Analysis of Electronic Money in Indonesia

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Abstract. Today's advanced technology encourages people to transact using electronic money (e-money). Currently, more and more Indonesians are using electronic money, this can be seen from the volume of electronic money transactions that have increased from year to year. People prefer to transact using electronic money because it is easier to transact with traders. This study aims to analyze the variables of interest rates, inflation, money supply, e-money, and electronic money transactions in Indonesia. This type of research is a quantitative analysis using secondary data from 2011 to 2021 with quarterly data type per year taken from Bank Indonesia (BI), World Bank, and BPS (Central Bureau of Statistics). The analysis method used is VAR (Vector Autoregressive) and sharpened with Forecast Error Variance Decomposition (FEVD). The results of the VAR analysis show that there is a contribution to the variable itself and other variables. From the estimation results it turns out that there is a reciprocal relationship between one variable and another or in other words all variables, namely Inflation, JUB, E-Money, Interest Rates, and Electronic Money Transactions, contribute to each other. The results of the FEVD analysis show that not all variables contribute to the variable itself.

*Keywords: E-Money, Inflation, Money Supply, Interest Rates, Electronic Money Transactions*

1. INTRODUCTION

The current digital era requires people to be smart and take advantage of the convenience of interacting with each other. The increasing economic development has a major influence on people's lives in various fields including the digital economy (Rangkuty, 2021). Various digital innovations in various fields prove that people also take part in the development of the current era. Along with that, payment instruments have also experienced special growth in non-cash payment systems both on a domestic and international scale. One of the biggest impacts of technology-based payment systems is the emergence of payment instruments known as electronic money (e-money) and virtual money. This electronic money appears as an answer to the needs of the community in payment instruments that are expected to be a payment medium that can complete transactions quickly, easily, and cheaply. Electronic money or digital money is a means of payment in electronic form where the value of money is stored in the form of electronic media. Current technological developments make electronic money a means of exchange that stores value in electronic form.

To get this electronic money, users must deposit or pay using physical or cash to the electronic money issuing company to then be stored in electronic media before using it for transaction purposes. Usually, transactions require an internet network, because of its use such as smartphones or computers. This electronic money facilitates various transactions so

that users do not need to carry cash. In addition to speed and convenience in payment, electronic money has several benefits, one of which is that users do not need to be bothered with change when transacting even in small amounts. Bank Indonesia (BI) as the monetary regulator in Indonesia, defines the value of electronic money if it fulfills two elements (Darliansyah et al., 2022). The first is the value of money stored electronically in a medium such as a server or chip. The second is the value of electronic money managed by the issuing entity as referred to in the law governing banks. In Indonesia there are two types of electronic money, the first is server- or card-based electronic money. The second is server-based or application-based electronic money (Wikipedia, 2023).

The following can be presented the development of E-Money in the country of Indonesia in the period 2011-2021 as follows:
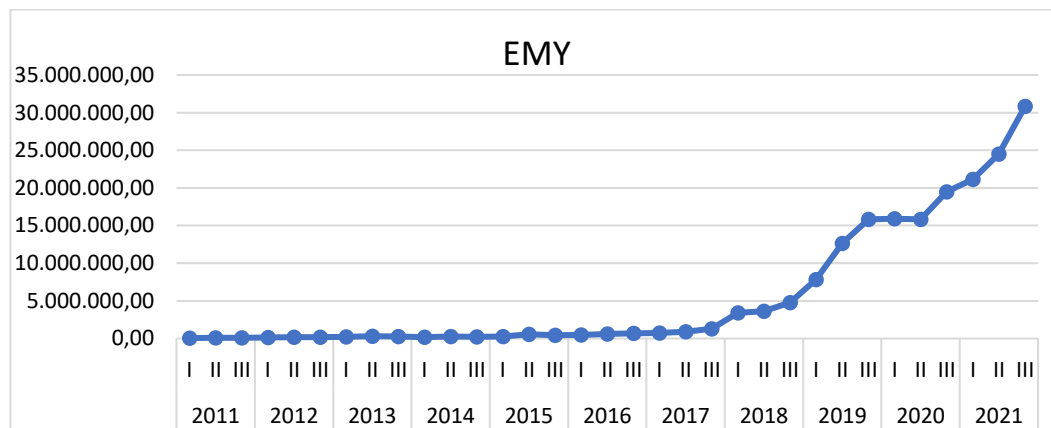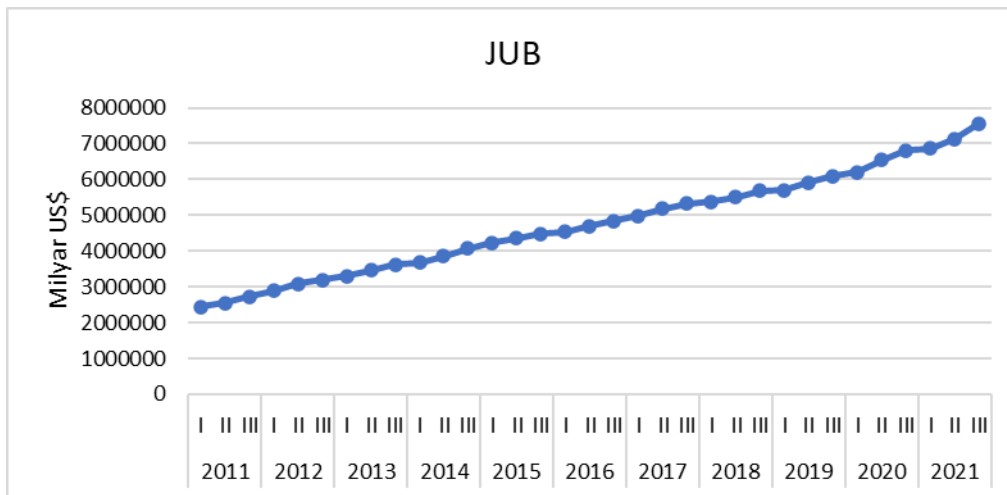

Source: Bank Indonesia

Figure 1. E-Money Development from 2011 to 2021 (US$ Billion)

Figure 1 shows that most Indonesian countries have greatly increased using E-Money for transactions from 2011 to 2021. Because of the development of the digital world which makes many Indonesians prefer to use E-Money when making transactions because transactions using E-Money do not have to change in cash, therefore many Indonesians choose to use E-Money when making transactions and make it easier for people not to use cash when making transactions.

The amount of money in circulation in Indonesia is very important, because of its role as a transaction tool for economic movement. The amount of money in circulation in the hands of the public must develop normally. The amount of money in circulation must be controlled by the capacity of a country's economy, that is, the amount of money in circulation is not too much and not too little. The money supply is carried out by the Central Bank as the monetary authority with its policies in controlling the money supply.

Source: World Bank

Figure 2. 2011-2021 Money Supply in Indonesia (US$ Billion)

It can be seen in Figure 2 that there are fluctuations in the money supply in Indonesia in the 11-year study period (2011-2021). Where the money supply has increased from year to year normally.

Along with the implementation of electronic money as a transaction tool for various purposes, people inevitably have to have electronic money in their pocket or wallet. From year to year, transactions using electronic money in Indonesia have developed. This can be seen from the high population level and with an increase in financial literacy, community inclusion is an aspect that can affect the growth of economic activities using electronic money. From 2011-2021 electronic money transactions experienced a huge increase.
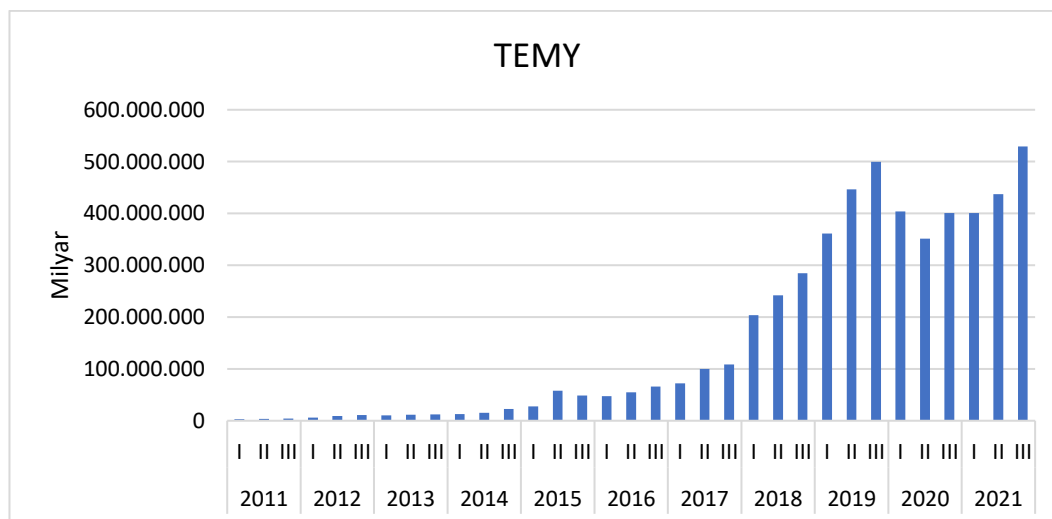
Source: Bank Indonesia

Figure 3. Electronic Money Transactions in Indonesia 2011-2021 (Billion)

Figure 3 shows that there are changes in electronic money transactions in Indonesia in the 11-year study period (2011-2021). In the current digital era, transactions using

electronic money show fluctuations before finally experiencing a significant decline in 2020 and then experiencing an increase in 2021.

2. METHODS

This research approach uses a quantitative approach with an associative type. Quantitative research methods can be explained as research methods based on the philosophy of positivism, used for data collection using research instruments, and statistical data analysis, with the aim of testing predetermined hypotheses (Sugiyono 2011). According to (Rusiadi, et al., 2015) quantitative research is research that aims to determine the relationship between two or more variables.

This research was conducted in Indonesia, using time series secondary research data sourced from the World Bank and Bank Indonesia. This research technique uses VAR (Vector Autoregressive) analysis.

3. RESULTS AND DISCUSSION

Research Results

a. Unit Root Test Results (Stationarity Test)

Stationarity test should be done with Dicky Fuller's extended unit root test. Apart from the Dicky Fuller test is the Augmented Dicky Fuller (ADF) which attempts to minimize autocorrelation. This test contains regression of the first differential of time series data on the lag of the variable (Kuncoro, 2011). To find out and test whether data from year to year is stationary is to conduct a unit root test. In this study, the stationarity test met the criteria at the 2st Difference stage which can be seen in the following table:

Table 1. Data Stationary Test Results Through Units at 2st Difference

Variable	Augmented Dickey-Fuller test statistic	Prob	Description
LNEMY	-7.965516	0.0000	Stationary
TEMY	-6.276626	0.0000	Stationary
SB	-5.995222	0.0000	Stationary
INF	-3.345442	0.0238	Stationary
JUB	-9.644206	0.0000	Stationary

Source: Eviews 10, data processed 2024

The Augmented Dickey-Fuller results in the table above show that of the five variables tested, the unit root test with 2st difference is stationary with a probability of 0.00 or (0.00<0.05).

b. Johansen Cointegration Test Results

The results of the Johansen cointegration test conducted with the help of the eviews 10 program are as follows:

Table 2. Johansen Cointegration Test Results

Unrestricted Cointegration Rank Test (Trace)				
Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.659990	79.50556	69.81889	0.0069
At most 1	0.549488	46.06333	47.85613	0.0730
At most 2	0.276568	21.34487	29.79707	0.3365
At most 3	0.202018	11.30866	15.49471	0.1932
At most 4 *	0.129882	4.312937	3.841466	0.0378
Trace test indicates 1 cointegrating eqn(s) at the 0.05 level				
* denotes rejection of the hypothesis at the 0.05 level				
**MacKinnon-Haug-Michelis (1999) p-values				

Source: Eviews 10, data processed 2024

From Table 2 of the Johansen cointegration test, it is known that there are 2 cointegrated equations at the five percent level, which means that there is a long-term relationship between variables.

c. Granger Causality Test Results

To determine whether or not there is a short-term relationship between the variables studied by looking at the qualified equation, the Granger causality test is conducted. The results of the Granger causality test stated that the research variables have a relationship with each other in the short-term, medium-term, and long-term.

d. Lag Stability Test Results

This lag length test is conducted to see how much lag stability is optimal to use in the analysis. Determination of optimal lag stability can be done by looking at the Akaike Information Criterion (AIC) criteria. The more optimal lag stability is the lag value that has a smaller Akaike Information Criterion (AIC) value. The results of lag stability testing in the study can be seen in the following table.
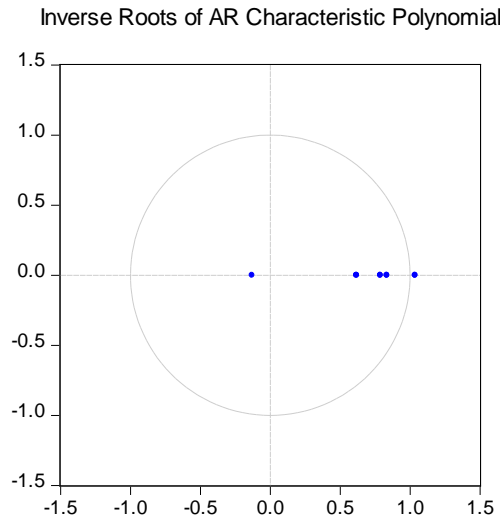
Table 3. Lag Stability Test Results

Research Lag Length	Akaike AIC value
Lag 1	5.924967
Lag 2	5.998232

Source: Eviews 10, data processed 2024

Based on the results of lag 1 and lag 2 above, it shows that at lag 1 the AIC value is 5.924967, smaller than the lag 2 AIC value of 5.998232. so it can be concluded that lag 1 VAR users are more optimal than lag 2. So this study uses lag 1 to analyze it.

e.   Structure Lag Stability Test Results

This structural lag stability test or var system stability needs to be done to see the stability condition of the system used. If the VAR system is stable, the resulting FEVD test results will be considered valid. The following are the processed results of the VAR system stability test data:

Inverse Roots of AR Characteristic Polynomial

Source: Eviews 10, data processed 2024
Figure 4. Structure Lag Stability Test Results

f.   Vector Autoregressive (VAR) Analysis

After all assumption tests have been fulfilled, including the stationarity test, cointegration test, causality test, optimal lag level determination test, and structural lag stability test, the next step is to analyze the VAR model. This analysis is carried out to determine whether or not there is significance between exogenous variables and endogenous variables.

Table 5. Summarized Results of VAR Analysis

Variable	Largest Contribution 1	Largest Contribution 2
INF	JUBt-1 1.44E-06	SBt-1 0.875012
JUB	JUBt-1 1.003883	TEMYt-1 0.000284
LNEMY	TEMYt-1 2.61E-09	LNEMYt-1 0.461308
SB	SBt-1 0.906143	Inflasit-1 0.011347
TEMY	JUBt-1 15.07793	TEMYt-1 -3762406

Source: Eviews 10, data processed 2024

The conclusion of the VAR analysis contribution as in Table 12 above shows the first and second largest contributions to a variable, which are then analyzed as follows:

1) VAR Analysis of Inflation

   The biggest contribution to Inflation is JUB, if the inflation value is too high in a country then JUB will also increase.

2) VAR analysis of JUB

   The biggest contribution to the JUB is the JUB itself, if the JUB value is high it will result in decreased purchasing power, which will make electronic money transactions decline.

3) VAR analysis of LNEMY

   The biggest contribution to LNEMY is TEMY, if the TEMY value is high, there will be less cash (coins and paper) in circulation. Because electronic money is a cash alternative that is more efficient and safer.

4) VAR Analysis of Interest Rates

   The biggest contribution to interest rates is the interest rate itself, if the value of interest rates increases, the public's interest in consumption will decrease and attract more people to save their funds in banks.

5) VAR Analysis of TEMY

   The biggest contribution to TEMY is JUB, if the value of JUB is high it will increase the price of goods and services.

g. **Impulse Response Function (IRF) Test Results**

   The results of the impulse response function test for each variable are described in the following graph.
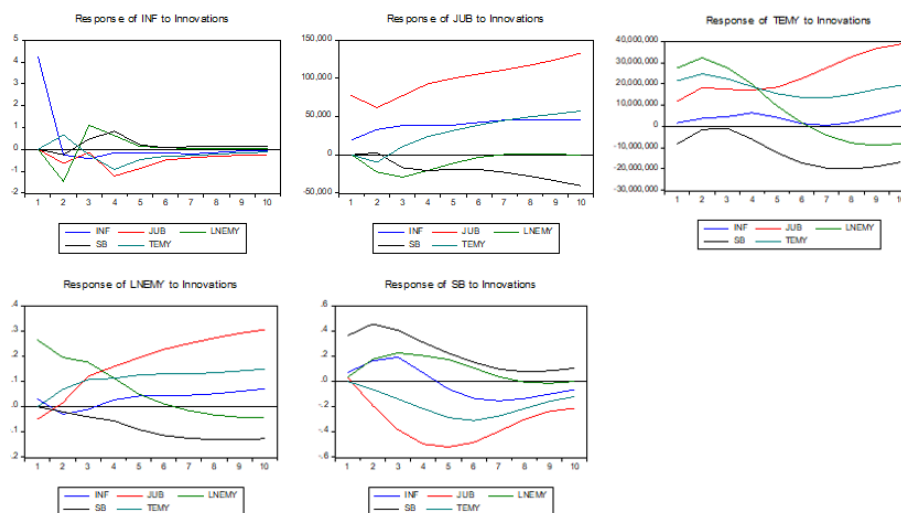
Source: Eviews 10, data processed 2024

Figure 5. IRF Test Results

In the short term, the INF variable (4.239589) is responded positively by JUB, SB, EMY, and TEMY by (0.000000). In the medium term where the standard deviation of INF is (-0.147739), it is responded negatively by JUB (-0.872563), and TEMY (-0.464035), then responded positively by SB by (0.016483) and EMY by (0.129751). And in the long run, the standard deviation of INF (-0.042749) is negatively responded to by JUB (-0.266935), and TEMY (-0.122281) then positively responded by SB (0.151004), and EMY (0.033042).

Then in the short term, the JUB variable (77601.12) is responded positively by SB, EMY, TEMY by (0.000000) and INF by (19471.85). In the medium term where the standard deviation of JUB is (100206.1), it is negatively responded by SB (-18605.80), and EMY (-10898.57), then positively responded by INF by (38951.74) and TEMY by (31847.41). And in the long run, the standard deviation of JUB (133138.4) is negatively responded to by SB (-40464.23), EMY (-973.5227) then positively responded by INF (45114.64), and TEMY (57384.58).

The variable SB (0.363608), in the short term, is responded positively by JUB (0.029050), INF (0.070379), EMY (0.033196), and TEMY (0.000000). In the medium term where the standard deviation of SB is (0.222974), it is negatively responded by INF (-0.060347), JUB (-0.5185588), and TEMY (-0.285025), then positively responded only by EMY by (0.222974). In the long run, the standard deviation of SB (0.104357) is negatively responded by JUB (-0.211983), INF (-0.064600), EMY (-0.000747) and TEMY (-0.119108).

EMY variable (0.263667), in the short term, is responded positively by INF (0.029808), SB, and TEMY by (0.000000). In the medium term where the standard deviation of EMY is (0.050865), it is negatively responded to by SB (-0.090022), then positively responded by INF (0.041859), JUB (0.193756), and TEMY (0.125654). And in the long run, the standard deviation of EMY of (-0.042613) is negatively responded to by SB of (-0.042613), then positively responded by INF (0.071140), JUB (0.305244) and TEMY (0.149075).

Variable TEMY (21492583), in the short term responded positively by INF (1725816), JUB (11989401), and EMY (27590955) then responded negatively by SB (-8119787). In the medium term where the standard deviation of TEMY is (15526883), it is responded negatively by SB (-12316676), then responded positively by INF (4245562), JUB (18437393), and EMY (9704111). And in the long run, the standard

deviation of TEMY is (19408967) negatively responded by EMY (-8072014), and SB (-16756383) then positively responded by INF (7488923), and JUB (38762754).

h. Forecast Variance Decomposition (FEVD) Test Results

Variance Decomposition aims to determine the presentation of the contribution of each variable to a variable both in the short, medium, and long term. So that it can be used as a recommendation for taking for that variable. By using the Variance Decomposition method in Eviews, the following results are obtained:

Table 6. Policy Recommendations for Inflation

Period	Inflation itself	Largest 1	Largest 2
Short Term (Period 1)	100.0%	Inflation 100.0%	-
Medium Term (Period 5)	96.55%	Inflation 96.55%	Interest Rate 2.20%
Long Term (Period 10)	94.17%	Inflation 94.17%	Interest Rate 2.78%

Source: Eviews 10, data processed 2024

Based on the research results shown in Table 6, the results of Inflation in the short term (period 1) estimated error variance of 100.0% explained by Inflation itself. While the variables JUB, LNEMY, SB, and TEMY do not affect the Inflation variable in the short term.

In the medium term (period 5) the estimated error variance of 96.55% is explained by Inflation itself. Other variables that most influence the policy variable other than Inflation itself are Interest Rate by 2.20%, then TEMY by 0.68%, JUB by 0.35% while the smallest one that affects Inflation is LNEMY by 0.19%.

In the long run (period 10) the estimated error variance of 94.17% is explained by Inflation itself. Other variables that most influence the Inflation variable itself are Interest Rate by 2.78%, then TEMY by 1.59%, JUB by 1.09% while the smallest influence on Inflation is LNEMY by 0.35%.

Table 7. Policy Recommendations for Money Supply

Period	JUB itself	Largest 1	Largest 2
Short Term (Period 1)	96.30%	JUB 96.30%	Inflation 3.69%
Medium Term (Period 5)	85.24%	JUB 85.24%	Inflation 9.15%
Long Term (Period 10)	79.13%	JUB 79.13%	Inflation 7.56%

Source: Eviews 10, data processed 2024

Based on the research results shown in Table 7, the results of JUB in the short term (period 1) estimated an error variance of 96.30% which is explained by JUB itself.

While Inflation, LNEMY, SB, and TEMY variables do not affect the Inflation variable in the short term.

In the medium term (period 5) the estimated error variance of 85.24% is explained by JUB itself. Other variables that influence the policy variable the most besides JUB itself are Inflation by 9.15%, then TEMY by 4.24%, and Interest Rate by 1.29% while the smallest one that affects JUB is LNEMY by 0.05%.

In the long run (period 10) the estimated error variance of 79.13% is explained by JUB itself. Other variables that most influence the JUB variable itself are TEMY by 10.45%, then Inflation by 7.56%, and Interest Rate by 2.73% while the smallest influence on Inflation is LNEMY by 0.11%.

Table 8. Policy Recommendations for E-Money

Period	LNEMY itu sendiri	Largest 1	Largest 2
Short Term (Period 1)	95.88%	LNEMY 95.88%	JUB 2.70%
Medium Term (Period 5)	58.82%	LNEMY 58.82%	TEMY 2.44%
Long Term (Period 10)	29.44%	LNEMY 29.44%	TEMY 32.30%

Source: Eviews 10, data processed 2024

Based on the research results shown in Table 8, the results of LNEMY in the short term (period 1), the estimated error variance is 95.88%, which is explained by LNEMY itself. While Inflation, JUB, Interest Rate, and TEMY variables do not affect in the short term.

In the medium term (period 5), the estimated error variance of 58.82% is explained by LNEMY itself. Other variables that most influence the policy variable other than LNEMY itself are TEMY by 24.11%, then JUB by 13.13%, and Interest Rate by 2.74% while the smallest influence on LNEMY is Inflation by 1.17%.

In the long term (period 10) the estimated error variance of 29.44% is explained by LNEMY itself. Other variables that most influence the LNEMY variable itself are TEMY at 32.30%, then JUB at 31.97%, and Interest Rate at 4.90% while the smallest influence is Inflation by 1.36%.

Table 9. Policy Recommendations for Interest Rate

Period	SB itu sendiri	Largest 1	Largest 2
Short Term (Period 1)	95.49%	SB 95.49%	Inflation 2.00%
Medium Term (Period 5)	53.21%	SB 53.21%	TEMY 17.71%
Long Term (Period 10)	41.79%	SB 41.79%	JUB 25.66%

Source: Eviews 10, data processed 2024

Based on the research results shown in Table 9, the results of the Interest Rate in the short term (period 1), the estimated error variance of 95.49%, which is explained by the Interest Rate itself. While Inflation, JUB, LNEMY, and TEMY variables do not affect in the short term.

In the medium term (period 5), the estimated error variance of 53.21% is explained by the Interest Rate itself. Other variables that most influence the policy variables other than the Interest Rate itself are TEMY by 17.71%, then JUB by 16.85% and LNEMY by 10.01% while the smallest influence on LNEMY is Inflation by 2.19%.

In the long term (period 10) the estimated error variance of 41.79% is explained by the Interest Rate itself. Other variables that most influence the Interest Rate variable itself are JUB by 25.66%, then TEMY by 20.79% and Interest Rate by 9.85% while the smallest influence is Inflation by 1.89%.

Table 10. Policy Recommendations for E-money Transaction

Period	TEMY itu sendiri	Largest 1	Largest 2
Short Term (Period 1)	52.90%	TEMY 52.90%	LNEMT 44.93%
Medium Term (Period 5)	51.64%	TEMY 51.64%	LNEMY 43.74%
Long Term (Period 10)	50.58%	TEMY 50.58%	LNEMY 32.71%

Source: Eviews 10, data processed 2024

Based on the research results shown in Table 10, the TEMY results in the short term (period 1), the estimated error variance is 52.90%, which is explained by TEMY itself. While Inflation, JUB, LNEMY, and Interest Rate variables do not affect in the short term.

In the medium term (period 5), the estimated error variance of 51.68% is explained by TEMY itself. Other variables that most influence the policy variable other than TEMY itself are LNEMY by 43.74%, then JUB by 3.86%, and Interest Rate by 0.70% while the smallest influence on TEMY is Inflation by 0.03%.

In the long run (period 10) the estimated error variance of 50.58% is explained by TEMY itself. Other variables that most influence the TEMY variable itself are LNEMY by 32.71%, then JUB by 14.34% and Interest Rate by 2.12% while the smallest influence is Inflation by 0.22%.

Based on the results of the Forecast Error Variance Decomposition (FEVD) analysis, it is known that several interactions occur. The interaction between policy variables shows that variance Decomposition describes policy variables that are more

effective. For more details, the following are the results of the interaction of electronic money in Indonesia.

Table 11. Effectiveness of Electronic Money Vitality Policy

Variable	Electronic Money Transmission		
	Short Term	Medium Term	Long Term
INF	INF (100.0%) -	INF (96.55%) SB (2.20%)	INF (94.17%) SB (2.78%)
JUB	JUB (96.30%) INF (3.69%)	JUB (82.24%) INF (9.15%)	JUB (79.13%) INF (7.56%)
LNEMY	LNEMY (95.88%) JUB (2.70%)	LNEMY (58.82%) TEMY (2.24%)	LNEMY (29.44%) TEMY (32.30%)
SB	SB (95.49%) INF (2.00%)	SB (53.21%) TEMY (17.71%)	SB (41.79%) JUB (25.66%)
TEMY	TEMY (52.90%) LNEMY (44.93%)	TEMY (51.64%) LNEMY (43.74%)	TEMY (50.58%) LNEMY (32.71%)

Source: Data processed, 2024

a. Effectiveness Through Inflation Variables

The FEVD test results show that in the short term Inflation control is done by Inflation itself. In the medium and long term, inflation control policy is influenced by interest rates. If the prices of goods and services tend to increase or called inflation, it will cause a decrease in people's welfare. Due to inflation, the prices of goods and services will rise, while people's income does not change. This can reduce people's welfare.

b. Effectiveness through the JUB Variable

The FEVD test results show that for the short, medium, and long term, JUB is controlled by Inflation. The result of this study shows that JUB affects Inflation. (Eliya, et al., 2017) which states that the JUB variable has no significant effect on inflation.

c. Effectiveness Through LNEMY Variables

The FEVD test results show that in the short term, LNEMY is controlled by the JUB variable. However, in the medium and long term, LNEMY is controlled by Inflation. In the short term, it can be said that with the increase in JUB, the government

can utilize the increase in JUB for the smooth running of economic activities. Economic activities such as production, distribution, and consumption in the country. The results of this study are not supported by research belonging to (Nur & Abrista, 2023) which shows that the electronic money variable in the short term does not significantly affect JUB.

d. Effectiveness through Interest Rate Variables

The FEVD test results show that for the short term, interest rate control is carried out by the Inflation variable, in the medium term by the TEMY variable, and for the long term by the JUB variable. The results of this study are in line with (Diana, 2022) research which states that interest rates have a positive and significant effect on inflation in Indonesia.

In controlling the interest rate for the long term is done by the JUB variable, this is not in line with research (Parulian & Utami, 2024) which states that the interest rate variable has a significant negative effect on JUB.

e. Effectiveness Through TEMY Variables

The FEVD test results show that for the short, medium and long term TEMY control is carried out by LNEMY. The results of this study indicate that TEMY has an effect on LNEMY. When LNEMY increases, this can make it easier for people to use as a means of payment to merchants through transactions using e-money.

4. CONCLUSION

Based on the results of the analysis and discussion that has been carried out, it can be concluded that based on the results of the Variance Decomposition Analysis, there are variables that have the greatest contribution to the variable itself both in the short, medium, and long term. The Variance Decomposition results of each variable are as follows:

a. In the Inflation variable, it is known that in the short term, the increase in Inflation is only done by Inflation itself, then in the medium and long term, in addition to Inflation itself, it is also influenced by the Interest Rate. This means that to increase Inflation, the government must increase the Interest Rate.

b. In the JUB variable, it is known that in the short, medium, and long term, Inflation increases JUB. This means that to increase JUB, the government must reduce Inflation.

c. On the LNEMY variable, it is known that for the short-term increase, LNENMY is done by JUB. For the medium and long term, LNEMY is done by TEMY. This means that to increase LNMEY, the government must increase JUB and TEMY.

d. In the Interest Rate variable, it is known that for the short term, the increase in interest rates is driven by inflation, the medium-term increase in interest rates is done by TEMY, and the long-term increase in interest rates is done by JUB. This means that to increase the interest rate the government must increase Inflation, TEMY, and JUB.

e. In the TEMY variable, it is known that for the short, medium and long term the increase in TEMY is done by LNEMY. It means that to increase TEMY.

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