that Bitcoin is not a reliable hedge in the United States. Can Bitcoin hedge against inflation in the Eurozone? The study found no relationship between Bitcoin and inflation hedging in this region. This implies that Bitcoin is not an effective safeguard against Eurozone inflation. Can Bitcoin hedge against inflation in the Philippines? Similar to the Eurozone, there was no relationship between Bitcoin and inflation hedging in this country. Thus, there might be better choices for hedging against inflation in the Philippines. Can Bitcoin hedge against inflation in Ukraine?

As the findings suggest, there was no significant relationship between Bitcoin and inflation hedging in Ukraine. Bitcoin may not provide hedging properties in this country. Can Bitcoin hedge against inflation in Canada? The research reveals a correlation between Bitcoin's ability to hedge against inflation and the Canadian market. This suggests that Bitcoin could hedge against inflation in Canada. Can Bitcoin hedge against inflation in India? The study also identifies a relationship between Bitcoins hedging capabilities and inflation in India, implying that it could offer some benefits as an inflation hedge within the economy. Can Bitcoin hedge against inflation in Nigeria? While the study did not find a relationship indicating Bitcoin's effectiveness as an inflation hedge in Nigeria, it suggests that Bitcoin may not serve as a hedge against inflation in Nigeria.

Overall, the findings of this research indicate that the ability of Bitcoin to hedge against inflation varies across different countries. While it shows potential as a hedge in some markets like Canada and India, it may be ineffective in others like the United States, the Eurozone, the Philippines, Ukraine, and Nigeria. Therefore, investors, portfolio managers, and policymakers must consider these country-specific variations when evaluating Bitcoin's role as a potential inflation hedge. As with any study, this research has limitations, such as data constraints and model assumptions. Future research can build upon these findings and explore additional factors that may influence the hedging properties of Bitcoin in different economic contexts. Nevertheless, this study contributes valuable insights into the growing knowledge of cryptocurrencies and their role in financial risk management.

REFERENCES

Ahmet, Ş., Halil, E., Burcu, B. (2022), How important is corporate governance features and the lags on audit reports in firm performance: The case of Turkey. Studies in Business and Economics, 17(1), 218-237.

Ali, A.M. (2021), E-learning for students with disabilities during covid-19: Faculty attitude and perception. Sage Open, 11(4), 215824402110544.

Allen, D.T., McAleer, M. (2020), A nonlinear autoregressive distributed lag (NARDL) analysis of west Texas intermediate oil prices and the DOW JONES index. Energies, 13(15), 4011.

Allor, P. (2020), The effect of monetary policy and inflation on the exchange rate: A case study of Ghana. Journal of Economics and International Finance, 12, 151-163.

Anu, T.M., Elampari, K. (2022), Forecasting of total column ozone using regression analysis and LSTM-RNN machine learning approach. Indian Journal of Science and Technology, 15, 1420-1428.

Arshad, S., Vu, T.H.N., Warn, T.S., Ying, L.M. (2023), The hedging ability of gold, silver and bitcoin against inflation in ASEAN countries. Asian Academy of Management Journal of Accounting and Finance, 19(1), 121-153.

Ashimbayev, T., Tashenova, S. (2018), Prospects for using cryptocurrency in the economy of Kazakhstan and the attitude of the national bank. European Research Studies Journal, 21, 524-532.

Balcilar, M., Bouri, E., Gupta, R., Roubaud, D. (2017), Can volume predict Bitcoin returns and volatility? A quantiles-based approach. Economic Modelling, 64, 74-81.

Baur, D.G., Lucey, B.M. (2010), Is gold a hedge or a safe haven? An analysis of stocks, bonds and gold. Financial Review, 45, 217-229.

Belinsky, A. (2019), Gas pipeline infrastructure and economic growth of Russian regions: Panel co-integration analysis. E3s Web of Conferences, 102, 02002.

Blau, B.M., Griffith, T.G., Whitby, R.J. (2021), Inflation and bitcoin: A descriptive time-series analysis. Economics Letters, 203, 109848.

Bodie, Z. (1976), Common stocks as a hedge against inflation. The Journal of Finance, 31, 459-470.

Chainalysis. (2022), 2022 Global Crypto Adoption Index. (website reference).

Chen, S., Dong, H. (2020), Dynamic network connectedness of bitcoin markets: Evidence from realized volatility. Frontiers in Physics, 8, 582817.

Choi, S., Shin, J. (2021), Bitcoin: An inflation hedge but not a safe haven. Finance Research Letters, 46, 102379.

Conlon, T., Corbet, S., McGee, R.J. (2021), Inflation and cryptocurrencies revisited: A time-scale analysis. Economics Letters, 206, 109996.

Daho, R.B.A. (2021), The relationship between cryptocurrency prices and share prices of technology companies in light of COVID-19. International Journal of Economics and Financial Issues, 11(5), 37-44.

Duan, C., Hung, K., Liu, S. (2021), Forecasting volatility in Taiwan with encompassing regression models. International Journal of Economics Finance and Management Sciences, 9(2), 62.

Dyhrberg, A.H. (2016), Hedging capabilities of Bitcoin. Is it the virtual Gold? Finance Research Letters, 16, 139-144.

Egbe, I.S., Onuora, U.R., Iteh, A.A., Onyeanu, E.O. (2021), Effect of economic variables on the financial performance of listed firms manufacturing consumer goods in Nigeria. Universal Journal of Accounting and Finance, 9(6), 1235-1246.

Ernst and Young. (2021). 2021 Global Alternative Fund Survey. United Kingdom: Ernst and Young.

Fama, E.F., Schwert, G.W. (1977), Asset returns and inflation. Journal of Financial Economics, 5, 115-146.

Fseifes, E.A.K., Warrad, T.A. (2020), The impact of domestic and external public debt on the economic growth of Jordan. International Journal of Business and Economics Research, 9, 254-262.

Graaf, T.A.D., Sack, A.T. (2018), When and how to interpret null results in NIBS: A taxonomy based on prior expectations and experimental design. Frontiers in Neuroscience, 134, 1016.

Habtai, A., Urbye, M. (2021), The Bitcoin Dilemma CC BY-NC 4.0 (Master's Thesis, NTNU).

Herman, H., Shara, A.M., Silalahi, T., Sherly, S., Julyanthry, J. (2022), Teachers' attitude towards minimum competency assessment at Sultan Agung senior high school in Pematangsiantar, Indonesia. Journal of Curriculum and Teaching, 11, 5430.

İlhan, A., Özdemir, M., Eryigit, K.Y. (2021), Makro ihtiyati politikalarin kredi büyümesini sinirlamadaki rolü: Türkiye örneği. Journal of Yaşar University, 16(61), 393-413.

Ismail, M.R., Hussain, S.I., Noorani, M.S.M. (2020), An early warning system for flood detection using critical slowing down. International Journal of Environmental Research and Public Health, 17, 3390.

Jeribi, A., Masmoudi, W.K. (2021), Investigating dynamic interdependencies between traditional and digital assets during the COVID-19 outbreak: Implications for G7 and Chinese financial investors. Journal of Research in Emerging Markets, 3, 60-80.

Kinkyo, T. (2022), Hedging capabilities of Bitcoin for Asian currencies. International Journal of Finance and Economics, 27(2), 1769-1784.

Lee, Y.R., Rhee, J.H. (2022), A VECM analysis of Bitcoin price using a time-varying co-integration approach. Journal of Derivatives and Quantitative Studies, 30, 1108.

Liu, G., Zhao, J., Tian, G., Li, S., Lu, Y. (2022), Visualizing knowledge evolution trends and research hotspots of artificial intelligence in colorectal cancer: A bibliometric analysis. Frontiers in Oncology, 12, 3389.

Longo, R., Podda, A.S., Saia, R. (2020), Analysis of a consensus protocol for extending consistent subchains on the bitcoin blockchain. Computation, 8(3), 67.

Lupekesa, C.S.B., Tsoku, J.T., Metsileng, L.D. (2022), Econometric modelling of financial time series. International Journal of Management, Entrepreneurship, Social Science and Humanities, 5(2), 52-70.

Matkovskyy, R., Jalan, A. (2021), Can bitcoin be an inflation hedge? evidence from a quantile-on-quantile model. Revue Économique, 72(5), 785-797.

Miyan, M.S., Biplob, M.N.K. (2019), Revisiting exports, imports and economic growth nexus: Empirical evidence from Bangladesh (1981-2017). Modern Economy, 10(2), 523-536.

Mutambo, C., Shumba, K., Hlongwana, K. (2021), Exploring the mechanism through which a child-friendly storybook addresses barriers to child participation during HIV care in primary healthcare settings in KwaZulu-Natal, South Africa. BMC Public Health, 21, 508.

Opusunju, M.I., Opusunju, M.I. (2021), Effect of financial literacy on the growth of MSMEs. International Journal of Research Publications, 90. 10.47119/IJRP1009011220212541.

Paule-Vianez, J., Prado-Román, C., Gómez-Martínez, R. (2020), Economic policy uncertainty and bitcoin. Is bitcoin a safe-haven asset? European Journal of Management and Business Economics, 29(3), 347-363.

Phochanachan, P., Pirabun, N., Leurcharusmee, S., Yamaka, W. (2022), Do bitcoin and traditional financial assets act as an inflation hedge during stable and turbulent markets? Evidence from high cryptocurrency adoption countries. Axioms, 11(7), 339.

Plakandaras, V., Bouri, E., Gupta, R. (2021), Forecasting bitcoin returns: Is there a role for the US-China trade war? Journal of Risk, 23(3), 75-93.

Priyadi, U., Utami, K.P., Muhammad, R., Nugraheni, P. (2021), Determinants of the credit risk of Indonesian Sharīah rural banks. ISRA International Journal of Islamic Finance. ahead-of-print. 10.1108/IJIF-09-2019-0134.

Qin, M., Su, C.W., Tao, R. (2021), BitCoin: A new basket for eggs? Economic Modelling, 94, 896-907.

Rahman, M.M., Islam, M., Roy, M. (2020), Modeling inflation in Bangladesh. Open Journal of Statistics, 10, 4236.

Rehman, A., Cismas, L., Anda, M. (2022), The three evils: Inflation, poverty and unemployment's shadow on economic progress-a novel exploration from the asymmetric technique. Sustainability, 14, 8642.

Rothman, T. (2019), Trading the dream: Does social media affect investors. Activity-the story of Twitter, Telegram and Reddit. International Journal of Financial Research, 147, 5430.

Shaista, A., Thi Hong, NV., Too Shaw, W., Loke, M.Y. (2023), The hedging ability of gold, silver and bitcoin against inflation in ASEAN countries. Asian academy of signals of major financial crashes in bitcoin using persistent homology. IEEE Access, 8, 20204-202057.

Simanjuntak, R.M.P., Elisabeth, D.M., Purba, S., Sitohang, S., Tarigan, N. (2023), Determination in village financial governance during the COVID-19 pandemic. Jurnal Akuntansi Aktual, 10(1), 24-36.

Simchenko, O.L., Grakhov, V., Krivorotov, V., Chazov, E.I., Suntsov, A.S. (2021), The Integrated Economic Model of Oil Field Development in the Context of New Industrialization. In: Proceedings of the VIII International Scientific and Practical Conference 'Current Problems of Social and Labour Relations' (ISPC-CPSLR 2020).

Smales, L.A. (2022), Cryptocurrency as an Alternative Inflation Hedge? Available from: https://www.ssrn.com/abstract=3883123

Tian, L., Dong, H. (2023), Study on the dynamic relationship between Chinese residents' individual characteristics and commercial health insurance demand. International Journal of Environmental Research and Public Health, 20(6), 4797.

Urquhart, A. (2016), The inefficiency of bitcoin. Economics Letters, 148, 80-82.

Wahyudi, H., Palupi, W.A. (2023), Relationship between energy consumption, foreign direct investment, and labor force participation using the VECM model: Empirical study in OECD countries. International Journal of Energy Economics and Policy, 13(2), 157-165.

Wissmann, P. (2022), Is Bitcoin a Good Asset for Inflation Hedging?-A Comparison between Bitcoin Returns and the Inflation Rates of the USA, the Eurozone, India, Kenya, and Venezuela. University of Twente Student Theses.

Yi, S., Liu, H., Chen, T., Fan, Y. (2023), A deep LSTM-CNN based on the self-attention mechanism with input data reduction for short-term load forecasting. IET Generation Transmission and Distribution, 17(7), 1538-1552.

Zimon, G., Tarighi, H. (2021), Effects of the COVID-19 global crisis on the working capital management policy: Evidence from Poland. Journal of Risk and Financial Management, 14, 169.