JOURNAL OF DEVELOPING ECONOMIES
https://e-journal.unair.ac.id/JDE/index

ANALYSIS OF THE INFLUENCE OF THE VALUE OF NON-CASH PAYMENT TRANSACTIONS ON THE AMOUNT OF MONEY SUPPLY IN INDONESIA

Mazraaten Thoyyibah*[1]

Wasiaturrahma[2]

[1,2] Department of Economics, Faculty of Economics and Business, Airlangga University, Surabaya, Indonesia

ABSTRACT

This literature explains the influence of credit card, debit card, and e-money transaction values on Indonesia's M1 and M2 money supplies. Time series data from January 2010 to August 2023 are used taken from the official websites of Bank Indonesia and the Central Statistics Agency. The Vector Error Correction Model (VECM) is the analysis method employed. According to the study's findings, the M1 and M2 money supply is significantly impacted by the value of debit card transactions in both the short and long term. While it has a large short-term impact on M1 and M2, the credit card transaction value variable has a negligible long-term impact on M2. In addition, the value of e-money transactions demonstrates that they have a large impact on M1 both in the short and long terms. On the other hand, it has a significant impact on M2 in the short term but not on M2 in the long run.

Keywords: *Money Supply, Non-Cash Payments, VECM*

JEL: E51; O330

ARTICLE INFO

Received: February 21st, 2024
Revised: May 15th, 2024
Accepted: May 27th, 2024
Online: November 20th, 2024

*Correspondence:
Mazraaten Thoyyibah

E-mail:

mazraaten.thoyyibah-2022@feb.unair.ac.id

To cite this document: Thoyyibah, M., & Wasiaturrahma. (2024). Analysis of The Influence of The Value of Non-Cash Payment Transactions on The Amount of Money Supply in Indonesia. *Journal of Developing Economies*, *9*(2), 358-375. https://doi.org/10.20473/jde.v9i2.55320

Introduction

Bank Indonesia and commercial banks are the monetary authorities with the power to print and distribute money (Khamidah, 2022). Commercial banks are the ones who issue demand deposits, whereas Bank Indonesia is required to create currency (coins and paper money) that is in the hands of the general public. In the digital age, technological advancements have significantly impacted payment networks and the financial industry. The shift in transactions to non-cash has occurred, which may have an impact on the instruments and payment processes used in economic transactions (Lintangsari et al., 2018). This innovation allows for the determination of quantity targets as a kind of financial control. The public is accustomed to using debit/ATM cards, credit cards, e-money, SKNBI, BI RTGS, e-wallets, and other non-cash payment methods. In addition, the adoption of non-cash instruments expedites and enhances the efficacy of payments, hence impacting the circulation of money (Lu & Su, 2017). Another advantage is a decrease in crimes like robbery and theft. Furthermore, those

Journal of Developing Economies p-ISSN: 2541-1012; e-ISSN: 2528-2018
DOI: 10.20473/jde.v9i2.55320

who may use broader public facilities, as well as retail centers, have made non-cash purchases a habit (Tazkiyyaturrohmah, 2018).

Istanto & Fauzie (2014) state that there are three different kinds of quantities in Indonesia: base money (M0), narrow money (M1), and broad money (M2). Bonds with M2 added to them constitute M3, a more expansive concept of money (Maesaroh & Triani, 2012). Nevertheless, Widyanita (2018) claims that only M1 and M2 are frequently utilized. Therefore, a key component of maintaining financial and monetary economic stability is the infrastructure of the financial system. Due to inflation and technical advancements, Indonesia's M1 and M2 numbers rise annually, which raises the country's total need for money (Fatmawati & Yuliana, 2019). Bank Indonesia launched the National Cashless Movement (GNNT) program in 2014 to enable safe, simple, and efficient payments. It is anticipated that the GNNT program will lessen barriers to non-cash payments, including instances of ripped or counterfeit money as well as outdated money that shouldn't be in circulation (Ramadhani & Nugroho, 2021). The purpose of this program is to make use of cutting-edge payment and banking system technology that has been put into place in other nations.

Debit cards experienced a significant increase in 2022 reaching 256.05 million units, while credit cards amounted to 17.20 units in the same year. Credit cards are not used as much as debit cards. The development of the amount of e-money in circulation is increasing and it has become a payment that is very popular with the public so that the figure of 90.00 million units in 2017 shot up to 772.56 million in 2022. The following is a graph of the development of non-cash payments.

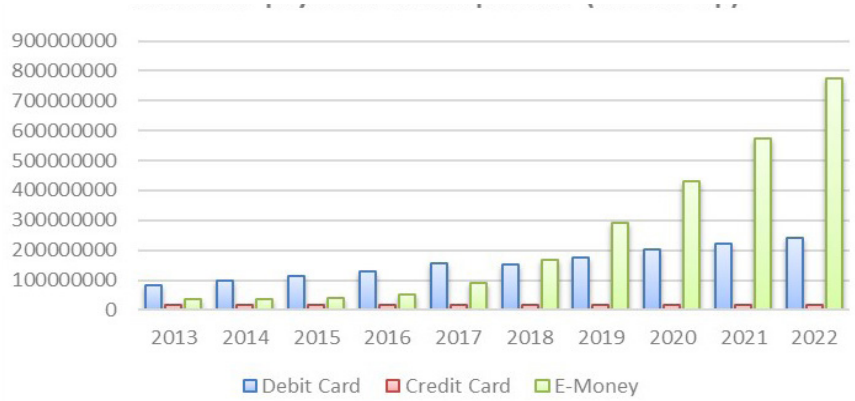

Figure 1: Non-cash payment developments (Million Rp)

Ferlicia et al. (2022) examined the effects of GDP, money supply (M0), money turnover, and non-cash transactions (APMK and electronic money). The results of the study show that there is a correlation between the amount of money in circulation and non-cash payments, with the correlation being positive throughout the COVID-19 pandemic and negative during other periods,

This contrasts with a study conducted by Putri (2016), who discovered that credit cards affected the quantity of money in Indonesia's economy before and after COVID-19. Other research concerns the impact of non-cash payment mechanisms on the Indonesian economy and demand for money.

The findings indicate that the Indonesian economy and the need for cash are positively impacted by non-cash payments, in this instance debit cards, credit cards, electronic money, clearing, and RTGS (Nursari et al., 2019). Furthermore, in M1 and M2 money circulation, Istanto & Fauzie (2014) investigated the transaction volume and value of non-cash payment

instruments (credit cards, debit cards, e-money, SKNBI, BI RTGS, and e-wallet). The study's findings indicate that the only factor negatively affecting the M1 and M2 money supply is the SKNBI transaction value.

Qi (2023) investigated how China's money supply was affected by e-money. The study's findings demonstrate that e-money benefits traditional money. Specifically, e-money raises commercial bank reserves and decreases the amount of currency in circulation. Commercial banks will face exponentially greater risks as e-money and the percentage of non-cash transactions expand, owing to the limited impact of e-money substitutes over cash. The same study was also carried out in Nigeria and found that the state's money supply benefits from digital financing (Obinne et al., 2018). E-money hasn't had a major influence on India's money circulation to date, which runs counter to the findings of studies done there (Ranjan & Kar, 2014).

Based on previous research findings, results in various countries vary. This is caused by differences in the variables used, research periods, research methodologies, or even the policies of each country. Previous research also examined more about non-cash payments on M1 or M2, whereas the novelty in this research is that M1 and M2 are studied simultaneously to see the effect of non-cash payments in the short and long term with VECM and this research tries to cover this research gap. So researchers are curious about the actual nominal value of each non-cash payment instrument used in transactions at each point in time. In addition, Bank Indonesia has been promoting a non-cash society since 2014, which makes this research important for further research. These problems are becoming more serious, as a result of globalization and digitalization.

Literature Review

Irving Fisher put forward a theory about quantity theory, which is part of classical theory. The primary focus of this theory, which also looks at how the two interact, is the relationship between the money supply and demand. Fisher seeks to determine the relationship between the entire money supply (M), and the total amount spent on the final products and services produced in the economy, or P X Y, where P denotes the level of prices and Y is the total output (income) (Mishkin & Eakins, 2012).

According to Mishkin & Eakins (2012), Keynes proposed the liquidity preference hypothesis, which examines three reasons why people want money: transactional, precautionary, and speculative, Keynes and other economists recognized that new payment systems might have an impact on the demand for money in addition to transaction reasons. Credit cards, for instance, enable users to make even modest purchases without carrying cash. Additionally, the ability of investors to make electronic payments from their brokerage accounts may reduce demand for money.

According to Swandi & Barusman (2022), the payment system encompasses various modes of money transfer, ranging from basic instruments to intricate systems including numerous organizations and regulated processes. A simplified banking system with two parts is explained by the early history of money production. The Central Bank sets monetary policy, which includes the minimum reserve ratio and the amount of base money. Additionally, the general public can use savings and lending services provided by commercial banks (Xiong & Wang, 2022)sparking concerns that their simultaneous imposition may have unexpected effects on bank lending and its response to monetary shocks. This paper reformulates the bank lending channel (BLC).

Ritonga in Heryadi et al. (2020) asserts that the money supply from the Central Bank and the public's demand for money determine how much money is in circulation in an economy at any given time. Rahmawati (2022), however, claims that there are three primary players in the money-generating mechanism. They are the public or domestic private sector, commercial banks, and the monetary authority. To satisfy the public's demand for money and the monetary authority's requirement for an adequate amount of money in circulation, these three principal players interact. The non-cash payment instruments that financial institutions issue fall into two categories; cards (APMK) and electronic money (e-money) are used with this instrument. Credit cards, ATM cards, and debit cards are the various forms that APMK takes. In contrast, electronic money is card- and application-based (server-based) (Khairi & Gunawan, 2019).

Debit/ATM cards are a type of payment that utilizes a bank-issued card that is directly linked to the balance of a savings account. Consequently, the balance will be automatically deducted if a debit card is used for the purchase. Debit cards can also be used to pay for credit cards, utilities, phones, water, and taxes; they can be used to send money (transfers) between accounts at the same bank or different banks; they can be used to purchase prepaid credit; they can be used for phone banking; and they can be used to make purchases of goods (Khairi & Gunawan, 2019). Debit cards are a type of digital banking tool that is utilized anywhere that consumers choose to pay for their goods (Pandey & Nirala, 2016). If the acquirer or card issuer has satisfied the cardholder's payment responsibilities in advance and the user is required to make on-time payments, credit cards are a component of the APMK that can be used to pay for purchases and/or cash payments with users agreeing to reimburse the loan in full or in installments (Solikin & Suseno, 2002). Users are given credit cards, which are tiny plastic cards with price machines on them. Owners are thus able to purchase products and services mostly by their financial constraints (Surekha et al., 2022).

The payment innovation known as electronic money, or e-money, has moved from being card-based to server-based; e-money is stored on a device held by the user, in this case, an internet network that supports prepaid card access (sometimes referred to as digital money) (Pérez, 2017). Article 1, Paragraph 3, Number 20/6/PBI/2018 contains provisions about electronic money. Under these regulations, electronic money must be issued by the value of funds placed ahead of time with the issuer, have monetary value recorded electronically on a media server or chip, and not be a deposit as that term is defined by banking law (Putri & Prasetyo, 2020).

Based on the background, theoretical basis, previous research, and other empirical studies, the hypotheses of this research are:

H1: the value of debit card transactions, credit card transactions, e-money transactions has a significant effect on the money supply M1 in Indonesia in the long and short term.

H2: the value of debit card transactions, credit card transactions, e-money transactions has a significant effect on the money supply M2 in Indonesia in the long and short term.

Data and Research Methods

Monthly time series data covering the research period from January 2010 to August 2023 are used, because during this period the transformation of non-cash use was seen very rapidly over 13 years. Data are available until August 2023, so the research period used is not until the end of the year. Data sources from the official website of Bank Indonesia and the Central Statistics Agency (BPS) provide secondary data for this investigation.

The empirical model used is VECM because this estimation is used to see short-term and long-term relationships in time series data. The EViews 12 software was used to process this data analysis method. The model specifications in the long term can be formed as follows.

$$\ln M1 = \beta_0 + \beta_1 M1_{t-1} + \beta_2 LnNTKD_{t-1} + \beta_3 LnNTKK_{t-1} + \beta_4 LnNTEM_{t-1} \quad (1)$$

$$\ln M2 = \beta_0 + \beta_1 M2_{t-1} + \beta_2 LnNTKD_{t-1} + \beta_3 LnNTKK_{t-1} + \beta_4 LnNTEM_{t-1} \quad (2)$$

The equation model below is formed according to the results of VECM estimation in the short term using lag 2 and is characterized by the presence of ECT at the end of the equation as a form of adjustment from the short term to the long term. The short-term model specification is formed as follows.

$$\begin{aligned}\Delta \ln M1_t = {} & \beta_0 + \textstyle\sum_{i=1}^{p} \beta_1 \Delta LnM1_{t-1} + \sum_{i=1}^{p} \beta_2 \Delta LnM1_{t-2} + \sum_{i=1}^{p} \beta_3 \Delta LnNTKD_{t-1} \\ & + \textstyle\sum_{i=1}^{p} \beta_4 \Delta LnNTKD_{t-2} + \sum_{i=1}^{p} \beta_5 \Delta LnNTKK_{t-1} + \sum_{i=1}^{p} \beta_6 \Delta LnNTKK_{t-2} \\ & + \textstyle\sum_{i=1}^{p} \beta_7 \Delta LnNTEM_{t-1} + \sum_{i=1}^{p} \beta_8 \Delta LnNTEM_{t-2} + ECT_{t-1}\end{aligned} \quad (3)$$

$$\begin{aligned}\Delta \ln M2_t = {} & \beta_0 + \textstyle\sum_{i=1}^{p} \beta_1 \Delta LnM2_{t-1} + \sum_{i=1}^{p} \beta_2 \Delta LnM2_{t-2} + \sum_{i=1}^{p} \beta_3 \Delta LnNTKD_{t-1} \\ & + \textstyle\sum_{i=1}^{p} \beta_4 \Delta LnNTKD_{t-2} + \sum_{i=1}^{p} \beta_5 \Delta LnNTKK_{t-1} + \sum_{i=1}^{p} \beta_6 \Delta LnNTKK_{t-2} \\ & + \textstyle\sum_{i=1}^{p} \beta_7 \Delta LnNTEM_{t-1} + \sum_{i=1}^{p} \beta_8 \Delta LnNTEM_{t-2} + ECT_{t-1}\end{aligned} \quad (4)$$

Where:

LnM1 = Natural logarithm of narrow money (percent)

LnM2 = Natural logarithm of broad money (percent)

LnNTKD = Natural logarithm of debit card transaction value (percent)

LnNTKK = Natural logarithm of credit card transaction value (percent)

LnNTEM = Natural logarithm of e-money transaction value (percent)

ECT = *Error Correction Term*

The steps for the VECM estimate are as follows:

Stationary Test

In the extreme, stationary data are data that do not experience increases or decreases (are constant) throughout the observation time. The stationarity problem can also be tested using the Augmented Dickey-Fuller (ADF) method. Stationary tests are carried out at level and differencing levels, If the ADF value is smaller than the critical value test value at the α = 5% level, it can be concluded that the data are stationary (Kipchirchir et al., 2023). The following is a stationarity test with a unit roots test which can be written in the following equation:

$$\Delta y_t = \beta_1 + \beta_{2t} + \delta y_{t-1} + \alpha_1 \Delta y_{t-1} + \alpha_2 \Delta y_{t-2} + \ldots + \alpha_m \Delta y_{t-m} + \varepsilon \quad (5)$$

Optimal Lag Test

Determining the lag length is used to determine the time required for the dependent variable to respond to changes in other variables. Determination of the lag used is the AIC (Akaike Information Criterion), LR (Likelihood Ratio), FPE (Final Prediction Error), and SC (Schwarz Information Criterion) approaches. The lag length can be found by calculating the AIC approach:

$$AIC(q) = \log \frac{e'e}{T} + \frac{2q}{T} \quad (6)$$

If the maximum magnitude of Q is known, and q ≤ Q, then a lag can be selected that minimizes AIC or SC.

Cointegration Test

The cointegration test can be used to find out whether two or more economic variables have a long-term equilibrium relationship. To see whether the variables are cointegrated, it can be seen whether the data are stationary or not. One approach to cointegration testing is Johansen's Multivariate Cointegration Test method (Widarjono, 2007). The following is the equation in Johansen's method:

$$\Delta yt = A_1 y_{t-1} + A_p y_{t-p} + B\pi_t + \varepsilon_t \ldots\ldots\ldots\ldots\ldots\ldots \quad (7)$$

The Johansen method is used to determine whether the data are cointegrated or not by comparing the Max-Eigen value and trace value with critical values of 1% and 5%, so it is clear that the data are cointegrated and have a long-term relationship (Mashabi & Wasiaturrahma, 2021).

Vector Error Correction Model **(VECM)**

The VECM model is used if the variables are stationary at the difference stage and are cointegrated so that they can be seen in the long-term equation. In this study, the VECM estimation has two forms of relationship, namely long-term and short-term relationships. In general, the VECM model equation is as follows.

$$\Delta Y_t = \alpha_0 + \alpha_1 X_t + \alpha_2 + \mu_{t-1} + \varepsilon_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (8)$$

The information ε_t is the error term and μ_{t-1} is the lag error term value from the equation above.

Impulse Response Function **(IRF)**

IRF explains how to calculate the effect of a shock from one variable on other variables to determine which variables respond most strongly to the shock or shocks and for how long the influence of the shock will endure. The analysis was carried out using an IRF graph from the Vector Moving Average (VMA) representation (Ristianti & Purwadi, 2019). Here are the similarities;

$$Z_t = \mu + \sum_{i=0}^{\infty} \phi_t \varepsilon_{t-1} \quad (9)$$

Variance Decomposition

Variance Decomposition (VD) predicts the percentage contribution of variance for each variable resulting from changes made to particular VECM system variables, which is helpful (Ristianti & Purwadi, 2019). The following is an analysis of Variance Decomposition.

$$W_{jk,h} = \frac{\sum_{i=0}^{h-1} (e_j' \Theta_i e_k)^2}{\sum_{i=0}^{h-1} \sum_{k=1}^{K} (e_j' \Theta_i e_k)^2} \quad (10)$$

Finding and Discussion

The following is a description of the variable data used to analyze the influence of the value of debit card transactions, credit cards, and e-money on the money supply (M1 and M2) in Indonesia.

Table 1: Statistical Description of Variables

Variable	N	Mean	Std. Deviation	Minimum	Maximum
LnM1	164	13.96977	0.445253	13.10233	14.77440
LnM2	164	15.34811	0.393900	14.54136	15.95887
LnNTKD	164	19.84920	0.446320	18.75107	20.42069
LnNTKK	164	16.87756	0.252520	16.23764	17.40272
LnNTEM	164	14.27620	2.490590	10.79927	18.89362

The standard deviation value of the research variance is mostly close to 0; the lower the variability of the data the more reliable the average. That is, the data sets are not much different, and the number of observations in the study was 164.

Analysis Results

VECM analysis is used because there is cointegration or a long-term relationship between variables. When there is no cointegration relationship, the recommended analysis is VAR. Furthermore, IRF and VD analysis help to reveal the shock contribution of the variable, so estimates using VECM not only analyze the long- and short-term shocks but can also explain the shocks that occur throughout the study period.

Stationarity Test

Table 2: Stationarity Test Results at Level

Variable	ADF Value	Probability	Critical Value		Conclusion
LnM1	-1,191732	0,6775	1%	-3.471987	**Not stationary**
			5%	-2.879727	
			10%	-2.576546	
LnM2	-2.450323	0.1298	1%	-3.471192	**Not stationary**
			5%	-2.879380	
			10%	-2.576361	
LnNTKD	-3.761875	0.0041	1%	-3.471719	**Stationary**
			5%	-2.879610	
			10%	-2.576484	
LnNTKK	-1.464549	0.5491	1%	-3.471192	**Not stationary**
			5%	-2.879380	
			10%	-2.576361	
LnNTEM	0.417858	0.9832	1%	-3.470679	**Not stationary**
			5%	-2.879155	
			10%	-2.576241	

Table 2 shows the results of the stationarity test at all levels and that only the LnNTKD variable (the debit card transaction value) is stationary at the α=5% level. Meanwhile, the other variables do not pass as stationary because the statistical ADF value is smaller than the critical value, and apart from that, the probability value also shows greater than 0.05. So only one variable passes as stationary at the level; therefore, it is necessary to transform the data at the first difference level.

Table 3 shows that at the first differential level, all variables pass as stationary with probability values for the variables M1, M2, NTKK, and NTEM of 0.000 < 0.05. Apart from that, the ADF value also shows a greater value when compared to the critical value.

Table 3: Stationarity Test Results at the First Difference

Variable	ADF Value	Probability	Critical Value		Conclusion
LnM1	-9.554988	0.0000	1%	-3.471987	**Stationary**
			5%	-2.879727	
			10%	-2.576546	
LnM2	-7.708283	0.0000	1%	-3.471987	**Stationary**
			5%	-2.879727	
			10%	-2.576546	
LnNTKK	-12.78679	0.0000	1%	-3.471192	**Stationary**
			5%	-2.879380	
			10%	-2.576361	
LnNTEM	-11.72344	0.0000	1%	-3.471192	**Stationary**
			5%	-2.879380	
			10%	-2.576361	

Optimal Lag Test

Table 4 shows the optimal lag test results for the lag with the highest number of stars (*), with the AIC value at lag 2, meaning that the period of influence between the independent and dependent variables is two months.

Table 4: Optimal Lag Test Results

Lag	LogL	LR	FPE	AIC	SC	HQ
0	1241.433	NA	1.33e-13	-15.45542	-15.35932	-15.41639
1	1305.106	122.5703	8.23e-14	-15.93883	-15.36223	-15.70469*
2	1337.070	59.53279*	7.55e-14	-16.02588*	-14.96879	-15.59663
3	1354.087	30.63085	8.37e-14	-15.92609	-14.38850	-15.30173

Cointegration Test

Table 5: Johansen Cointegration Test Results

		M1			
Hypothesized No. of CE(s)	**Trace Statistic**	**0.05 Critical Value**	**Max-Eigen Statistic**	**0.05 Critical Value**	**Prob.****
None *	289.9535	47.85613	106.4091	27.58434	0.0000
At most 1 *	183.5444	29.79707	75.86388	21.13162	0.0000
At most 2 *	107.6806	15.49471	62.78052	14.26460	0.0000
At most 3 *	44.90003	3.841465	44.90003	3.841465	0.0000
		M2			
None *	281.3286	47.85613	104.3713	27.58434	0.0000
At most 1 *	176.9573	29.79707	67.88059	21.13162	0.0000
At most 2 *	109.0767	15.49471	63.02545	14.26460	0.0000
At most 3 *	46.05126	3.841465	46.05126	3.841465	0.0000

Tables 5 show that the Trace statistic and Max Eigen values are greater than the critical value at alpha 5%. Apart from that, the probability value also shows 0.0000 < 0.05. So it can be interpreted that there is a long-term relationship between variables M1 and M2 and the independent variables so that three cointegration equations can be formed respectively.

VECM estimation

Table t values are obtained at 1.974902 at 0.05%, or according to the results of manual calculations using the degree of freedom (DF) formula. This is to facilitate the determination of significant influences, so a comparison of statistical t and t tables is required. Besides, since this variable data are in Ln, the interpretation uses percentages.

Table 6: VECM M1 Estimation Results

Variable	Coefficient	t-Statistic	Conclusion
	Long Term		
LnNTKD (-1)	-5.013854	-10.0722	**Significant**
LnNTKK (-1)	0.931535	2.658181	**Significant**
LnNTEM (-1)	-0.256317	-2.245891	**Significant**
C	0.041752		
	Short Term		
ECT	0.129919	4.56051	**Significant**
D (LnM1 (-1)	-0.886083	-10.96831	**Significant**
D (LnM1 (-2)	-0.483408	-5.86142	**Significant**
D (LnNTKD (-1)	0.432655	3.83287	**Significant**
D (LnNTKD (-2)	0.240545	3.84595	**Significant**
D (LnNTKK (-1)	-0.062433	-1.35543	**Not significant**
D (LnNTKK (-2)	-0.058954	-1.44513	**Not significant**
D (LnNTEM (-1)	0.032194	2.06979	**Significant**
D (LnNTEM (-2)	0.011160	0.75835	**Not significant**
C		-0.000185	
R-Squared		0.506909	
Adj. R-Squared		0.477324	
t table = 1.974902			

Table 6 shows that, in the long term, all independent variables have a significant influence on the amount of money circulating in M1, whereas, in the short term, the variables NTKK (lags 1 and 2) and NTEM (lag 2) show a non-significant influence. The estimate of the long-term equilibrium model can be seen at the value of the coefficient and read in reverse from the mark of the factor. Here's equation model:

$$LnM1 = -0.041752 + 5.013854\, lnNTKD_{t-1} - 0.931535\, lnNTKK_{t-1} + 0.256317\, lnNTEM_{t-1} \quad (11)$$

The estimation results of the short-term equation model are as follows.

$$\begin{aligned} LnM1 = &- 0.000185 - 0.886083 lnM1_{t-1} - 0.483408 lnM1_{t-2} + 0.432655 lnNTKD_{t-1} \\ &+ 0.432655 lnNTKD_{t-2} - 0.062433 lnNTKK_{t-1} - 0.058954\, lnNTKK_{t-2} \\ &+ 0.032194 lnNTEM_{t-1} + 0.011160 lnNTEM_{t-2} + 0.129919 ECT_{t-1} \end{aligned} \quad (12)$$

Interpretation of long-term and short-term VECM estimates on equations 1.1 and 1.2 shows that the value variables of debit card transactions and e-money have a positive impact, so it can be concluded that an increase of 1%t in NTKD and NTEM can increase the amount of money circulating in M1 by 5.01 and 0.25% in the long term. The same result in the short-term variables NTKD and NTEM also shows positive values on lags 1 and 2. Whereas NTKK in the long and short term shows negative values that can be understood when there are increases in NTKK by 1%, it can decrease the quantity of money in circulation in M1.

Table 6 shows the results of the R-squared coefficient of determination in the VECM M1 estimation wherein the independent variables in the model contribute 50.6% to the M1 money supply. This means that 49.4% is the contribution of influence from other variables outside the model, Meanwhile, the adjusted R-squared value shows an influence of 47.7%, which means 52.3% is explained by other variables not studied.

Table 7 shows that, in the long term, all variables show significant influence, whereas in the short term NTKK and NTEM have no significant impact and only NTKD has a significant impact on the amount of money circulating in M2. This is demonstrated by the statistical t values of NTKD of 3.99 and 4.21, which are larger than the t table 1.97. Here' are the estimates for the VECM M2.

Table 7: VECM M2 Estimation Results

Variable	Coefficient	t-Statistic	Conclusion
	Long Term		
LnNTKD (-1)	4.678230	9.15137	**Significant**
LnNTKK (-1)	-0.916884	-2.54752	**Significant**
LnNTEM (-1)	0.240711	2.05553	**Significant**
C	0.056632		
	Short Term		
ECT	-0.077984	-4.62918	**Significant**
D (LnM2 (-1)	-0.772522	-10.3102	**Significant**
D (LnM2 (-2)	-0.461481	-6.09131	**Significant**
D (LnNTKD (-1)	0.252028	3.99172	**Significant**
D (LnNTKD (-2)	0.151410	4.21694	**Significant**
D (LnNTKK (-1)	-0.041461	-1.47414	**Not Significant**
D (LnNTKK (-2)	-0.036530	-1.45479	**Not Significant**
D (LnNTEM (-1)	0.011987	1.31921	**Not Significant**
D (LnNTEM (-2)	0.008651	0.98229	**Not Significant**
C		-0.0000641	
R-Squared		0.566045	
Adj. R-Squared		0.540008	
t table = 1.974902			

The results of VECM M2 estimation show that all variables have a significant effect on the money supply M2 in the long term. This is because the statistical t value of all variables has a greater value when compared to the t table value of 1.974902. Short-term estimates show that NTKK and NTEM have no significant influence on the amount of money circulating in M2. Long-term equations can be seen on the value of the coefficient and read it in reverse of the result of the factor.

$$LnM2 = 0.056632 - 4.678230\ lnNTKD_{t-1} + 0.916884\ lnNTKK_{t-1} - 0.240711\ lnNTEM_{t-1} \quad (13)$$

The estimation results of the short-term equation model are as follows.

$$LnM2 = -0.0000641 - 0.772522 lnM2_{t-1} - 0.461481 lnM2_{t-2} + 0.252028 lnNTKD_{t-1} + 0.151410 lnNTKD_{t-2} - 0.041461 lnNTKK_{t-1} - 0.036530 lnNTKK_{t-2} + 0.011987 lnNTEM_{t-1} + 0.008651 lnNTEM_{t-2} - 0.077984 ECT_{t-1} \quad (14)$$

The interpretation of the long-term equation is that when the value of credit card transactions increases by 1%, the money supply M2 can increase by 0.91%, whereas when NTKD and NTEM increase it can reduce M2 by 4.67 and 0.24%. The short-term equation shows different results in that NTKD and NTEM show positive values which can be interpreted as when an increase occurs it can increase M2. The R-squared value in Table 7 shows that the VECM M2 estimation results have an influence contribution of 56.6% to M2 and 43.4% influence from other variables outside the model. Meanwhile, the Adjusted R-squared was 54.0%, while the remaining 46.0% was explained by other variables.

Impulse Response Function (IRF)

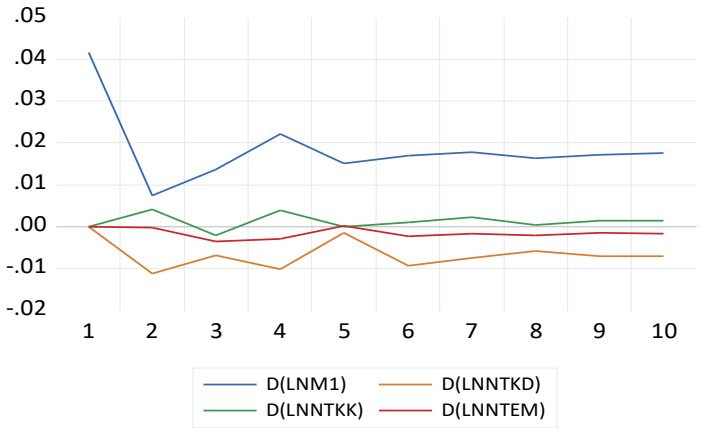

Figure 2: M1 response to LNNTKD, LNNTKK, and LNNTEM

From Figure 2 it can be explained that M1's response to the shock variable in the value of debit card transactions is that from the first period to the tenth period there is a negative trend. This is shown by the IRF line which tends to be below the horizontal line until the final period. M1's response to the credit card transaction value variable experienced a negative trend in the third and fifth periods; this was proven in that period as the IRF line was below the horizontal line. Meanwhile, in the e-money transaction value variable, M1's response to the shock of the e-money transaction value variable in the first and fifth periods experienced a positive trend and apart from these two periods had a negative trend until the tenth period.

Figure 3 shows M2's response to the variables that influence it. In the first and fifth periods, M2's response to the shock value of debit card transactions was positive. This is proven in that only the first and third periods of the IRF line are above the horizontal line while the IRF lines in the other periods are below the horizontal line. In contrast to M2's response to the shock value of credit card transactions in the third and fifth periods which gave a negative response, apart from that M2 gave a positive response in all periods except the third and fifth periods. Apart from that, the e-money transaction value variable shows that the IRF line is below the horizontal line from the second period to the last period. So M2's response to the

shock in the value of e-money transactions has a negative trend throughout the period except in the initial period.

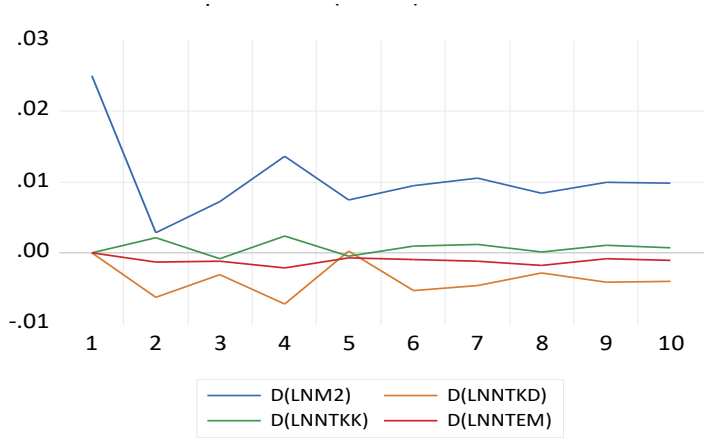

Figure 3: M2 response to LNNTKD, LNNTKK, and LNNTEM

Variance Decomposition

Table 8: Results of Variance Decomposition Analysis M1

Variance Decomposition of D (LNM1):					
Period	**S.E.**	**D(LNM1)**	**D(LNNTKD)**	**D(LNTKK)**	**D(LNNTEM)**
1	0.041612	100.0000	0.000000	0.000000	0.000000
2	0.043925	92.65274	6.437109	0.907792	0.002357
3	0.046691	90.64294	7.813765	0.986252	0.557039
4	0.052876	88.18368	9.724856	1.345309	0.746154
5	0.054997	89.01153	9.054586	1.243853	0.690028
6	0.058373	87.56163	10.53925	1.137989	0.761134
7	0.061542	87.09329	10.98354	1.155567	0.767611
8	0.063990	87.15706	10.95843	1.074276	0.810230
9	0.066665	86.95306	11.20952	1.040134	0.797279
10	0.069315	86.81767	11.38351	1.007024	0.791793

Table 8 shows the results of the Variance Decomposition of variable M1. At the beginning of the period, the variable value of debit card, credit card, and e-money transactions did not influence M1. However, in the third period, the independent variables began to influence M1, it can be seen that in period 2 the value of debit card transactions influenced 6.43%, credit cards 0.90%, and e-money only 0.002%. The variable value of debit card transactions that had the biggest influence from the second period to the tenth period reached 11.3%. Meanwhile, the credit card transaction value variable does not have a big influence, until in the tenth period its contribution is 1.00%. Apart from that, the e-money transaction value variable shows a very small influence from the second to tenth periods below 1%.

Table 9 shows that the debit card transaction value variable did not influence the initial period. However, in the second period, the debit card contributed 5.77% and the contribution value of this variable was large until the tenth period reached 11.87%. So period ten is the period that has the greatest influence among all periods. Apart from that, the credit card transaction value variable had a small influence in the second period, namely only 0.65%. The increase in influence occurs in the fourth to seventh periods. The largest contribution value from credit card transaction value was in the fourth period, reaching 1.12%. Meanwhile, the

value of e-money transactions showed a very small influence throughout the period, not yet reaching 1%. In the seventh period, the contribution value was highest when compared to all periods, namely 0.99%.

Table 9: Results of Variance Decomposition Analysis M2

Variance Decomposition of D (LNM2):					
Period	**S.E.**	**D(LNM2)**	**D(LNNTKD)**	**D(LNTKK)**	**D(LNNTEM)**
1	0.024958	100.0000	0.000000	0.000000	0.000000
2	0.026002	93.29865	5.779284	0.659393	0.262676
3	0.027191	92.29567	6.577014	0.709429	0.417887
4	0.031422	87.97176	10.12230	1.125551	0.780383
5	0.032311	88.54157	9.579317	1.087873	0.791237
6	0.034120	87.10829	11.04524	1.056991	0.789483
7	0.036054	86.56320	11.56098	1.058941	0.816875
8	0.037170	86.55453	11.45709	0.996587	0.991793
9	0.038719	86.31725	11.72000	0.999745	0.963002
10	0.040175	86.19194	11.87967	0.961582	0.966801

The Influence of Debit Card Transaction Values on the Money Supply (M1 and M2)

According to the findings of the VECM estimation, the money supply, both M1 and M2, is significantly impacted by the value of debit card transactions both in the short and long term. Debit cards are now accepted for transactions involving cash withdrawals, interbank and intrabank fund transfers, other payment purposes, and shopping transactions. Therefore, the presence of a debit card can affect the M1 and M2 money supply. Withdrawing demand deposits as part of M1 is very easy to withdraw in cash, so having a debit card has a big impact on the amount of money circulating in society. Apart from that, the savings deposit part of M2 can easily be withdrawn due to the development of ATM facilities (Istanto & Fauzie, 2014). This is according to Keynes' theory that the money supply is a very influential factor in economic activity so that payment innovation can increase the demand for money (Lapong, 2016).

This research is in line with the results of previous research (Azhar et al., 2020; Ekocha et al., 2023; Hasanah & Hasmarini, 2023; Kipchirchir et al., 2023; Ma'rifah & Faridatussalam, 2023; Wasiaturrahma et al., 2019) which show that non-cash payment instruments, one of which is debit cards, have a significant effect on the amount of money circulating in Indonesia, both M1 and M2. Research results from Pandey & Nirala (2016) state that customers prefer to use debit cards because of easy accessibility and this can create competition with other payment instruments. However, India shows that non-cash payments have not shown a significant influence on money circulation in India (Ranjan & Kar, 2014). In the end, it will return to the policies set by each country which are different, policies between countries cannot be equated because there are differences in culture and rules.

The Influence of Credit Card Transaction Values on the Money Supply (M1 and M2)

Credit cards show a significant influence on M1 and M2 in the long term, while in the short term there is no significant influence. Credit cards have great potential to drive the country's economy because they can help increase people's purchasing power in both consumptive and productive terms. The impact in the short term may not be visible because, currently, people are not very familiar with this card. Based on the theory put forward by Keynes, one of the motives for someone to hold money is just in case. This is closely related to

credit cards, which make it easy to have a balance that can be used in advance in unforeseen circumstances. Apart from that, a person's decision to use a credit card is also influenced by the level of income they have; this is related to the theory presented by Fisher, where income influences the demand for money.

Users can use it for shopping payment transactions, fund transfers, and so on. So it can affect the money supply of both M1 and M2 because of the convenience offered by credit card providers. Apart from that, in the long term it can be seen from the VECM estimation results that it has no significant effect on M2. This could be because people now have many choices for using loans. The presence of online loan applications can influence the use of credit cards because using online loans is not as complicated as using credit cards. High loan interest is also the reason why someone thinks about using a credit card.

The results of this research support previous findings (Azhar et al., 2020; Ferlicia et al., 2022; Hasanah & Hasmarini, 2023; Istanto & Fauzie, 2014) that credit card transactions do not have a significant effect on the M1 and M2 money supply in both the short term and long term. Apart from that, different findings by Hafidh & Sholeh (2016) show that the proxy variable for non-cash credit card transactions has a positive and significant effect on the demand for money. Meanwhile, Ma'rifah & Faridatussalam (2023) show that the value of credit card transactions has a positive and significant effect on the amount of money circulating in Indonesia.

The Influence of E-Money Transaction Value on the Money Supply (M1 and M2)

The value of e-money transactions has a significant effect on M1 and M2 in the long term, while in the short term it has no effect. The presence of e-money really helps people as an alternative to non-cash payments. However, in the short term, it has not had a significant effect due to the uneven distribution of financial networks and their inclusion in remote areas. In general, people who have experienced a smooth network can certainly take advantage of this instrument. In the long term, e-money has quite a lot of potential for increasing non-cash payment transactions due to constant innovation. Keynes' theory explains that new innovations in payment systems can change people's demand for money.

The innovation of e-money is now available in the form of an application that can be installed via smartphone. By using this application, users can easily make payments and other transactions such as retail payments, electricity payments, PDAM payments, etc. E-Money is a digital wallet that makes it very easy for users to top up their balance. Many people are familiar with e-money applications in the form of digital wallet applications such as DANA, LinkAja, OVO, GoPay, ShopeePay, etc. The more choices there are, the smoother transaction activities will be. Therefore, the value of e-money transactions has a significant effect on M1 in the short and long term. Meanwhile, in the long term, e-Money does not have a significant effect on M2, because by using e-money transactions they have daily limits. Apart from that, e-money is usually used in small-amount transactions in contrast to other payment instruments.

This research supports previous findings (Azhar et al., 2020; Heryadi et al., 2020; Istanto & Fauzie, 2014; Ma'rifah & Faridatussalam, 2023; Qi, 2023; Wei, 2018) that e-money transactions affect the amount of money circulating in Indonesia. During the pandemic, the use of e-money also grew very rapidly due to the government's policy of using e-money applications to disburse pre-employment funds. In addition, in China, the development of e-money for money in circulation is very important to increase the effectiveness of monetary policy.

Conclusion

In summary, the amount of money in circulation in Indonesia, both M1 and M2, is significantly impacted, both short and long term, by the value of debit card transactions. The amount of credit card transactions, on the other hand, has a long-term and short-term considerable impact on the money supply of M1, but not on M2. The value of e-money transactions demonstrates the same patterns, with M1 being significantly impacted both short and long term, whereas M2 is only significantly impacted short term. This research has been carried out by many researchers, and their finding have not been much different from the results of this study. Similar research has been carried out in Indonesia and in other countries to see the effect on the money supply, money demand, and money velocity. Several countries apply the same rules regarding payment systems as Indonesia, so the results are similar to research results in China and Nigeria, while differences in research results can be seen from research conducted in India.

Due to the quick growth of non-cash payment systems, all non-cash payment services must enhance transaction security and handle complaints quickly to prevent losses for both customers and service providers. Organizers need to take responsibility for their actions and offer people protection from online fraud. It is hoped that more research may be done on how the amount of money in circulation in Indonesia is affected by the volume of non-cash payment transactions—in this case, debit cards, credit cards, and e-money, In addition, as small traders currently use the QRIS and M-Banking variables extensively, more research is required on these.

The recommendation of this research is that the policy that has been established by Bank Indonesia regarding the goal of a cashless society under the name of the National Non-Cash Movement (GNNT) program must be implemented continuously so that the program can run well and have a positive impact on the Indonesian economy as well as an impact on the structure of non-cash payments in Indonesia. Apart from that, there is a need to increase the distribution of adequate internet networks in areas that have not been touched by the internet, with the aim being that society at large can take advantage of the digitization of non-cash payments and achieve financial inclusion.

Declaration

Conflict of Interest

There are no conflicts of interest.

Availability of Data and Materials

Data available on request.

Authors' Contribution

MT played a leading role by research conceptualization, data collection, data analysis, and writing the manuscript. W support in research conceptualization.

Funding Source

No funding was received to assist with the preparation of the manuscript

Acknowledgment

We want to thank Airlangga University for their technical support and all the contributors who helped in this study.

References

Azhar, Z., Putra, H. S., & Huljannah, M. (2020). *Implications of Using E-money and APMK on the Money Supply: The Case of Indonesia*. *152*, 209–220. https://doi.org/10.2991/aebmr.k.201126.025

Ekocha, S., Ugwuanyi, W., & Ekocha, J. O. (2023). Exploring the impact of digital financial services on broad money supply in Nigeria. *Advance Journal of Banking, Finance and Investment, 7*(3), 1–18.

Fatmawati, M. N. R., & Yuliana, I. (2019). Pengaruh Transaksi Non Tunai Terhadap Jumlah Uang Beredar Di Indonesia Tahun 2015- 2018 Dengan Inflasi Sebagai Variabel Moderasi. *Ekspansi: Jurnal Ekonomi, Keuangan, Perbankan Dan Akuntansi*, *11*(2), 269–283. https://doi.org/10.35313/ekspansi.v11i2.1608

Ferlicia, S., Suhel, S., & Andaiyani, S. (2022). Non-Cash Instruments and Money Supply in Indonesia During Pandemic Covid-19. *Signifikan: Jurnal Ilmu Ekonomi*, *11*(2), 383–398. https://doi.org/10.15408/sjie.v11i2.26491

Hafidh, A. A., & Sholeh, M. (2016). Analisis Transaksi Non-Tunai (Less-Cash Transaction) Dalam Mempengaruhi Permintaan Uang (Money Demand) Guna Mewujudkan Perekonomian Indonesia Yang Efisien. *Prosiding Seminar Nasional*, *2*, 750–764.

Hasanah, R., & Hasmarini, M. I. (2023). Analysis Effect of Cashless Payments in the Digitalization Era On Money Supply in Indonesian. *Proceeding Medan International Conference Economics and Business, 1,* 1100–1112.

Heryadi, H., Azwardi, A., & Sukanto, S. (2020). The causality among e-money, manufacturing, services and money supply: an empirical evidence of ASEAN countries. *Jurnal Perspektif Pembiayaan Dan Pembangunan Daerah*, *8*(3), 269–276. https://doi.org/10.22437/ppd.v8i3.9518

Istanto, L., & Fauzie, S. (2014). Analisis Dampak Pembayaran Non Tunai Terhadap Jumlah Uang Beredar Di Indonesia. *Jurnal Ekonomi Dan Keuangan*, *2*(10), 610–622.

Khairi, M. R., & Gunawan, E. (2019). Analisis Penggunaan Alat Pembayaran Menggunakan Kartu (Apmk) dan E-Money Terhadap Konsumsi Masyarakat di Banda Aceh. *Jurnal Ilmiah Mahasiswa Ekonomi Islam*, *1*(1), 19–36.

Khamidah, W. (2022). *Analisis Pengaruh BI Rate, Kurs, Uang Elektronik dan Transaksi Alat Pembayaran Menggunakan Kartu (APMK) terhadap Jumlah Uang Beredar di Indonesia Tahun 2016-2020* [Bachelor's thesis, Universitas Tidar].

Kipchirchir, E., Kalio, A., & Kibet, L. (2023). Effect of Financial Innovation on Money Demand in the East African Community. *Asian Journal of Economics, Business and Accounting*, *23*(9), 12–22. https://doi.org/10.9734/ajeba/2023/v23i9959

Lapong, P. R. (2016). Analisis Kausalitas Jumlah Uang Beredar dan Suku Bunga Acuan Bank Indonesia (BI Rate) di Indonesia Periode 2009.1–2015.4. *Jurnal Berkala Ilmiah Efisiensi, 16*(2). 278-287

Lintangsari, N. N., Hidayati, N., Purnamasari, Y., Carolina, H., & Ramadhan, W. F. (2018). Analisis Pengaruh Instrumen Pembayaran Non-Tunai Terhadap Stabilitas Sistem Keuangan Di Indonesia. *Jurnal Dinamika Ekonomi Pembangunan*, *1*(1), 47-62. https://

doi.org/10.14710/jdep.1.1.47-62

Lu, Y., & Su, Z. (2017). The Development Trend of Electronic Money and Its Influence on Currency Liquidity. *Advances in Economics, Business and Management Research, 42,* 152–156. https://doi.org/10.2991/isbcd-17.2017.31

Ma'rifah, S. L., & Faridatussalam, S. R. (2023). An Analysis of the Effect of Debit Card Transaction Nominals, Credit Card Nominals, E-Money Nominals on the Level of the Total Money in Circulation in 2013-2022. *Proceeding Medan International Conference Economics and Business, 1,* 1576–1583.

Maesaroh, I., & Triani, L. F. (2012). Determinant of the Amount of Money Circulating in Indonesia (Review Money Supply (M2) 2006-2011). *Proceeding of International Conference Sustainable Competitive Advantage, 2(*1).

Mashabi, M., & Wasiaturrahma, W. (2021). Electronic Based Payment Systems and Economic Growth in Indonesia. *Jurnal Ilmu Ekonomi Terapan*, *6*(1), 97-121. https://doi.org/10.20473/jiet.v6i1.26287

Mishkin F. S., & Eakins, S. G. (2012). Financial Markets and Institutions. Boston: Prentice Hall.

Nursari, A., Suparta, I. W., & Moelgini, Y. (2019). Pengaruh Pembayaran Non Tunai Terhadap Jumlah Uang yang Diminta Masyarakat. *Jurnal Ekonomi Pembangunan*, *8*(3), 169–182. https://doi.org/10.23960/jep.v8i3.46

Obinne, G., Efanga, U., & Clifford, E. (2020). Investigating the impact of digital finance on money supply in Nigeria. *Nigerian Journal of Banking and Financing,* 12(1), 47-55.

Pandey, B. B., & Nirala, C. (2016). A Study on Customer Perception Towards Usage of Debit Cards in Chhattisgarh. *Asian Journal of Management*, *7*(1), 17. https://doi.org/10.5958/2321-5763.2016.00003.2

Pérez, A. (2017). The Impact of Money Supply and Electronic Money: Empirical Evidence from Central Bank in China.*BMC Public Health*, *5*(1), 1–8.

Putri, A. I. N. (2016). Pengaruh E-Money Terhadap Jumlah Uang Beredar di Indonesia pada Sebelum dan Sesudah Covid-19.[Bachelor's thesis, Universitas Islam Indonesia].

Putri, C. A., & Prasetyo, P. E. (2020). Money Supply, Counterfeit Money, and Economic Growth Effect to E-Money Transaction. *Efficient: Indonesian Journal of Development Economics*, *3*(1), 634–649. https://doi.org/10.15294/efficient.v3i1.35951

Qi, M. (2023). The Impact of E-money on China ' s Money Supply. *SHS Web of Conferences, 170,* 01003. https://doi.org/10.1051/shsconf/202317001003

Rahmawati, A. (2022). *Fintech Development and Money Supply in Indonesia*. [Master's thesis, University of Tokyo].

Ramadhani, W., & Nugroho, Y. (2021). Pengaruh Pembayaran Non Tunai dan Tingkat Suku Bunga Kebijakan Terhadap Sistem Pembayaran di Indonesia. Journal of Business & Banking, 11(1), 129–149. https://doi.org/10.14414/jbb.v11i1.2591

Ranjan, R. P., & Kar, R. (2014). The Dynamics of Money Velocity , External Sectors and Electronic Transactions in India: Connecting dots using Empirical Approach. *Journal of Applied Economics and Business Research*, *4*(3), 189–209. http://www.aebrjournal.org/

Ristianti, D. F., & Purwadi, J. (2019). Implementasi Metode VECM (Vector Error Corection Model) dalam Menganalisis Pengaruh Kurs Mata Uang, Inflasi dan Suku Bunga terhadap Jakarta Islamic Indeks (JII). *Jurnal Ilmiah Matematika*, *6*(1), 13-21. https://doi.org/10.26555/konvergensi.v6i1.19544

Solikin, & Suseno. (2002). UANG: Pengertian, Penciptaan, dan Peranannya dalam Perekonomian. Jakarta: Pusat Pendidikan Dan Studi Kebanksentralan (PPSK) Bank Indonesia.

Surekha, M., Umesh, D., & Dhinakaran, D. D. P. (2022). a Study on Utilization and Convenient of Credit Card. *Journal of Positive School Psychology*, *6*(4), 5635–5645.

Swandi, D. R., & Barusman, A. F. (2022). Penerapan Sistem Kliring Nasional Bank Indonesia (SKNBI) Dalam Rangka Efektivitas Sistem Pembayaran. *SIBATIK JOURNAL: Jurnal Ilmiah Bidang Sosial, Ekonomi, Budaya, Teknologi, dan Pendidikan, 1*(7), 1089-1104.

Tazkiyyaturrohmah, R. (2018). Eksistensi Uang Elektronik Sebagai Alat Transaksi Keuangan Modern. *Muslim Heritage*, *3*(1), 21-39. https://doi.org/10.21154/muslimheritage.v3i1.1240

Wasiaturrahma, W., Wahyuningtyas, Y. T., & Ajija, S. R. (2019). Non Cash Payment and Demand for Real Money in Indonesia. *Journal of Economics, Business & Accountancy Ventura*, *22*(1), 1–8. https://doi.org/10.14414/jebav.v22i1.1575

Wei, M. (2018). *An Empirical Analysis of the Impact of Internet Finance on Money Supply*. *Advances in Economics, Business and Management Research, 67,* 104–108. https://doi.org/10.2991/ebmcsr-18.2018.19

Widarjono, Agus. 2007. *Ekonometrika Teori dan Aplikasi untuk Ekonomi dan Bisnis Edisi 2.* Yogyakarta: EKONISLA.

Widyanita, A. T. (2018). *Dampak Alat Transaksi Non Tunai Berbasis Kartu Terhadap Tingkat Inflasi di Indonesia Pada Tahun 2010-2016.* [Thesis, Universitas Brawijaya]

Xiong, W., & Wang, Y. (2022). A reformulation of the bank lending channel under multiple prudential regulations. *Economic Modelling*, *114*, 105916. https://doi.org/10.1016/j.econmod.2022.105916