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NON-CASH PAYMENT SYSTEM INNOVATION AND ITS IMPLICATIONS ON FINANCIAL SYSTEM STABILITY IN INDONESIA

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Abstract

This study examines the impact of non-cash payment innovations on Indonesia's financial system stability from 2009 to 2019. As technological advancements reshape payment systems, they present both opportunities and risks to financial stability. By utilizing the Structural Vector Auto Regression (SVAR) method, the study finds that the shift towards cashless payments reduces M1, indicating a decrease in the money supply. Additionally, innovations in the payment system increase the velocity of money circulation, which tends to drive inflationary pressures. However, the inflationary effect of non-cash payment transactions diminishes over time. This research highlights the dual nature of non-cash payment instruments in influencing both financial stability and inflation dynamics.

Keywords: *Financial System Stability; Non-Cash Payment Instruments; SVAR.*

JEL Classification: *E41, E52, G21*

INTRODUCTION

The payment system plays an important role in the economy concerning financial system stability goals. The definition of a payment system based on UU No.23 Tahun 1999 concerning Bank Indonesia is a system that includes a set of rules, institutions, and mechanisms used to carry out the transfer of funds to fulfill an obligation arising from economic activity. As a system, the payment system consists of several components which include policies, institutions, instruments, operational mechanisms, infrastructure, and legal instruments (Bank Indonesia, 2006). Payment instruments are instruments that have been agreed upon by the user in conducting transactions. At first, the instrument or payment system was known as the barter system, in line with its development, certain units have been recognized which have a value known as money. Until now, money has become one of the main forms of payment in society. Given the continuing advancement of technology, payment instruments keep evolving from cash-based payment systems to cashless payment instruments. In addition, there are also paperless payment instruments such as electronic fund transfers and card-based payment instruments. Non-cash payments are

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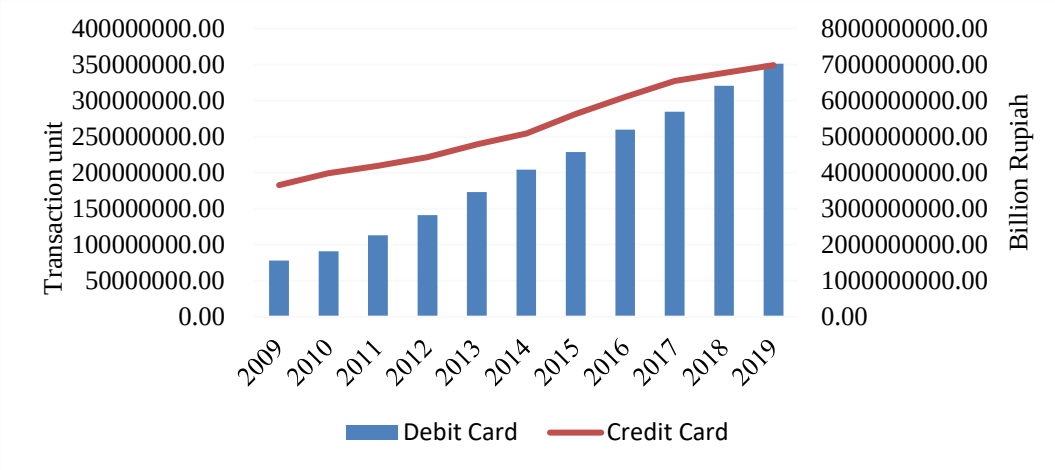
generally made through inter-bank transfers or intra-bank transfers through the bank's internal network. Furthermore, non-cash payments can be made by card as a means of payment such as debit cards and credit cards.

In Figure 1, it can be seen that the development of the non-cash payment instruments based on card-based payment instruments (APMK) transaction volume has increased every year, which means that non-cash payment instruments have been accepted by the public as part of the transaction. This increase was also supported by a program launched by Bank Indonesia as the monetary authority, namely Gerakan Nasional Non Tunai (GNNT) in 2014. Gerakan Nasional Non Tunai (GNNT) was launched to encourage and increase public awareness, business players, and government institutions to use an efficient and easy non-cash payment system in financial transactions. Non-cash payment instruments or instruments emerged as an answer to the needs of the community in sending funds or making payments that cannot be fulfilled by cash (Bank Indonesia, 2006). Supported by technological advances and changes in people's lifestyles as well as the development of innovations that add to the types of non-cash transactions. Non-cash payment instruments have evolved from paper (paper-based) to electronic and even digital (digital cash). Electronic money regulation is regulated in Bank Indonesia regulation No.20/6/PBI/2018 concerning Electronic Money, the value of electronic money is the value of money stored electronically in a media server or chip. Unlike debit cards and credit cards which are directly linked to the user's account, transactions via e-money are not linked to the user's account.

Figure 1 Volume Level of Card-Based Payment Instrument Transactions (in Million Rupiah) in Indonesia in 2009 – 2019



Source: Bank Indonesia (data processed).

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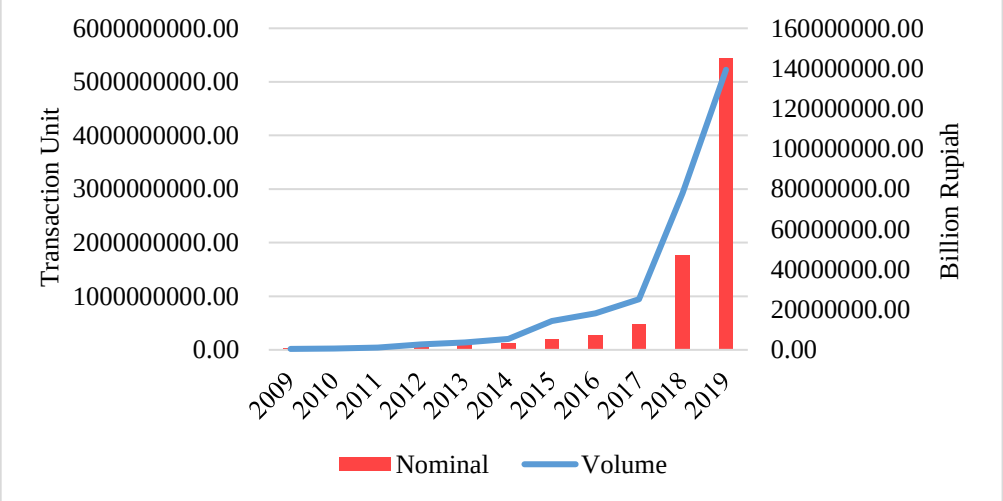
The volume and nominal value of electronic money transactions continue to increase every year. Currently, there are 50 electronic money issuers, 34 credit card issuers, and 118 debit card issuers who have obtained permission from Bank Indonesia and have issued non-cash payment instruments. Based on Figure 2 in 2010, the nominal transactions of electronic money reached Rp 693.47 billion. Until September 2019, the number of electronic money increased compared to the end of 2018. Nominal transactions using electronic money have also doubled compared to the previous Rp 47.2 trillion and in September 2019 to 95.7 trillion. This increase was supported by innovations in electronic money, which initially could only be stored in electronic media in the form of chips. Currently, the value of money can be stored in electronic media.

Figure 2 Volume and Nominal Levels of Electronic Money Transactions (in Rupiah) in Indonesia in 2009 – 2019



Source: Bank Indonesia.

The rapid progression of information technology provides convenience, speed, and smoothness to the payment system in all its forms. Nevertheless, rapid technological advancements also generate potential disruptions to the payment system, destabilizing the financial system. Given rapid changes in the payment system, this study aims to analyze the stability of the financial system in Indonesia due to the development of non-cash payment instruments. The payment system is closely related to the financial stability function performed by the central bank. The financial system is said to be stable if it can withstand shocks so that it does not interfere with the circulation of money and credit, the intermediation function for the allocation of savings to various investment activities, as well as the payment process in the economy. Financial innovations outside of formal financial institutions will increase

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fragmentation and risk to financial system stability (Warjiyo, 2016). Financial system stability is a condition in which economic mechanisms in pricing, fund allocation, and risk management function properly and support economic growth (Bank Indonesia, 2006). The crisis that happened in Indonesia in 1997-1998, as well as the global crisis in 2008, raised awareness of the importance of maintaining financial system stability in maintaining a sustainable economy, as well as complementing the inflation targeting framework of monetary policy that focuses on the inflation rate. By maintaining financial system stability, it is possible to minimize various financial crises that may occur in the future.

Identification of financial system stability is generally forward-looking. Financial system stability can be understood by knowing the factors that can affect financial system stability. In general, there are two indicators of financial system stability in Indonesia, namely microprudential and macroprudential. Among the macroprudential indicators are economic growth, the balance of payments, inflation rate, interest rates, exchange rates, the effects of crisis contagion, and others. The existence of innovation in non-cash payment innovations is expected to affect inflation through propagation speed on the money demand (M1) and the velocity of money simultaneously. Referring to Irving Fisher's quantity theory of money, inflation is a price proxy where the change is proportional to the money supply, ceteris paribus. If the amount of money circulating in the community is too much, it will trigger an increase in prices. The price increase that occurs continuously will have the potential to cause inflation. Continuous inflation will disrupt financial system stability (Lintangsari et al., 2018).

LITERATURE REVIEW

Payment System

Payment can be interpreted as a transfer of value between two parties, where simultaneously there is a transfer of goods and services. Every economic activity will involve the payment process. (Bank Indonesia, 2006). The definition by Committee for Payment and Settlement Systems/Bank for International Settlement (BIS, 1996) which is an international institution defines the interaction between these entities as consisting of a set of instruments, procedures, and Informal Funds Transfer (ITF) System which are components to facilitate the circulation of funds.

Non-Cash Payment Instruments

Currently, payment instruments are classified as cash and non-cash payments. The development of this payment system is supported by the existence of payment instruments using cards (APMK). Payment transactions with card-based instruments are account-based so that transactions are carried out at the bank level with the method

chosen by each bank according to the scale of its network operations. Non-cash payment instruments can be divided into access products and prepaid products (Hidayati, 2006). Characteristic differences between access products and prepaid products are:

1. Access Product (Debit Card and Credit Card)
a) There is no registration of funds on the card instrument.
b) The Funds are fully under the management of the bank, as long as there is no authorization from the customer to make payments.
c) At the time of the transaction, the card is used to provide online access to the issuer's computer to obtain authorization to make payments to various customer accounts, both in the form of a savings account (debit card) or customer account, which will then be directly debited. Thus, payments using credit cards and debit cards require online communication with the computer issuer.

2. Prepaid Products (e-money and e-wallet)
a) The value of money has been recorded in an e-money or e-wallet instrument, or often referred to as a stored value.
b) Funds recorded in this payment instrument are fully in the control of the consumer.

Financial System Stability

Financial system stability does not yet have a standard definition, therefore definitions of Financial System Stability emerge which say that a financial system enters an unstable stage when the system has endangered and hampered economic activity. According to Bank Indonesia, the meaning of financial system stability can be understood by conducting research on factors that can cause instability in the financial sector. Schinasi (2004) defines financial system stability as the ability of the financial system to allocate sources of funds to support economic activities, manage risks, and survive turmoil. Understanding financial system stability can be done by understanding the factors that cause instability in the financial system. Instability in the financial system can be triggered by market failures from both external and internal sources. Identification of financial system instability is forward-looking. This is to determine the potential risks that will occur and affect the condition of the financial system in the future.

Schinasi (2004) defines financial system stability as the ability of the financial system to allocate sources of funds to support economic activities, manage risks, and survive turbulence. Financial system stability is considered dynamically in line with changes in elements in the financial system. Understanding financial system stability can be done by knowing the factors that cause instability in the financial system. In general, there are two kinds of factors that affect financial system stability as shown

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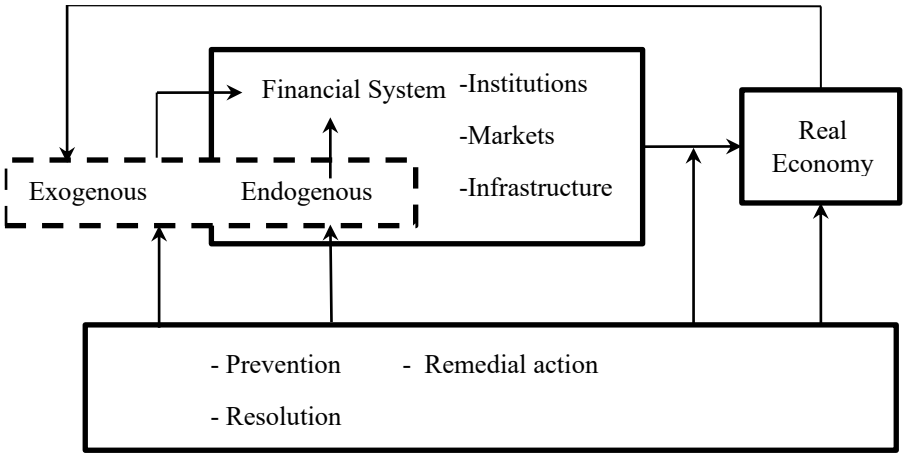
in Figure 3, namely endogenous factors originating from the financial system itself, and exogenous factors originating from outside the financial system.

Figure 3 Factors Affecting Financial System Performance



Source: Houben and Kakes (2004).

Legend
Policy
Source of imbalances
Influence

For this reason, it is necessary to control the factors that influence and are influenced by the financial system. Indicators for measuring financial system stability, consisting of macroprudential and microprudential indicators. Macroprudential consists of policies aimed at maintaining overall financial system stability through limiting systemic risk. In understanding the effect of non-cash payment system innovation on financial system stability, this study limits the measurement of financial system stability based on macroprudential policy indicators, which consist of inflation and interest rates. Inflation through the substitution effect, namely the money supply and the velocity of money.

Based on research conducted by Lintangsari et al. (2018), e-money transactions and debit card transactions have a positive effect on the money supply which can cause inflation and disrupt financial system stability, although not directly. In addition, e-money transactions have a negative effect on the reference interest rate which can then affect the transmission of savings interest rates and credit interest rates. If individuals continue to increase transactions using e-money, it will affect the decline in interest rates which can lead to inflation. The rate of inflation that continues to rise will result in disruption of financial system stability.

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Classic Theory of Money

The theory of the demand for money or the theory of the quantity of money initiated by Irving Fisher, formulated as follows:

$$M.V = P.T \quad (1)$$

M is the money supply, V is the velocity of money, P is the price, and T is the number of transactions that occur in the economy. In this theory, it is explained that changes in the money supply will be proportional to changes in prices if V and T are assumed to be constant. Irving Fisher said that acceleration is determined by institutions in the economy that affect the way individuals in the economy make transactions. If the public uses non-cash payment instruments to carry out their transactions, the use of cash is reduced when making purchases, so that less cash is needed to carry out transactions generated by nominal income and the acceleration will increase (Mishkin, 2008). The correlation of non-cash payment instruments to money turnover is seen based on the real money balances approach. By using the money demand function, it can be explained the relationship between real money balances (M/P) that you want to hold with real income (Y).

$$\left(\frac{M}{P}\right)^{d} = \kappa.Y \quad (2)$$

where *k* is a constant. Assuming that the money demand is the same as the money supply (M/P), the following equation is obtained:

$$\left(\frac{M}{P}\right) = \kappa.Y \quad (3)$$

Then the equation (3) can be changed to:

$$M.\left(\frac{1}{\kappa}\right) = P.Y \quad (4)$$

or

$$M.V = P.Y \quad (5)$$

Then equation 2.5 is known as the income velocity of money:

$$V = \frac{Y}{\left(\frac{M}{P}\right)} \quad (6)$$

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$$\frac{1}{\kappa} = \frac{Y}{\left(\frac{M}{P}\right)} \quad (7)$$

This theory says that the velocity of money (V) will change if the money demand function changes. In Hidayati's study (2006), the issuance of e-money as a non-cash payment instrument is assumed to change the money demand function, which then reduces the average amount of cash held by the public (average money holdings) and will reduce the *k* parameter.

Keynes's Theory of Money Demand

Keynes stated that the public's demand for money is based on three motives, namely the motive for transactions, the motive for precaution, and the motive for speculation. In the transaction motive, if the receipts and expenditures made by a person have the same amount and period, then the individual does not need money in the transaction. However, in reality, the amount and period between receipts and disbursements are different, so money is needed to facilitate the course of transactions carried out. The volume of transactions carried out depends on the income. The greater the income, the volume of transactions will increase.

Development of Keynes's (Baumol-Tobin) Money Demand Theory

Baumol and Tobin with the inventory model state that there are two things that affect people's choices in holding money or assets, namely transaction costs that must be incurred when choosing to hold assets because holding assets reduces liquidity and there is a return obtained by holding assets. The optimal level of money held by the community can be formulated as follows (Zahara, 2018):

$$Md = \frac{Md}{P} = \sqrt{\frac{2\alpha T}{r}} \quad (8)$$

Md : optimal level of money stock
αT : transaction fee
r : return of assets

In the context of the inventory model, demand for non-interest-bearing money, namely currency, and demand for deposits (in this case it is assumed that there is no interest on deposits in the form of checking accounts) is determined by real income, interest rates, and transaction costs. The inventory model from Baumol and Tobin is considered appropriate to take into account the effect of non-cash payment instruments, namely by accommodating the transaction cost variable in addition to the interest rate.

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Syarifuddin et al. (2009) explained that currently there is a shift in the definition of saving deposits. Withdrawing savings deposits can be done very easily, especially with the development of ATM facilities, namely the freedom of withdrawal, almost like a demand deposit, although there are still restrictions on the number of withdrawals in one day. Non-cash payments are not only made through accounts in the demand deposit category but also savings deposit accounts. The demand for currency will be affected, which will decrease with the ease of non-cash payments that resemble the function of currency.

In their model, Baumol and Tobin assume that individuals receive payments once in a period and spend in that period. Thus money provides zero interest rate income, held only because it is used for transactions. It can be concluded that Baumol-Tobin states that when interest rates increase, the amount of cash held for transactions will decrease, which means that the acceleration will increase as interest rates increase. The demand for money by the public in the Baumol-Tobin model is determined by two factors, namely transaction costs, and returns from holding other types of deposits or assets. Transaction costs (redemption costs) will arise when people choose to hold assets even though on the other hand a return is obtained on these assets. Meanwhile, by holding currency, people lose the opportunity to get a return, although, on the other hand, transaction costs can be eliminated.

Syarifuddin et al. (2009) in their research said that in analyzing the demand for money (M1), it is necessary to emphasize again the difference with the initial Baumol-Tobin model, which assumes that by holding money people do not get a return. Currently, by saving their funds on demand or saving deposits with non-cash payment instruments facilities such as debit cards and electronic money, the public still enjoys the function of currency and can earn returns. The demand for currency will decrease along with the development of non-cash payment instruments. Thus the money demand function (M1) becomes as follows:

$$m^d = \frac{m^d}{P} = f(Y, r, \frac{NC}{P}) \quad (9)$$

where:

m^d : money demand
NC : cashless payment transactions
P : price index
Y : GDP real
r : interest rate

From this equation, it can be seen that the demand for money by the public is determined by the level of real GDP, the interest rate (return) from other types of

deposits or assets, and the value of the payment transaction. non-cash (Syarifuddin, 2009).

METHODOLOGY

The type of data used in this research is secondary data. Secondary data is data obtained indirectly and becomes supporting data in a study. This study uses annual data for the period 2009-2019 for the narrow money (M1), the velocity of money (v), BI rate, electronic money transactions volume, debit card transactions, and credit card transactions taken from the official statistical website of Bank Indonesia. The CPI data for the 2009-2019 period was taken from the official BPS website.

Operational Definition

1. Financial System Stability

Financial System Stability is a condition that enables the national financial system to function effectively. Indicators of measuring financial system stability in this study are inflation and interest rates. The effect of inflation on financial system stability is through the substitution effect, namely changes in the demand for money (M1) and the velocity of money circulation (v).

2. Total Money Supply (M1)

This study uses M1 data which is the money supply in a narrow sense consisting of currency plus demand deposits. M1 is a very liquid money supply calculation.

3. Velocity of Money

Money turnover is the average number of times per year (turnover) of one unit of currency used to purchase the total goods and services produced in the economy (Mishkin, 2008).

4. Inflation

Inflation is defined as a general and continuous increase in prices over a certain period of time (Mishkin, 2008). The indicator used to measure the inflation rate is the Consumer Price Index (CPI).

5. Real Income (y)

GDP is basically the sum of the final values of goods and services produced by all economic units. In this study, real GDP is at constant prices, which shows economic growth from year to year. Real income used in this study is real income based on constant prices for the 2010 base year, where the data is already quarterly data.

6. Interest Rate (BI rate)

BI Rate is the reference interest rate set by Bank Indonesia. Where the BI rate is the interest rate that reflects the monetary policy stance set by Bank Indonesia to the public.

7. Debit Card

In this study, debit card transactions are proxied by the volume of transactions using a debit card, namely the number of cash withdrawals, purchases, and transfers of funds made using a debit card in a certain period.

8. Credit Card

In this study, credit card transactions are proxied by the volume of transactions using a debit card, namely the number of shopping transactions made using a credit card in a certain period.

9. Electronic Money

In this study, electronic money transactions are proxied by the volume of transactions using electronic money, namely the number of shopping transactions made using debit cards in a certain period of time, whether electronic money is based on chips or servers.

Analysis Method

This study aims to examine the effect of non-cash payment instruments on financial system stability using the SVAR analysis method. The analysis of this research is the Structural Vector Autoregressive (SVAR) modeling which is the development of the Vector Autoregressive (VAR) modeling using the Eviews 10 program. In SVAR, restrictions are placed based on a strong theoretical relationship in the ordering scheme of the variables used. in the VAR system (Damayanti, 2014). The main analysis in this study relies on impulse response functions (IRFs) and forecast error variance decompositions (FEVDs). The data used in this research is Indonesian monetary data which is then analyzed using the SVAR approach. This study is based on the measurement of seven variables that affect financial system stability to analyze shocks of non-cash payment instruments on financial system stability in Indonesia. Then the interest rate is an exogenous variable, which can affect the stability of the financial system through its effect on the money supply which can help control inflation.

The SVAR modeling in this study is based on the long-term restriction of the unrestricted VAR model. The model of the influence of non-cash payments on financial system stability has an equation that is formulated as follows:

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The above model can be written in the form of an equation as follows:

$$e_t = \beta_{11}(L)_{emoney} + \theta_1 r + u^{emoney} \quad (10)$$

$$d_t = \beta_{22}(L)_{debit} + \theta_2 r + u^{debit} \quad (11)$$

$$k_t = \beta_{33}(L)_{kredit} + \theta_3 r + u^{kredit} \quad (12)$$

$$y_t = \beta_{41}(L)_{emoney} + \beta_{42}(L)_{debit} + \beta_{43}(L)_{kredit} + \beta_{44}(L)_y + \theta_4 r + u^y \quad (13)$$

$$m_{1t} = \beta_{51}(L)_{emoney} + \beta_{52}(L)_{debit} + \beta_{53}(L)_{kredit} + \beta_{54}(L)_y + \beta_{55}(L)_{M1} + \theta_5 r + u^{M1} \quad (14)$$

$$v_t = \beta_{61}(L)_{emoney} + \beta_{62}(L)_{debit} + \beta_{63}(L)_{kredit} + \beta_{64}(L)_y + \beta_{65}(L)_{M1} + \beta_{66}(L)_v + \theta_6 r + u^v \quad (15)$$

$$i_t = \beta_{71}(L)_{emoney} + \beta_{72}(L)_{debit} + \beta_{73}(L)_{kredit} + \beta_{74}(L)_y + \beta_{75}(L)_{M1} + \beta_{76}(L)_v + \beta_{77}(L)_{ihk} + \theta_7 r + u^{ihk} \quad (16)$$

Where *y* is Real GDP, *e* is the volume of electronic money transactions, *k* is the volume of credit card transactions, *d* is the volume of debit card transactions, *v* is the velocity of money, *m* is the narrow money (M1), *i* is the inflation rate (CPI), and *r* is the interest rate (BI7DRR). In this equation, it is a vector of serially uncorrelated shocks. Then the structural equation above can be explained as follows:

$$\begin{bmatrix} Emoney \\ Debit \\ Kredit \\ PDB\,riil \\ M1 \\ V \\ IHK \end{bmatrix} = \begin{bmatrix} \beta_{11} & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & \beta_{22} & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & \beta_{33} & 0 & 0 & 0 & 0 \\ \beta_{41} & \beta_{42} & \beta_{43} & \beta_{44} & 0 & 0 & 0 \\ \beta_{51} & \beta_{52} & \beta_{53} & \beta_{54} & \beta_{55} & 0 & 0 \\ \beta_{61} & \beta_{62} & \beta_{63} & \beta_{64} & \beta_{65} & \beta_{66} & 0 \\ \beta_{71} & \beta_{72} & \beta_{73} & \beta_{74} & \beta_{75} & \beta_{76} & \beta_{77} \end{bmatrix} \begin{bmatrix} Emoney \\ Debit \\ Kredit \\ PDB\,riil \\ M1 \\ V \\ IHK \end{bmatrix} + \begin{bmatrix} 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} \theta_1 r \\ \theta_2 r \\ \theta_3 r \\ \theta_4 r \\ \theta_5 r \\ \theta_6 r \\ \theta_7 r \end{bmatrix} + \begin{bmatrix} u_{emoney} \\ u_{debit} \\ u_{kredit} \\ u_{PDBriil} \\ u_{M1} \\ u_v \\ u_{ihk} \end{bmatrix}$$

a) Equation 10 shows that the electronic money shock variable is a variable that is influenced by the shock variable itself and is influenced by interest rates.
b) Equation 11 shows that the debit card shock variable is a variable that is influenced by the shock variable itself and is influenced by interest rates.
c) Equation 12 shows that the credit card shock variable is a variable that is influenced by the shock variable itself and is influenced by interest rates.
d) Equation 13 shows that the real GDP shock variable is a variable that is influenced by the shock variable itself and the non-cash payment instrument variable and is influenced by interest rates.

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e) Equation 14 shows that the shock variable in the money supply (M1) is influenced by real GDP, the volume of non-cash payment instrument transactions, namely transactions using debit cards, credit cards, electronic money, and the shock variable itself. And influenced by interest rate (r) as an exogenous variable.
f) Equation 15 shows that the money circulation shock variable is influenced by real GDP, the volume of non-cash payment instrument transactions, namely transactions using debit cards, credit cards, electronic money, the money supply (M1), and the shock variable itself. And influenced by interest rate (r) as an exogenous variable.
g) Equation 16 shows that the inflation shock variable is influenced by the money velocity variable (v), and money demand (M1). Inflation is also influenced by the volume of non-cash payment instrument transactions, namely transactions using debit cards, credit cards, electronic money, the money supply, the velocity of money, and the shock variable itself. And influenced by interest rate (r) as an exogenous variable.

The above model is over-identified which is used to identify the model and this model is recursive. After the iteration process, the coefficients on the matrix are known as a form of estimation of the SVAR model. The estimation results are needed as the basis for analyzing innovation accounting, namely through impulse response functions and factor error variance decompositions. The above model is over-identified which is used to identify the model and this model is recursive. After the iteration process, the coefficients on the matrix are known as a form of estimation of the SVAR model. The estimation results are needed as the basis for analyzing innovation accounting, namely through impulse response functions and factor error variance decompositions.

RESULTS

Stationary Test

The initial step in SVAR estimation is testing the stationarity of the data on each variable. Stationarity testing is used to test the stationarity of the data to avoid spurious regression or spurious regression. Tests are carried out to determine whether the error term of the data has been normally distributed or not. The test method used to perform the stationary test of the data in this study is the Philips-Perron (PP) test to see whether the data is stationary at the level (I0) or difference (I1).

From the results of the stationary Phillips-perron unit root test, it was found that the critical value of real debit card transactions, credit card transactions, electronic money transactions, narrow money (M1), the velocity of money (v), interest rates (r), and real GDP $\alpha = 5\%$ which is smaller than the PP test statistic for each variable. This means that the Phillips-Perron unit root test results indicate the presence of a unit root. Thus, debit card transaction volume data in Indonesia is not stationary at the level.

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Then at the first difference level, it is found that the critical value of real debit card transactions, credit card transactions, electronic money transactions, narrow money (M1), the velocity of money (v), interest rates (r), and real GDP α = 5% which is greater than PP test statistic value for each variable. This means that the results of the Phillips-perron unit root test indicate the absence of a unit root. Thus, the data on the seven variables that affect financial system stability is stationary at the first difference level.

Optimum Lag Test

Determining the number of lags used correctly will affect the residual results which are Gaussian (free from autocorrelation and heteroscedasticity problems) (Damodar, 2004). Determination of lag length is used to determine the length of influence of a variable on the previous period and other endogenous variables. The optimal lag determination test is seen through several approaches such as LR (sequential modified LR test statistic), FPE (Final Prediction Error), AIC (Akaike Information Criterion), SC (Schwarz information criterion), and HQ (Hannan-Quinn information criterion). The results of determining the optimal lag test can be seen as the optimal lag length lies in lag 3. The selection of lag 3 as the optimal lag is based on the estimation results of FPE, AIC, and HQ criteria with a value of 2.21ee-11*, -5.790036*, and -3.332188** is lag 3 which is indicated by the presence of an artistic sign (*). Therefore, in the next estimation, lag 3 is used in the SVAR equation model.

Structural Vector Autoregression (SVAR) Model Estimation

Structural Vector Autoregression (SVAR) estimation model is a development of the VAR model. SVAR is a theoretical VAR model because there is a theoretical basis that is applied to the VAR model in the form of several restrictions. Before estimating the SVAR, the estimation was carried out using the VAR approach by testing the data stationarity and determining the optimal lag. Based on the results of the VAR estimation, then several restrictions are applied based on the variables used in the study in period t which will only be affected by shocks from the previous equation and shocks to the variables themselves. The results of the SVAR estimation can be seen as follows:

$$\begin{bmatrix} emoney \\ debit \\ credit \\ gdpreal \\ M1 \\ v \\ cpi \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 & 0 & 0 \\ -0{,}003 & 0{,}089 & 0{,}152 & 1 & 0 & 0 & 0 \\ -0{,}030 & -0{,}074 & 0{,}042 & -0{,}040 & 1 & 0 & 0 \\ 3{,}345 & 207{,}118 & -252{,}443 & -369{,}632 & 77{,}455 & 1 & 0 \\ -0{,}354 & 6{,}657 & 2{,}959 & 120{,}299 & -125{,}627 & -0{,}410 & 1 \end{bmatrix}$$

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In this study, the SVAR estimation results will be an indicator that aims to produce a regression that is not false. Therefore, further analysis in the SVAR system emphasizes the analysis of the Impulse Response Function (IRF) and Forecast Error Variance Decomposition (FEVD) (Gujarati, 2004). So to be able to answer the research objectives, the analytical tools used will focus on the results of innovation accounting, namely IRF and FEVD.

Impulse Response Function

To get an idea of the relationship of non-cash payment instruments to financial system stability, it can be seen through the impulse response function with the response of variables that affect financial system stability, namely velocity of money(V), money demand (M1), and inflation rate (CPI). In this case, there are three variables analyzed, namely the volume of debit card transactions, the volume of credit card transactions, and the volume of electronic money transactions. The horizon used is 44 quarters and shock is represented by one standard deviation of the relevant variable. The impulse response image will show the response of a variable due to shock from other variables up to several periods after the shock occurs. If the image on the impulse response shows a movement closer to the point of equilibrium (convergence), the response of a variable due to a shock will gradually disappear.

The results of the IRF estimation can be seen in Figure 4, in this analysis debit card transactions are used as impulses and macroeconomic variables as responding variables. Based on Figure 4 it can be concluded that the response to debit card shock shows dynamic results. Based on the results of the impulse response, initially, the increase in debit card transaction volume was responded to by a decrease in the money demand (M1), and then in the third period, the response was positive. However, this did not last long and continued to experience fluctuating responses near the point of convergence. Thus, the shock of debit card transaction volume has a negative effect on the narrow money (M1). Furthermore, the increase in debit card transaction volume was responded to by an increase in the velocity of money, then in the third period, the response was a decrease in the velocity of money response. However, this did not last long and continued to experience fluctuating responses near the point of convergence. Thus, the shock of debit card transaction volume has an impact on increasing the value of the velocity of money response. The results of impulse responses show that the inflation rate (CPI) has increased up to the third period. However, entering the fourth period the response turned negative. This movement continues to fluctuate near the point of equilibrium (convergence). Thus, the shock of debit card transaction volume has a positive effect on the inflation rate (CPI).

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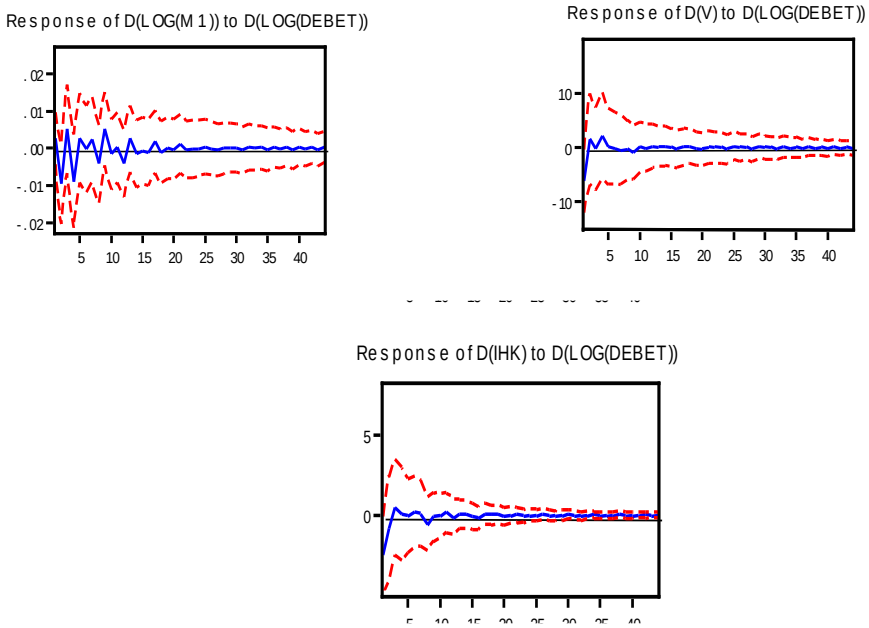
Figure 4 The shock of Non-Cash Payment Instruments (Debit Transaction Volume)



In this analysis, credit card transactions are used as impulses and macroeconomic variables as responding variables. Based on Figure 5, it can be concluded that the response to credit card shock shows dynamic results. Based on the impulse response results, initially, the increase in credit card transaction volume was responded to by an increase in the narrow money (M1). Entering the third period, the increase in the volume of credit card transactions was responded to by a decrease in the response value of the narrow money (M1). However, this did not last long and continued to experience fluctuating responses near the point of convergence. Thus, the shock of credit card transaction volume has a positive effect on the narrow money (M1)

Furthermore, the increase in credit card transaction volume was responded to by a decrease in the velocity of money and the inflation rate (CPI). Entering the third period, the increase in credit card transaction volume was responded to by a decrease in the response value of the velocity of money and the inflation rate. This movement continues to fluctuate near the point of equilibrium (convergence). Thus, the shock of credit card transaction volume has a negative effect on the velocity of money and the inflation rate (CPI).

In this analysis, electronic money transactions are used as impulses and macroeconomic variables as responding variables. Based on Figure 6, it can be concluded that the response to the electronic money shock shows dynamic results. Based on the results of the impulse response, initially, the increase in the volume of electronic money transactions was responded to by a decrease in the narrow money

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(M1). Entering the fourth period, the increase in the volume of electronic money transactions increased the response value of the narrow money (M1). However, this did not last long and continued to experience fluctuating responses near the point of convergence. Thus, the shock in the volume of credit card transactions has a negative effect or causes a decrease in the narrow money. Furthermore, the increase in the volume of electronic money transactions was responded to by an increase in the velocity of money and the inflation rate (CPI). However, entering the third period the response has decreased. This movement continues to fluctuate near the point of equilibrium (convergence). Thus, the shock in the volume of electronic money transactions has a positive effect or causes an increase in the velocity of money and the inflation rate (CPI).

Figure 5 The shock of Non-Cash Payment Instruments (Credit Transaction Volume) Response to Emoney Transaction Volume Shock

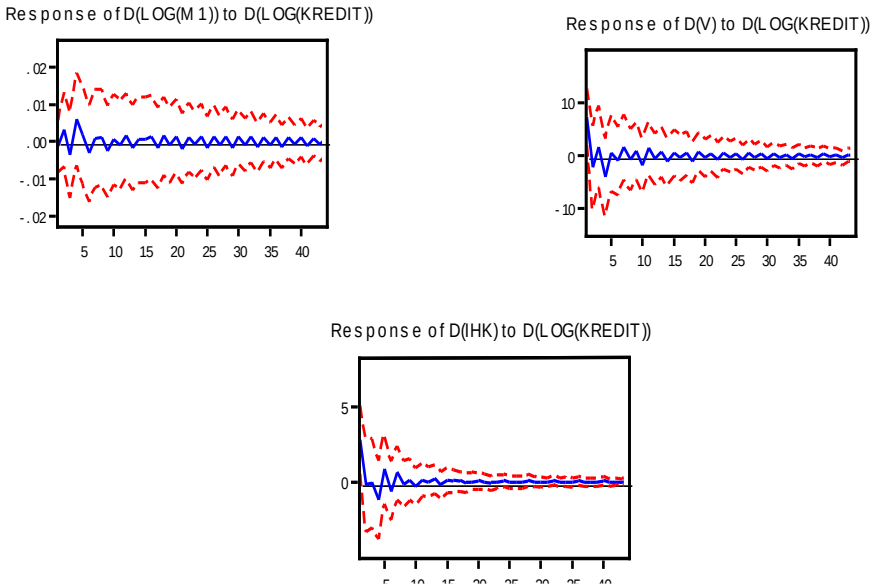

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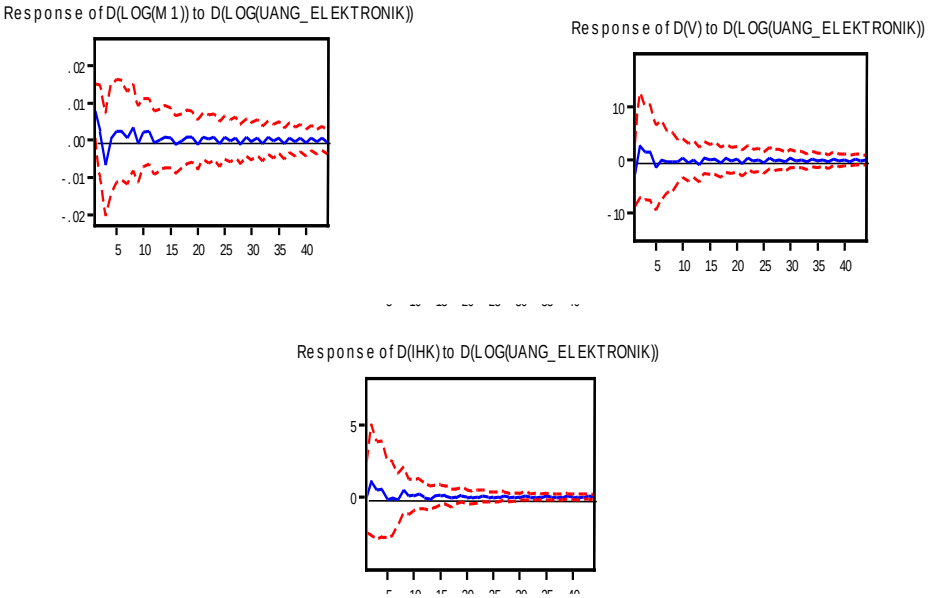
Figure 6 The shock of Non-Cash Payment Instruments (Emoney Transaction Volume) Response to Credit Card Transaction Volume Shock



Forecast Error Variance Decomposition

Forecast Error Variance Decomposition FEVD is used to show the forecast proportion of other variables and the variables themselves. This test is used to show how big the variance is before and aftershocks from other variables to see the relative effect of variables on other variables in a study.

Variance Decomposition Variable of Narrow Money (M1)

Analysis of variance decomposition of the narrow money variable (M1), shows that the variable that is expected to have the greatest contribution to the narrow money (M1) in the next 10 quarters is the narrow money (M1) itself with an average contribution per quarter of 46.3%, followed by the contribution of electronic money transaction volume of 7.76%, credit card transactions 6.85%, and debit card transactions 5.61%. During the next 10 quarters, the narrow money (M1) provides the largest average quarterly contribution, but the contribution every quarter continues to decline.

Variance Decomposition Velocity of Money (V)

Analysis of variance decomposition of the velocity of money variable shows that the variable that is expected to have the greatest contribution to the velocity of money

in the next 10 quarters is the velocity of money itself with an average contribution per quarter of 55.90%, followed by the contribution of transaction volume. debit card 13.29%, credit card transaction volume 12, 44%, and electronic money transaction volume 3.20%. During the next 10 quarters, the velocity of money provides the largest average quarterly contribution, but the contribution every quarter continues to decline. This is inversely proportional to the variable volume of credit card transactions which shows an increasing contribution every quarter.

Variance Decomposition Inflation (CPI)

Analysis of the variance decomposition of the inflation variable shows that the variable that is expected to have the largest contribution to the inflation rate in the next 10 quarters is the velocity of money with an average contribution per quarter of 64.00%, followed by the contribution of credit card transaction volume of 12.72 %, debit card transaction volume 10.66%, and electronic money transaction volume 2.35%. During the next 10 quarters, the velocity of money provides the largest average quarterly contribution, but the contribution every quarter continues to decline. This is inversely proportional to the variable volume of debit card transactions, volume of credit card transactions, and volume of electronic money transactions, which in general show an increasing contribution every quarter.

DISCUSSION

The effect of non-cash payment instruments on financial system stability can be seen from the response of the factors that influence them to the shock of each non-cash payment instrument. Based on the results of the impulse response, it shows that an increase in the volume of non-cash transactions has an impact on the money demand (M1) and the velocity of money, which in turn will have an impact on inflation. The increase in the volume of debit card transactions and electronic money transactions reduced average money holdings, or money held by the public, namely currency. Where the decrease in average money holdings will decrease the parameters *k*, which then increases the velocity of money (Hidayati, 2006). This happened because of the substitution of the use of payment instruments from cash to non-cash payment instruments. The increasing velocity of money indicates that the higher the circulation of money in the economy. The high circulation of money in the economy will have an impact on increasing prices, which then causes inflation. Based on the quantity theory of money put forward by Irving Fisher, inflation is caused by the amount of money if the acceleration of money is constant. In contrast to Fisher, Keynes argues that the velocity of money (v) is not constant or can change (Wardani, 2017). Inflation that occurs continuously can disrupt financial system stability.

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CONCLUSION

The development of payment instruments that were originally only cash to non-cash occurred due to technological developments. The structural vector autoregression (SVAR) model is able to capture the influence of the variables that affect financial system stability on fluctuations from non-cash payment instruments quite well. Based on the research that has been done, several conclusions were obtained including:

Based on the impulse response results, the increase in the volume of debit card transactions and electronic money transactions was responded to by a decrease in the response value of the narrow money (M1), an increase in the response value of the velocity of money, and an increase in the response value of the inflation rate. Meanwhile, the increase in the volume of credit card transactions led to a decrease in the value of the inflation rate response. But then the response tends to decrease towards the equilibrium condition or close to zero is called convergence. Thus, the shock of the growth of non-cash transactions will be responded to, and the longer it will disappear so the more the shock does not leave a permanent effect on the variable.

Based on the results of the impulse response, it shows that an increase in the volume of non-cash transactions has an impact on the narrow money (M1) and the velocity of money circulation, which in turn will have an impact on inflation. The increase in the volume of debit card transactions and electronic money transactions reduced average money holdings or money held by the public, namely cash-based. Where the decrease in average money holdings will decrease the *k* parameters, then lead to an increase the velocity of money (Hidayati, 2006). This happened because of the substitution of the use of payment instruments from cash to non-cash payment instruments. The increasing velocity of money indicates that the higher the circulation of money in the economy. The high circulation of money in the economy will have an impact on increasing prices, which then causes inflation and eventually, disrupts the stability of the financial system.

The suggestions that can be given based on the results of this study to encourage the stability of the Indonesian financial system towards the innovation of non-cash payment instruments are the need to necessary to maintain or control a certain nominal limit on each payment instrument so that the amount of money circulating in the community can be maintained and minimize the occurrence of inflation. Data on the use of electronic wallet transactions (e-wallet) is needed to complement further research in order to achieve a more thorough and comprehensive research. In addition to that, further research should utilize other variables and incorporate different methods and models to increase the variety of research.

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