International Summit on Science Technology and Humanity
ISETH 2023
ISSN: 2807-7245 (online)

Central Bank Digital Currency and Financial Stability in Indonesia: Analysis on Vector Error Correction Model (VECM) Approach

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Abstract

Introduction/Main Objectives: Central Bank Digital Currency (CBDC) is an electronic form of banknotes, but different from virtual currency or cryptocurrency which are not issued by the state, the CBDC issued and guaranteed by the central bank. The aim of this study is to investigate the impacts of CBDC on financial stability using a Vector Auto-regressive model. The endogenous variables in the VAR estimation contain the Central Bank Digital Currency Attention Index (CBDCA), composite stock price index, real exchange rate, and interest rate (BI7DRR). Background Problems: The presence of CBDC will change the objective of Bank Indonesia and influence the structure of the monetary policy, which is no longer focused on achieving a low and stable inflation rate but on achieving price stability. Novelty: Although CBDCs will be launched worldwide, there are a limited number of empirical studies that have analyzed their impact on financial stability, especially for the case study in Indonesia. In this paper, we also use the Vector Error Correction Model (VECM) model with stochastic volatility and Impulse Response Function to make a forecast and see the impacts of shocks on the financial variables. Research Methods: In this study, we used monthly time series data from January 2019 – January 2023. In order to find the correlation between CBDC and the financial market we used the Granger causality model and impulse response function analysis. Finding/Results: The results of this study prove that CBDC has a positive correlation with the real exchange rate, and financial markets such as stock or bond prices have a positive response to shocks in CBDC. Conclusion: In this study, we used monthly time series data from January 2019 – January 2023. We use empirical tests to examine the CBDC attention index in relation to index attention, exchange rates, interest rates and IHSG. Our empirical results show that in Granger causality there is no causal relationship between CBDC and other macroeconomic variables. whereas in the IRF analysis, the response to the CBDC shock tends to be stagnant, the FEVD results show short-term and long-term shock fluctuations in the CBDC and other variables. These results indicate that CBDC does not have a significant effect on the macroeconomic variables used as indicators of financial system stability, but on the contrary, people's attention to CBDC depends on the condition of the variables in the financial system. On the other hand, the development of CBDC depends on economic conditions. The uncertainty surrounding CBDC plays an important role in indicating that the introduction of CBDC brings significant changes to the economy.

Keywords: *Central Bank Digital Currency, VAR model, Financial Stability*
JEL Classification: *C22, E42, E44, E5*

Introduction Section

In this technological era, money and payment systems have evolved rapidly. The development of digital networks and information technology, as well as the increasing proportion of Internet-based retail, is creating demand and technological space for digital transactions, which has the potential to fundamentally change payment systems and financial intermediation.. Nugraha & Putriani (2023) shows that ICT development in the financial sector can enhance economic growth, and reduce inflation and poverty in Indonesia. Puspitasari et al. (2022) also proved that the last few years, especially since the COVID-19 pandemic occurred, the used of cash money for transaction has greatly reduced. People tend to allocate their money in other assets or in the form of deposits. Thus, several central banks in the world are exploring the idea of issuing central bank digital currency (CBDC) (Agur et al., 2022). Blockchain is the core technology of Bitcoin, and technological advancements in this area have a major impact on payment methods, e-commerce, and cross-border remittances. Blockchain technology is also widely used in cryptocurrencies, and more than 5.000 blockchain-based cryptocurrencies have emerged in the last 10 years. Zhang & Huang (2022)shows that in the rapidly changing digital world, more and more transactions are being processed online and less and less paper money is being used to keep up with the

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trend.This is why central banks around the world are interested in switching to digital currencies. Central Bank Digital Currency (CBDC) has become a major focus of interest in the last few years and in numerous countries (Morgan, 2022). CBDC as a financial asset has significant liquidity and yield differences compared to other assets. CBDCs are a variant of cryptocurrencies issued by central banks that combine encryption and digital ledger technology to provide this digital currency.CBDC is an account-based liability, denominated in national currency, with the central bank that may or may not earn interest. It can be used for bank deposits as a medium of exchange and a store of wealth.This process converts the available currency using direct deposits at the central bank or commercial banks (Sadiq et al., 2023). As the use of banknotes decreases and the proportion of digital payments increases, retail CBDCs provide the public with a new access point to central bank money and thus provide an important "anchor" or source of confidence in currencies and payment systems, and facilitate financial access.In addition, CBDCs are built using distributed ledger technology (DLT) and "smart contracts".CBDC offers a series of new technological capabilities in terms of speed, efficiency, and security of payments, transmission of monetary policy (Morgan, 2022).

If CBDC is implemented, this new "digital currency" may create new opportunities. On the one hand, in terms of payments, on the other hand, it may directly affect monetary policy and the way central banks ensure their two important functions: monetary stability and financial stability.(Alonso et al., 2021). Regarding the CBDCs and their effect on financial stability, there is, still, a great deal of doubt. For example, the future configuration of financial systems, the architecture of CBDCs and the systems that support them, and the extent to which they will eventually be used are all unpredictable.(Elsayed & Nasir, 2022). Purnawan & Puspitasari (2021)demonstrates how there is a countercyclical relationship between economic stability and uncertainty. Thus, the economy will become unstable if a significant level of uncertainty is permitted.When it comes to payments, CBDC can be used, for instance, as a cryptocurrency-like digital payment system that targets businesses and consumers.It can also function as the financial industry's central bank currency, facilitating real-time stock trading and establishing a connection to blockchain-based ownership management. Opening public central bank accounts in order to implement CBDC will have the potential effects on banking operations listed above.(Purnawan & Riyanti, 2019).

The most recent research on CBDC can be categorized according to several factors, including technical innovation, CBDC model optimization, definitions and types, security and privacy concerns, and an examination of the effects of CBDC on the banking system, monetary policy, and monetary system. For instance, Helmi et al., (2023) uses a non-linear framework, the time-varying vector autoregressive (TVP-VAR), to examine the impacts of news about CBDC on the financial and cryptocurrency markets. Wang et al., (2022)using a vector autoregression (VAR) to examine the impact of CBDC News on Financial Markets, the findings indicate that financial markets are more susceptible to CBDC Uncertainty than CBDC Focus as a stand-in for CBDC. Purnawan & Riyanti (2019) Demonstrates how CBDC enhances financial inclusion, offers new monetary instruments, and transmits monetary policy. However, very few studies look into how current regulatory and media discussions about CBDCs impact financial market behavior. Quantitative studies of the impact of CBDCs on financial markets are hampered by the lack of data or proxies that can represent and reflect the CBDCs given that the process of developing and adopting them is still in its early stages. (Wang et al., 2022) . The analysis's findings indicate that, in the near run, only the consumer confidence index matters; macroeconomic factors don't matter much.Macroeconomic factors don't really matter. IHSG has no significant impact over the long term, but interest rates and the consumer confidence index do.Investors can use a country's CBDC to make mutual fund investments. Since that CBDCs are typically regarded as a type of instantaneous digital currency, these transactions may be more effective and swift. (Nugraha et al., 2021).

Zhang & Huang (2022) CBDC has a positive influence on the effectiveness of security resilience, payment efficiency, reducing issuance costs and improving transaction convenience. Morgan (2022) CBDC also provides universal and electronic access in mara denominations that the national digital central bank has an obligation to make publicly accessible. Elsayed & Nasir (2022) CBDC is also able to record all economic transactions and is open to state monitors so that it can be used as an opportunity to minimize and control global corruption. Zhou (2023) cbdc also provides universal and electronic access in mara denominations that the national digital central bank has an obligation to make publicly accessible. Although CBDC can have some positive effects, it also has a negative impact on the economy. Elsayed & Nasir (2022) argues that in the application of monetary policy transmission, the banking and financial sector, is something that should still be considered to adopt CBDC, because the understanding of CBDC and CBDC challenges is still limited so that it will hinder the formation of an optimal strategy. Zhou (2023) the issuance of cbdc is feared to reduce the cost of cash transactions and the issuance of cbdc will cause the loss of independence of monetary policy abroad.

To fill this research gap and conduct a quantitative analysis of CBDC's impact on financial markets, an attention index from available data can be used to track trends and variations in CBDC. In this study, we used monthly time series data from January 2019 – January 2023. To find the correlation between CBDC and the financial market we used the Granger causality model and impulse response function analysis. In this paper, we first empirically examine the impact of CBDC news on the financial markets. Our variables includes the Central Bank Digital Currency Attention Index, composite stock price index, real exchange rate, and interest rate (BI7DRR). In order to forecast and observe how shocks affect financial variables, we begin our empirical analysis with the Vector Error Correction Model (VECM) with stochastic volatility and Impulse Response Function. Our work provides fresh evidence for upcoming quantitative studies of CBDC, as well as

helpful proxies of CBDC uncertainty and concern. Additionally, this study effectively connects CBDC to financial markets and other volatility indicators, such as CBDC's attention index, which may serve as the basis for future.

Literature Review

Blockchain is the main technology behind most cryptocurrencies, and because of its advantages, blockchain-based CBDC can help to improve efficiency and develop more secure payment systems. Blockchain is also being investigated in research and prototype experiments related to CBDC (Zhang & Huang, 2022). In a scenario where agents prioritize security and anonymity over cash, bank deposits, and CBDC, the best design for a central bank digital currency (CBDC) is examined. Therefore, frequency for the use of a payment instrument determines its convenience (Agur et al., 2022). The rise of digital currencies could ensure fundamental changes in the structure of the financial system, opening up opportunities for banks to compete with private financial institutions in order to get more deposits. Central banks are not investment experts, they cannot invest in long-term projects and must rely on bank investment. rely on investment banks to do this(Fernández-Villaverde et al., 2020). It can be used for bank deposits, as a medium of exchange and a store of wealth. This process converts available currency with the help of direct deposits at the central bank or commercial bank (Sadiq et al., 2023). Monetary policy effectiveness for digital currency issued by retail central banks (Zhou, 2023). There is still a few research on CBDCs as it is a relatively new field in the virtual currency space. However, in order to learn more about CBDC, several researcher divided into five primary groups.

First, the primary technological advancement and CBDC model optimization are covered. The creation of digital currencies and blockchain technology is speeding up the process of developing CBDCs, according to central banks around the globe. The foundation of Bitcoin is blockchain technology, and advancements in this area have had a significant impact on cross-border transfers, e-commerce, and payment methods. Coins that use blockchain technology are also very common (Zhang & Huang, 2022). Finding the best countries to implement the CBDC and how it will affect open innovation in the payment industry The present state of Central Bank Digital Currency (CBDC), a digital currency backed by central banks, is examined in this article. This report presents its current state and discusses how some nations and currency regions are thinking about implementing it, emulating the Bahamas, China, and Uruguay, which have all completed two trials, and the Bahamas, which have implemented it on their territory. Initially, a subset of possible candidates for CBDC establishment was chosen. Secondly, factors are attributed to the reasons behind the implementation of CBDCs after they have been gathered. Bivariate correlation statistical techniques were used following the completion of the first two steps (Pearson, Spearman, and Kendall correlations) (Alonso et al., 2021). Create a straightforward and broadly applicable payment portfolio model to investigate the possibility of Central Bank Digital Currencies (CBDC) crowding out bank deposits. (Bian et al., 2021).

Second, The definition and varieties of CBDC are unlike digital central bank reserves or settlement accounts or physical cash, CBDC is a digital form of central bank money (Bian *et al.*, 2021). Based on the definition, the CBDC comprises both wholesale and retail CBDC, as per the current two-tier monetary system architecture. The wholesale CBDC handles interbank debt settlements, payments between financial institutions, and other interbank transactions. Regular clients or consumers pay directly for goods and services—such as shopping, travel, or personal transfers—using their accounts at the central bank. This is known as "retail CBDC." (Zhou, 2023). Retail CBDC offers the public a new point of access to central bank funds as cash use declines and a larger share of payments are made digitally. This creates a vital visible "anchor" or source of trust for money and the payments system while also promoting financial inclusion (Morgan, 2022)

Third, empirical research focuses on digital currency, blockchain security, and their effects on credit availability and financial stability, it also covers security and privacy to examine the potential of digital currency or blockchain and CBDC (Sadiq et al., 2023). Since anonymity is a crucial component of online transactions, cash is anonymous when used as currency. Peoples should have adequate privacy from CBDC, including transaction privacy and user identity anonymity, and safety. Security is essential to CBDC because of its digital nature. In addition to offering security features like no double spending, anti-counterfeiting, non-repudiation, and verifiability, CBDC should guard against potential fraud and attacks (Zhang & Huang, 2022). Agur et al. (2022) examines the best design for CBDC where agents prioritize anonymity and security over cash and bank deposits, and where network effects make a payment instrument's convenience dependent on user volume.

Fourth, examines how CBDC are affecting the monetary system and monetary policy. Due to the lack of knowledge about CBDCs, more research is necessary. This research should concentrate on the economic justification of CBDC as well as how they will affect the transmission of monetary policy, financial and price stability, inflation targeting, unconventional monetary instruments, central banks acting as lenders of last resort, and the issuance of forward guidance. (Elsayed & Nasir, 2022). Zhou (2023) Analyzed the macroeconomic impact on policy mix between CBDC rules and monetary policy. He proved that policy mix between digital currency and monetary policy can reduce macroeconomic volatility.As a supplement, a monetary policy of setting interest rates on government bonds is examined (Carapella, 2022).

Fifth, analyze of the impact of CBDCs on the banking system. The presence of CBDC enables central bank to engage in large-scale intermediation by competing for deposits with private financial intermediaries (Fernández-Villaverde et al., 2020). Central banks should use digital currency and blockchain in conjunction with an online technological payment

strategy to improve domestic financial stability and payment systems (Sadiq et al., 2023). Our study seeks to make two distinct contributions to the body of literature. First off, there aren't many empirical studies that have been done to evaluate the possible effects of CBDCs on financial markets, even though they will soon be accessible everywhere. Second, this paper aims to be the first empirical study to examine the response of the financial market to the real exchange rate, interest rate, composite stock price index, and Central Bank Digital Currency Attention Index (BI7DRR).

Methodology

Data

This study used time series monthly data from January 2019 - January 2023. The choice of this timeframe was due to the pandemic COVID-19 which is prompted a change to cashless payment methods. In addition, the result of a survey conducted by Bank for International Settlements (BIS) in 2019-2020 showed the ease of digital money transaction using blockchain technology has motivated central banks around the world to create the central bank digital currency (CBDC). In more detail, Table 1 show operational definitions of the variables used in this study.

Table 1. Operational Definition of Variables

Notation	Variable	Unit	Data Source
CBDC	Central Bank Digital Currency Attention Index	Index	*Wang et. al. (2022) link: https://sites.google.com/view/cryptocurrency-indices/the-indices/cbdc-indices*
ER	Exchange Rate	IDR/USD	*International Financial Statistics*
IR	Interest Rate	Percent	*Bank Indonesia*
STOCK	Composite Price Index	Index	*Indonesia Stock Exchange (IDX)*

In the central bank digital currency attention index (CBDC), exchange rate (ER), and composite price index (STOCK) variables, the natural logarithm (Ln) transformation is carried out before the estimation process, this aims to change the data to be more normally distributed.

Method

This research employs the Vector Error Autoregressive Model (VECM) for descriptive quantitative analysis. Its objective is to examine the short-term and long-term correlations among variables and assess the impact of shocks in the CBDC variable on other macroeconomic variables. VECM is a variant of the Vector Auto Regression (VAR) method specifically designed for non-stationary data and known to exhibit a cointegration relationship. The stages of VECM analysis are as described by Saputra and Sukmawati (2021).

1. Collect data and carry out data transformation before processing
2. Carry out a stationary test by applying the unit root test
3. After the variable passes the 1st Difference or 2nd Difference stationary test stage, the optimum lag is then determined using several criteria, such as the Akaike Information Criterion (AIC), Schwarz Information Criterion (SIC), and Hannan-Quinn Information Criterion (HQ)
4. If the optimum lag has been determined, then continue with the stability test using the AR Roots Table
5. Carry out the Johansen cointegration test, if there is no cointegration then the next estimation stage uses the VAR method. Conversely, if there is cointegration then the next stage uses the VECM analysis method
6. Test the feasibility of the model using the Portmanteau residual test
7. Granger causality test to see the causal relationship between variables,

8. Analyze the results of the Impulse Response Function (IRF) to see the response of the dependent variable in the VAR system to shocks in error terms and Forecast Error Variance Decomposition (FEVD) to see the magnitude of the contribution of the influence of each variable through the estimated error variance.

The VECM model in this research is formulated as follows

$$\Delta y_t = \alpha e_{t-1} + \beta_1 \Delta y_{t-1} + \beta_1 \Delta y_{t-2} + \_\_\_\_ + \beta_\rho \Delta y_{t-\rho+1} + \varepsilon_t$$

Where:

Δy_t = vector of first derivatives of the dependent variable

Δy_{t-1} = vector of first derivative of dependent variable with 1st lag

ε_{t-1} = error obtained from the regression equation between Y and X at the 1st lag and is also called ECT (Error Correction Term)

ε_t = residual vector

α = cointegration coefficient matrix

β_t = coefficient matrix of the it dependent variable, where i=1,2,…,p

Result and Analysis

In analyzing the relationship between central bank digital currencies and financial system stability in Indonesia, this study uses the CBDC Attention index to show public interest in the emergence of digital currencies. The variables used as indicators to show the stability of the financial system are interest rates, exchange rates, and the stock price index. Each of these variables has a different distribution, so before carrying out the data estimation process, the data is first transformed into the natural logarithm (Ln). The results of descriptive statistics of the data used in this study can be seen in Table 2 below.

Table 2. Descriptive Statistics of the Data

	LCBDC	LER	LSTOCK	IR
Mean	4.617575	9.582260	14.62718	0.043776
Median	4.609717	9.572968	14.64652	0.040000
Maximum	4.651663	9.703023	14.78617	0.060000
Minimum	4.601517	9.522374	14.32064	0.035000
Std. Dev.	0.016512	0.035102	0.119031	0.009300
Skewness	0.754471	1.404462	-0.951907	0.592804
Kurtosis	2.182400	5.058729	3.273489	1.848569
Jarque-Bera	6.013478	24.76218	7.552740	5.576728
Probability	0.049453	0.000004	0.022906	0.061522
Sum	226.2612	469.5307	716.7317	2.145000
Sum Sq. Dev.	0.013087	0.059143	0.680087	0.004152
Observations	49	49	49	49

The first step before estimating the VAR/VECM model is to carry out the Augmented Dickey Fuller (ADF) unit root test to ensure that the data used is stationary at the level, 1st Difference or 2nd Difference. The results of the data stationary test in this study can be seen in Table 3 below.

Table 3. Unit Root Test (ADF) Result

Variable	**Level**	***1st Difference***	***2nd Difference***	**Decision**
	Prob.	***Prob.***	***Prob.***	
LCBDC	0.3117	0.0000**	0.0000**	I(I)
LER	0.0396	0.0000**	0.0000**	I(I)
LSTOCK	0.4545	0.0000**	0.0000**	I(I)
IR	0.4819	0.1444	0.0000**	I(II)

***Indicates the rejection of the null hypothesis on the non-stationarity of the variable under consideration significance at 1%.*

Based on Table 3, it can be seen that only the CBDC attention index, exchange rate and stock price index variables are stationary at the 1st Difference level. However, all variables including the exchange rate are proven to be stationary at the 2nd Difference level. Therefore, in the subsequent estimation process all variables in the model are used in the form of 1st Difference and 2nd Difference specifically for exchange rates. Then the data pre-estimation process can be continued to the next stage, namely selecting the optimum lag and stability testing which can be seen in Table 4 and Figure 1.

Table 4. The result of Lag Order Selection Criteria test

Lag	AIC	SIC	HQ
0	-23.52781	-23.36561*	-23.46765
1	-23.86790*	-23.05690	-23.56714*
2	-23.66697	-22.20718	-23.12561

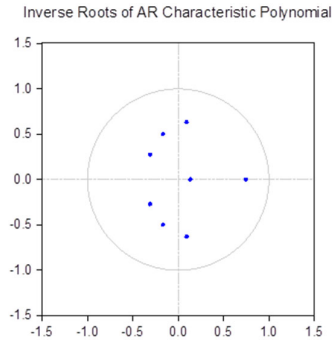

Figure 1. The result of stability test (AR Roots Graph)

Based on Table 4, it can be seen that the results of the optimum lag selection using several criteria (AIC, SIC, and HQ) show that the optimum lag is lag 1. Then at the next stage, stability checks are carried out on the model that has been given first differential treatment and lag 1 by analyzing the output results of the AR Root Graph shown in Figure 1. In the Inverse Roots of AR Characteristic Polynomial image, it can be seen that there are no points outside the circle. This proves that the VAR / VECM model estimation can be continued. To find out whether the variables in the model have long-term cointegration, the next step is to conduct a Johansen cointegration test to determine the method to be used at the estimation stage. The cointegration test results can be seen in table 5 below.

Table 5. Johansen Cointegration Result

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.618445	129.9898	47.85613	0.0000
At most 1 *	0.589499	84.70536	29.79707	0.0000
At most 2 *	0.536879	42.85767	15.49471	0.0000
At most 3 *	0.132464	6.678639	3.841466	0.0098

Table 5 shows the results of Johansen's cointegration test, which show that there is long-term cointegration between variables. This is indicated by the Trace Statistic value being greater than the critical value of 5% and greater than the Eigenvalue value. That means the next step in this study should be to analyze the long-term balance relationship between variables using the Vector Error Correction Model (VECM). The obtained VECM model must be tested using a model feasibility test (residual test Portmanteau). Table 6 shows the results of the VEC Residual Portmanteau Test.

Table 6. VEC Residual Portmanteau Tests for Autocorrelations

Lags	Q-Stat	Prob.*	Adj Q-Stat	Prob.*	df
1	1.821349	---	1.862744	---	---
2	7.430451	---	7.732734	---	---
3	14.19736	0.8204	14.98299	0.7774	20

The Portmanteau test results in Table 6 show the Q-stat value (14.19736) which is greater than the probability value (0.8204). This proves that there is no autocorrelation in the model, so the VECM model can be said to be feasible. The next estimation process is to carry out a causality test using the Granger Causality Test to determine the existence of a causal relationship between the variables in the model. The results of the Causality test can be seen in Table 7.

Table 7. Granger Causality Test

Null Hypothesis:	Obs	F-Statistic	Prob.
D(LER) does not Granger Cause D(LCBDC)	46	0.08026	0.9230
D(LCBDC) does not Granger Cause D(LER)		0.03909	0.9617
D(LSTOCK) does not Granger Cause D(LCBDC)	46	0.26212	0.7707
D(LCBDC) does not Granger Cause D(LSTOCK)		0.02043	0.9798
D(IR) does not Granger Cause D(LCBDC)	46	1.03828	0.3632
D(LCBDC) does not Granger Cause D(IR)		0.28788	0.7514
D(LSTOCK) does not Granger Cause D(LER)	46	0.10547	0.9001
D(LER) does not Granger Cause D(STOCK)		0.80609	0.4536
D(IR) does not Granger Cause D(LER)	46	0.36550	0.6961
D(LER) does not Granger Cause D(IR)		2.48218	0.0960
D(IR) does not Granger Cause D(LSTOCK)	46	0.05274	0.9487
D(LSTOCK) does not Granger Cause D(IR)		0.08947	0.9146

Based on the causality test results shown in Table 7, it can be seen that there is no causal relationship between the CBDC variable and other macroeconomic variables. This is indicated by a p-value greater than 0.05. Next, an impulse response function (IRF) analysis was carried out to see the effect of the shock of a variable on other variables in the model. The IRF results which can be seen in Figure 2, provides a forecasting picture for the next 10 periods regarding the response of a variable arising from a shock, either to the variable itself or to other variables in the model. Based on Figure 2, it can be seen that the response of the exchange rate, stock price index and interest rate variables to the CBDC attention index tends to stagnate. On the other hand, the response of the CBDC attention index to macroeconomic variables fluctuates more. The movement of the IRF line close to the equilibrium point indicates that the impact of shocks is short-term.

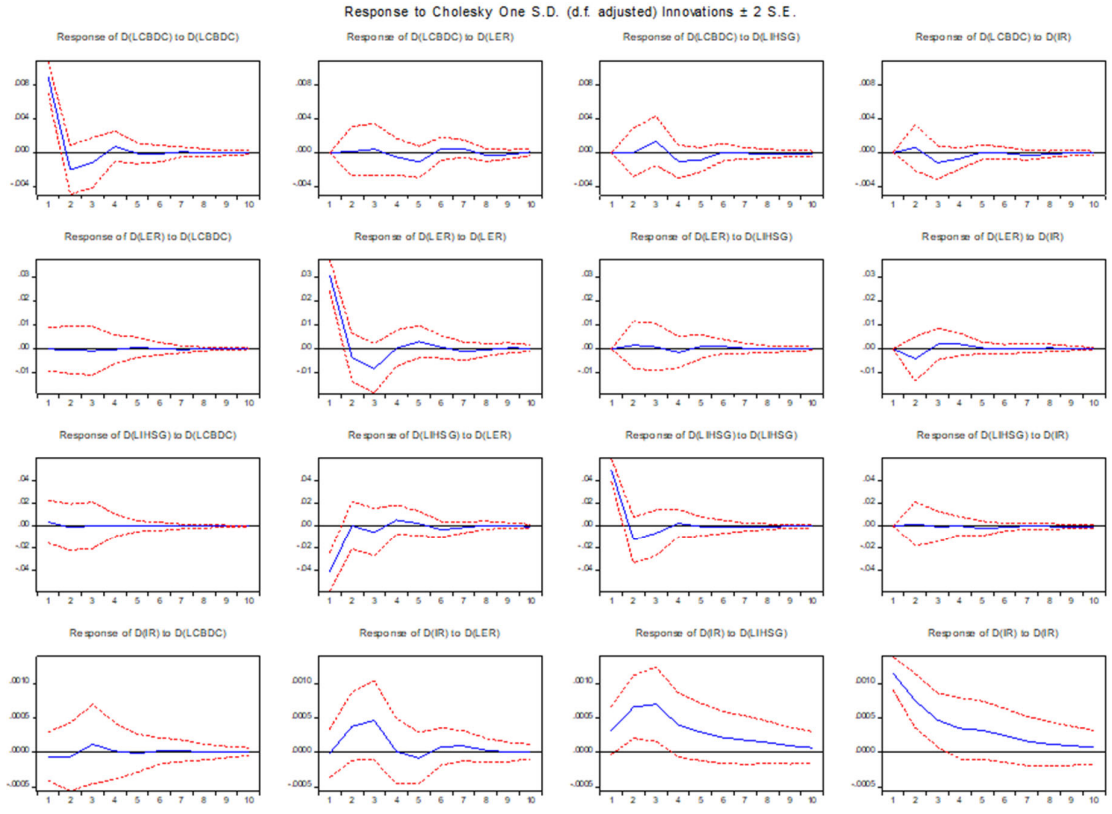

Figure 2. Result of Impulse Response Function (IRF)

The next analysis is to look at the Forecast Error Variance Decomposition (FEVD) results, as in Table 8 to Table 11. Table 8 shows the FEVD results for 10 periods for the CBDC variable. In the short term, periods 1 to 4, it can be seen that

the shocks that occurred in the CBDC caused at least 93.8% of the fluctuations in the CBDC itself. However, in the 5th to 10th periods, the fluctuations caused by the CBDC shock itself began to decrease, as the effects of shocks on other variables such as the exchange rate, stock price index and interest rates began to increase.

Table 8. Forecast Error Variance Decomposition (CBDC)

Variance Decomposition of D(LCBDC):					
Period	S.E.	D(LCBDC)	D(LER)	D(LSTOCK)	D(IR)
1	0.008973	100.0000	0.000000	0.000000	0.000000
2	0.009221	99.56993	0.023939	0.001957	0.404170
3	0.009483	95.66170	0.218311	2.175312	1.944673
4	0.009607	93.81691	0.485640	3.309013	2.388434
5	0.009707	91.89677	1.745037	4.015085	2.343111
6	0.009720	91.68403	1.967415	4.009137	2.339421
7	0.009737	91.36710	2.198361	3.998949	2.435591
8	0.009745	91.23088	2.292380	4.013603	2.463134
9	0.009748	91.17434	2.337041	4.026270	2.462349
10	0.009749	91.15943	2.342986	4.033621	2.463960

Table 9. Forecast Error Variance Decomposition (LER)

Variance Decomposition of D(LER):					
Period	S.E.	D(LCBDC)	D(LER)	D(LSTOCK)	D(IR)
1	0.030560	0.000776	99.99922	0.000000	0.000000
2	0.031072	0.027321	97.96078	0.247260	1.764636
3	0.032199	0.077678	97.61864	0.295558	2.008121
4	0.032286	0.081837	97.10246	0.483650	2.332054
5	0.032445	0.121583	96.99602	0.559170	2.323228
6	0.032470	0.121884	96.90485	0.651702	2.321568
7	0.032489	0.126617	96.89651	0.656262	2.320614
8	0.032494	0.126620	96.88380	0.656396	2.333188
9	0.032497	0.127276	96.87847	0.656982	2.337269
10	0.032499	0.127358	96.87413	0.661321	2.337192

Next, Table 9 shows the FEVD value for the next 10 periods for the rupiah exchange rate variable against the US dollar. As with the CBDC variable, the FEVD results for the exchange rate variable also show that in the short term, the greatest fluctuations are caused by shocks to the exchange rate variable itself. In the long term, for example in the 10th period, the influence of exchange rate shocks on exchange rate fluctuations decreases along with the influence of shocks from other variables.

Table 10. Forecast Error Variance Decomposition (LSTOCK)

Variance Decomposition of D(LSTOCK):					
Period	S.E.	D(LCBDC)	D(LER)	D(LSTOCK)	D(IR)
1	0.064270	0.337805	40.42603	59.23617	0.000000
2	0.065478	0.350640	38.95186	60.61309	0.084413
3	0.065997	0.350516	39.01848	60.54235	0.088651
4	0.066291	0.360166	39.39668	60.15404	0.089120
5	0.066368	0.360111	39.43328	60.01661	0.190004
6	0.066444	0.360297	39.54880	59.88558	0.205321
7	0.066461	0.360929	39.55691	59.87641	0.205757
8	0.066467	0.361140	39.56439	59.86823	0.206239
9	0.066471	0.361288	39.56667	59.86263	0.209417
10	0.066472	0.361391	39.56713	59.86061	0.210864

Table 10 shows the FEVD results for the stock price index variable and proves that fluctuations in the stock price index are around 60% influenced by shocks to the stock price index itself, and 39.5% are influenced by shocks to the exchange rate. Meanwhile, the CBDC and interest rate variables only contributed 0.3% and 0.2% respectively. This shows

that the effect of shocks on the exchange rate will cause greater fluctuations in the stock price index than other variables in the model.

Table 11. Forecast Error Variance Decomposition (IR)

Variance Decomposition of D(IR):					
Period	S.E.	D(LCBDC)	D(LER)	D(LIHSG)	D(IR)
1	0.001195	0.244860	0.010259	6.998336	92.74655
2	0.001603	0.302214	5.551001	20.82209	73.32469
3	0.001873	0.617405	10.24657	29.18594	59.95009
4	0.001946	0.578948	9.495615	31.21986	58.70557
5	0.001996	0.556702	9.200792	31.85882	58.38369
6	0.002024	0.550228	9.119406	32.10403	58.22634
7	0.002040	0.552679	9.175167	32.35196	57.92019
8	0.002049	0.548608	9.116990	32.56622	57.76818
9	0.002053	0.546284	9.078078	32.64667	57.72897
10	0.002056	0.545456	9.059620	32.67809	57.71684

Based on Table 11, it can be seen that in the short term, for example in the 3rd period, shocks to the interest rate have the largest contribution to fluctuations in the interest rate itself, which is 60%, followed by shocks to the stock price index which contributes 29.2%, the exchange rate is 10.2% and CBDC provides the smallest contribution of 0.6%.

The results of this investigation support those of Helmi et al. (2023), who found that there was little impact on the financial markets. Since CBDCs are still relatively new, the majority of research on the advantages and disadvantages of putting them into practice has been theoretical in nature, offering a basic qualitative examination of CBDCs and their technological advancements. However, one could counter that linear estimation methodologies are inappropriate for identifying dynamic linkages between CBDCs and financial cryptocurrency markets given the high volatility of digital currency prices over time. It has been determined that the linear VAR responses to CBDCU shocks are not statistically significant. The only exception is the cryptocurrency policy attention index, which received statistically significant positive feedback. It is discovered that the linear VAR's responses to CBDCU shocks are statistically insignificant. The cryptocurrency policy uncertainty index is the sole exception, displaying statistically significant positive responses. On the other hand, the time-varying responses show that there is a noticeable variation in the direction and significance of the responses to CBDCU shocks over time.

Conslusion

In this study, we used monthly time series data from January 2019 – January 2023. We use empirical tests to examine the CBDC attention index in relation to index attention, exchange rates, interest rates and IHSG. Our empirical results show that in Granger causality there is no causal relationship between CBDC and other macroeconomic variables. whereas in the IRF analysis the response to the CBDC shock tends to be stagnant, the FEVD results show short-term and long-term shock fluctuations in the CBDC and other variables. These results indicate that CBDC does not have a significant effect on the macroeconomic variables used as indicators of financial system stability, but on the contrary, people's attention to CBDC depends on the condition of the variables in the financial system. But on the other hand, the development of CBDC depends on economic conditions. The uncertainty surrounding CBDC plays an important role in indicating that the introduction of CBDC brings significant changes to the economy.

Acknowledgement

During this research, the author would like to thank ALLAH SWT for all the grace and blessings and provide fortitude during the process of completing the research. This achievement would not have happened without the blessing of ALLAH SWT. the author would also like to thank my entire family who always provide support and prayers during my study journey. Thank you to Prof. Dr. Anton Setiawan S.E.,M.Si. for facilitating the process of completing this research and a big thank you to Mrs. Inda Fresti Puspitasari S.Pd.,M.Sc. as my supervisor in completing this research and all my friends who have provided support and encouragement to me to be able to complete this research. Hopefully the results of this study can be useful and make a positive contribution to the related fields.

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