

Assessing the Role of Banking Technology in Promoting Economic Growth: Evidence from Indonesia

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Abstract. This study investigates the impact of banking technology, proxied by Bank Indonesia Real Time Gross Settlement (BI-RTGS) and electronic money transactions, on economic growth in Indonesia from 2010 to 2022. Using the Vector Error Correction Model (VECM), the authors analyze the relationship between banking indicators and economic growth. The results suggest that banking technology variables have a significant influence on economic growth, with electronic money showing a positive response and BI-RTGS exhibiting a negative response in the short run. However, the study has limitations, such as not accounting for the Covid-19 pandemic using dummy variables. The findings highlight the potential of electronic money as a tool to stimulate economic growth in Indonesia. Future research should explore the long-term effects of banking technology on economic growth and consider the impact of exogenous shocks like the pandemic.

Keywords: BI-RTGS, economic growth, electronic money, VECM

1. Introduction

Economic growth in Indonesia has experienced significant fluctuation. Based on the performance in 2022, it is found that there is a risk of global economy increasing again in 2022. This provides a challenge in terms of the efforts in accelerating the national economic recovery. Bank Indonesia strengthens synergy between the policy innovations of the Government and the Financial System Stability Committee (KSSK) which maintains the economic resilience from these global risks and continues to support the sustainability of the national economic recovery. With the economy recuperating and ensuring the household economy from the spill-over impacts of worldwide turmoil, financial approach is being coordinated at keeping up steadiness (pro-stability), whereas the macroprudential approaches, installment frameworks, cash showcase advancement, as well as financial and monetary consideration stay coordinated at advancing financial development (pro-growth) (Bank Indonesia, 2022).

The theory underlying this research which is about the three main components of economic growth is put forward by Todaro & Smith (2015). The three components of economic growth that are of prime significance are: (1) capital collection, counting all unused speculations on arrive, physical gear and human assets through enhancements in wellbeing, instruction, and work aptitudes; (2) Development in populace, and consequently inevitable development within the labor constrain; (3) Innovative progress-new ways of finishing errands. The innovative advance appeared expanded application of new logical information within the frame of innovations and advancements with respect to both physical and human capital (Todaro & Smith, 2015).

The development of banking continues to show an increase, especially in terms of the volume of assets collected. Judging from the development of a number of banking assets, it shows rapid development in less than 20 years. To analyze the development of a number banking assets, the indicators used to refer to the standards of the Directorate of Banking Research and Regulation of Bank Indonesia in 2000 in the main banking indicators section, specifically the item of total assets, and the distribution of funds. The use of electronic-based transactions is one area of technology that is expanding quickly in the Indonesian financial sector. The following is an illustration of the growth of assets and electronic money in Indonesia in 2010-2022 (Figure 1).

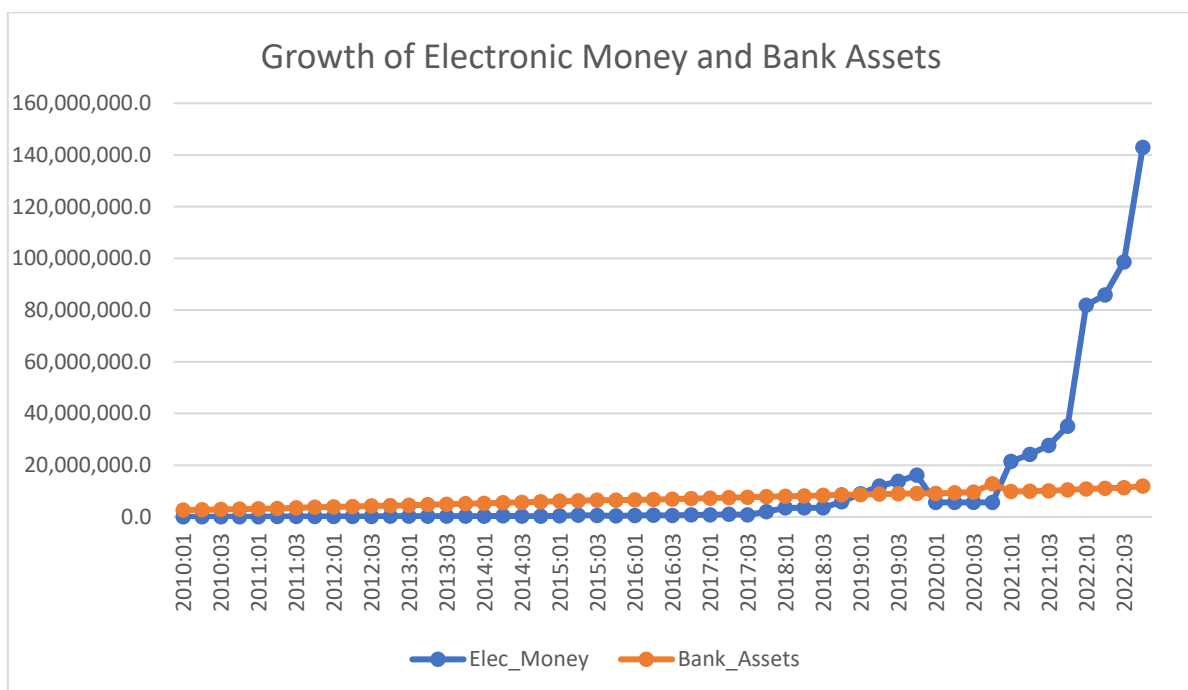


Fig.1: Growth of Total Assets and Electronic Money 2010-2022

The BI-RTGS system is an infrastructure used as a means of electronic fund transfers whose settlement is carried out instantly for individual transaction. Since its operation by Bank Indonesia on November 17, 2000, the BI-RTGS framework has played an imperative part in handling installment exchange exercises, particularly for handling installment exchanges that incorporate High Value Payment System Framework (HVPS) or large-value exchanges, to be specific exchange of Rp. 100 million and over which are pressing (Bank Indonesia 2023). In addition to BI-RTGS, the use of other technologies in most transactions has also been carried out since the Covid-19 pandemic in Indonesia. The use of technology is known as Financial Technology (Fintech). According to Otoritas Jasa Keuangan/Financial Services Authority (2022), the definition of fintech is an advancement within the monetary administrations industry that employs innovation. Fintech products are more often than not within the shape of framework built to carry out particular budgetary exchange instruments. In 1995, Bank Indonesia issued General Guidelines for Information Technology Control Systems (TSI) based on SK. Dir. No. BI.27/164/KEP/DIR and SE BI.27/9/UPPB which is dated March 31, 1995, is on the Use of Information Technology Systems by Bank Indonesia.

The main problem in this study is how the role and relationship of financial development, in this case banking technology, with economic growth. Some previous research results are described in this section. Starting from research that has been conducted in 10 European countries. Caporale, Rault, Sova dan Sova (2009) review the main features of the banking financial development and economic growth in ten countries over the period 1994-2007. The evidence suggests that the stock and credit markets are still underdeveloped in these economies, and that their contribution to economic growth is limited owing to a lack of financial depth. However, a more efficient banking sector is found to have accelerated growth. Estrada, Park and Ramayandi (2010) have conducted research on financial development and economic growth in developing countries located in Asia. The results stated that sound and efficient financial system are especially important for sustaining growth in developing Asia, because efficiency of investment will overshadow quantity of investment as the driver of growth in the region. There have also been many studies on banking and economic growth in other countries, including in Malaysia by Zakaria and Basah (2021), who analyzed financial development and economic growth with data from 1990-2019 using annual data and VECM analysis methods. The finding reveals that The FTSE Kuala Lumpur Composite Index and domestic credit produces a significant relationship towards GDP per capita in the long run and short run. Chung, Sun and Vo (2019) examined the causal relationship between financial development, liberalization and economic growth through technological innovation channel in five South East Asia countries during the period 1980-2012. They found that technological deepening is driven by deepening in the financial system and financial liberalization rather than changes in a country's market capitalization. Research in other neighbouring Southeast Asian countries has also been carried out, namely in Thailand. Wong, Lau and Yip (2020) investigated the relationship between cashless payments and economic growth. This research indicated that cashless payment stimulates economic growth in OECD countries. Intharak, Chancharat and Jearviriyaboonya (2022) stated that the relationship between financial development and economic growth have remained inconclusive. Literature collection and meta-analysis are employed to understand whether financial development promotes economic growth. A meta-analysis of Thailand's financial growth and economic prosperity from 1990 to January 19, 2021, was conducted to determine if the financial system's expansion had a natural effect on the structures that had the most significant effect on economic development

The role of banking with economic growth in Indonesia has been analyzed including Medyawati and Hermana (2010), Medyawati, Yunanto and Sutopo (2010), Nasrudin (2004), which uses basic concepts and models similar to Levine, and Loayza (2000) and Rohima, Mardalena and Widyanata (2022). The research's demonstrate that within the brief run as well as within the long run, charge card and credit card have an insignificant affected on financial development, whereas e-money features a positive and noteworthy affect. Cashless installment includes a noteworthy positive affect on financial development, sometime recently and amid COVID-19 widespread, be that as it may amid the

widespread, the affected of cashless installment on financial development was greater. As a result, the current cashless arrangement ought to be altered to make a productive installment framework whereas moreover considering the affected of utilizing cashless installment rebellious amid the COVID-19 widespread. Fitriyani, Hermawan and Safitri (2023) analyze the relationship between e-money, M2, and financial development in Indonesia. The comes about of the granger causality test appears that e-money and cash have one-way relationship with development. Besides, cash appears a positive and critical impact on development, whereas e-money does not have a critical impact. Levine (1997) states that economic activity and technological innovations undoubtedly affect the structure and quality of the banking system. Based on these studies, this research continues and extends previous research related to banking development and economic growth.

One of the basic reasons for choosing BI-RTGS and electronic money variables as a measure for banking technology indicators in this study is the sharp increase in the number of transactions during the study period, namely 2010-2022. BI-RTGS transactions experienced a significant increase at the end of March 2020, from 11649920.29 billion rupiahs increased to 16679340.67 billion rupiahs. At the end of September 2021, it also experienced a sharp increase, from 16679340.67 to 21636420.96 billion rupiahs. Transactions that occur in electronic money have also experienced a sharp increase, from 55 billion rupiah at the end of 2020 to 121 trillion rupiah at the beginning of 2021. The nominal increase in electronic money transactions continues to increase until it reaches 400 trillion rupiah at the end of 2022. The phenomenon of fluctuating transactions on BI-RTGS and electronic money is the main basis for choosing these two variables as indicators of banking technology. The number of BI-RTGS transactions from 2010 to 2022 can be seen in Figure 2.

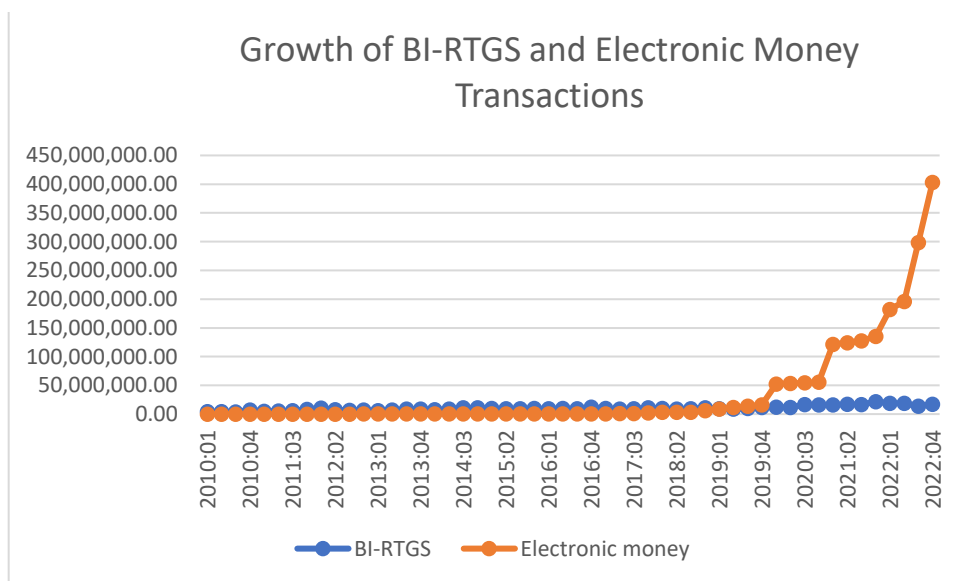


Fig.2: Growth of BI-RTGS and Electronic Money Transactions

Based on the results of previous studies, it can be seen that financial development and economic growth are closely related. This is another reason for using BI-RTGS and electronic money variables as indicators of banking technology which also describes financial development. Although various studies have been conducted in this context, research on the use of electronic money and transactions such as BI-RTGS in this study is still limited. Based on the results of previous research, it appears that no one used the BI-RTGS and electronic money variables simultaneously in the research model. This is the novelty of these research. For this reason, this research will analyze two variables that measure banking technology on the rate of economic growth in Indonesia. This study's objective is to examine how banking and banking technology have evolved in relation to economic growth using three indicators: assets, e-money, and BI-RTGS. The model in this study is different from previous studies.

It added two dummy variables as control variables (Medyawati & Hegarini, 2011); (Medyawati & Yunanto, 2013). Previous research conducted by Medyawati, Yunanto and Hegarini, (2021) on Fintech as a determinant of profitability is used as a reference for the selection of e-money and BI-RTGS variables as indicators of banking technology.

The structure of this paper is to start with an introduction that describes the background of this research, the main problems and research objectives, the results of previous research in various countries related to financial development and economic growth, followed by a literature review, namely a description of the results of previous studies followed by the limitations of each study, ending with the formulation of hypotheses. the next stage is a description of the research method, namely using the analysis method with VECM with the reasons for choosing the method, a description of the results and discussion, ending with conclusions, implications and research suggestions.

2. Literature Review

Here are a few related studies on banking and economic expansion. Levine, Loayza, and Beck (2000) discovered a positive correlation between the growth of banks and economic expansion; however, Levine focused more on the influence of exogenous banking components that vary widely across different countries in this analysis. Specifically, lagged values of financial development frequently make weak instruments for forecasting *changes* in financial development. This weak instrument problem can induce biases in finite samples and poor precision.

The comes about of Kar and Pentecost (2000) appeared that the heading of the causal relationship between banking development and economic expansion in Turkey is touchy to the choice of banking indicators utilized as a degree of managing of banking development. Kar and Pentecost (2000) demonstrated that the choice of banking indicators used to gauge banking development affects the direction of the causal relationship between economic growth and banking development in Turkey. Thus, the limitations of this study are, when financial development is measured by the money to income ratio the direction of causality runs from financial development to economic growth, but when the bank deposits, private credit and domestic credit ratios are alternatively used to proxy financial development, growth is found to lead financial development.

Boulila and Trabelsi, (2004) found that tight controls on the budgetary division in MENA nations (Center East and North Africa) over a long period, delay the execution of budgetary changes in those nations, proceeding the issues within the usage of changes (non-lending in specific). It assisted comes about in tall data and exchange costs, which in turn will anticipate asset advancement and monetary developing. The limitation of this study is that the research focused on countries in the Middle East and North Africa (MENA) region totaling 16 countries with different research time intervals. For example, Algeria was studied from 1964-1999, Bahrain from 1980-1998, and Egypt from 1960-1999.

Liang (2006) stated that the development of banking and rapid economic growth in China led to a wide income gap between the population located in the coastal areas of China. According to Inggrid (2006), there is a long-term, stable equilibrium between the growth of the financial sector and actual output. The generalizability of these findings should be interpreted with caution given the small sample size used and the limited variety of proxies for economic growth variables and financial sector variables. Employing a trivariate VAR framework, Abu-Badr and Abu-Qarn, (2006) it was found that there's frail back for having a long-run relationship between money related improvement and economic expansion. The limitation of this research is that it only examines 5 countries representing North Africa and the Middle East, namely Algeria, Egypt, Morocco, and Tunisia for North African countries and one Middle Eastern country, namely Syria. Diverse conditions happen in Malaysia where economic expansion impacts banking development over a long period of time, but an input relationship in not found (Ang & McKibbin, 2007). The limitation of this research is that this research uses data for the period 1960-2001, but the data period cannot be obtained for real interest rate data, which only obtained 35 data

observations. Other researchers discuss financial development and economic growth in a wider range of countries such as Luintel, Khan, Arrestis and Theodoridis (2008). The study conducted in 16 nations in Asia, Europe, and the United States, according to Luintel, Khan, Arestis, and Theodoridis (2008), revealed that, for the majority of the sample countries, financial structure and economic expansion appear to be crucial in explaining the level of output. The test also showed that the country-specific estimates and the panel estimates (parameters) do not agree. The results suggest that economic growth and output levels are dependent on financial structure and economic expansion. However, this study does not specifically describe the research period used. The authors only mention that they conducted country-by-country time-series analyses for 14 countries by utilizing the World Bank dataset on financial development and financial structure, which is recently updated to 2005

Hypothesis one: Banking represented by assets has positive affects to economic growth

Levine (1997), states that financial action and mechanical advancement without a doubt influence the structure and quality of the banking system. In this research, there are severe analytical problems with linking financial structure to economic performance, one of the them is existing research on financial structure does not quantify the structure of financial systems or how well different financial systems function overall. Amaral and Quintin (2010), found that the impact of such changes in mechanical parameters on yield is much more noteworthy when financial frictions occur. They stated that their model could be extended would be include other potential functions of the financial system. They ignore the role the financial systems play in alleviating informational imperfections. Amalia and Santoso (2022) expressed the electronic cash exchange have an affected on financial development within the long run. The proxy for financial development within pondered is GDP. In this research, to obtain stationary data results, it turned out that two stages had to be carried out, 'first difference' and 'second difference'. Stationary data is achieved at second degree, which in the author's view is quite rare in research that uses time series data. Christianti (2024), appeared the cashless installments did not affect economic development within the brief term. Be that as it may, within the long run, cashless installments within the frame of ATM/debit and electronic cash emphatically influenced Indonesia's financial development, indeed in spite of the fact that these comes about have remained reliable amid the Covid-19 pandemic. The results of this study indicated that in short term, cashless would not directly affect economic growth. This may be since cashless installments require time within the impartial accessibility of foundation improvement, computerized environments, and the method of open money related education, so it takes time for cashless to affect financial development. The weakness of the research for future research is that this research only discusses cashless, which consists of ATM/Debit, credit cards, and electronic money. However, the study did not include paper-based payments (cheque and giro bilyet). Using electronic money has a positive effect on GDP rate because it is driven by the ease of using electronic money. As a result, public consumption increases (Mashabi & Wassiaturahma, 2021). The difference between this study and the research of Mashabi and Wassiaturahma (2021) is the proxy for economic growth measured by GDP. However, this study uses the economic growth rate proxy (GDP rate) to measure economic growth. The limitations of this study include: limitations in variables, the electronic payment system in Indonesia is not only based on cards and electronic money, but there are still many other electronic payment tools, but this study only uses three payment tools.

Hypotheses two: Banking technology as measured by BI-RTGS and electronic money have positive affect to economic growth.

In this study, we attempt to address specific gaps in the extant literature in its fundamental domain by examining financial development and economic growth. The banking technology indicator in this study is a modification of previous research by Medyawati and Hegarini (2011), and Medyawati and Yunanto (2013), which is, using BI-RTGS as measured by nominal transactions. Apart from BI-RTGS, the nominal value of e-money transactions is also a consideration because during the Covid-19

pandemic, transaction activities through mobile devices showed an increase (Walfajdri & Dewi, 2021). This study develops on the previous research (Medyawati & Hegarini, 2011); Medyawati & Yunanto, 2013) focusing on the role of banking technology in economic growth.

3. Research Methods

The study's secondary data, which were gathered quarterly from multiple sources between 2010 and 2022. The data sources are Bank Indonesia (BI) and Financial Services Authority (OJK) publications in the form of Indonesia Banking Statistics, Indonesia Financial Statistics (IFS), and PBS (Central Bureau of Statistics) publications. The data includes total assets of all banks (Commercial Banks, Sharia Commercial Banks, Rural Banks and Sharia Rural Banks, Sharia Business Units), nominal BI-RTGS transactions, nominal electronic money transactions (e-money), and GDP growth rate at constants 2010 prices. The definition of the BI-RTGS system is an interbank electronic fund transfer system in rupiah currency whose settlement is carried out per transaction individually. BI-RTGS transaction value is the nominal / value of transactions processed in the BI-RTGS system at a certain period of time. (Bank Indonesia, 2005). The definition of electronic money in Bank Indonesia regulation no. 16/8/PBI/2014) in article 1 paragraph 3 that electronic money is a payment instrument that fulfills the elements, among others, the value of money is stored electronically in a media server or chip.

The research model is estimated using VECM, because the data is in the form of data from time series. Widarjono (2007), explained that often economic theory has not been able to determine the right specifications. For example, the theory is too complex so simplifications must be made or vice versa. Econometricians have developed a model that can help solve these problems, namely with the existence of an equation model called Vector Autoregression (VAR). The VAR model is built with the consideration of minimizing the theoretical approach with the aim of being able to capture economic phenomena well. Thus, VAR is a non-structural model or an atheoretical model, which may indicate a potential bias in the results. The VAR model is a linear model, so there is no need to worry about the shape of the VAR model. All variables both endogenous and exogenous that are believed to be interconnected can be included in the model (Widarjono, 2007).

VAR model specifications include variable selection and the number of time intervals used in the model. The estimation handle can as it were be done beneath the overidentified and just-identified conditions. Judging from the t-test, VAR estimation comes about are frequently inadmissible. The idleness of endogenous factors within the VAR framework may not be factually critical. In addition, the person coefficients within the VAR show are troublesome to translate. Econometricians utilize drive reaction investigation to track the reaction of endogenous factors in a VAR system due to a stun or alter within the unsettling influence variable (ϵ). Some important analyses that can be generated in a VAR model are impulse response, variance decomposition and causality test (Widarjono, 2007). Secondary data were tested with steps including unit root test, determination of the optimal level of inaction, cointegration test, causality test, VAR model stability test (AR Roots Table), impulse response analysis and variance decomposition. The VAR and VECM formation process is presented in Figure 3. The software used as a tool in data processing is E-views ver. 12.

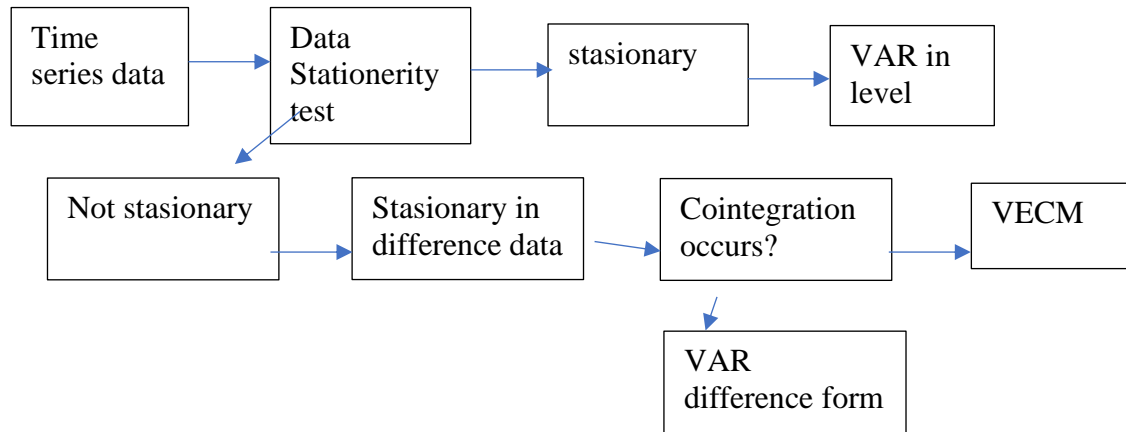


Fig.3: VAR and VECM formation process (Widarjono, 2007)

4. Result and Discussion

The identification of equations in this study was carried out by using the formula: $Kk \geq m-1$ (Gujarati, 2003), which makes the conditions obtained more identifiable. In this study, the amount of information obtained exceeds the desired number of estimated parameters. The first stage is the unit root test to ensure that the model that can be used is VECM. The result of the data from the stationarity test show that all variables in this study are not stationary at the level. This indicates that the data can be analyzed using the VECM model. The complete unit root test results are presented in Table 1 below.

Table 1. Level Data Stationarity Test Results

Variable	ADF t-Statistic	Mc Kinnon		Description
		Critical Value 5%	Prob.	
Assets	-0,014318	-2,922449	0,7838	Not stasionary
E-money	1.987714	-2,935001	0,8389	Not stasionary
BI-RTGS	-1.585024	-2,919952	0,9887	Not stasionary
Economic-Growth	-2.565189	-2.919952	0,9887	Not stasionary

Source: Data processed form Eviews 12

The next step is the differentiation process, which is a process of finding the difference between the data from one period to another in a sequential manner. The resulting data is called first-level differential data (first difference) (Widarjono, 2007). The cointegration test results indicate the existence of a long-term relationship between the variables studied. These results also determined the form of VAR that will be estimated later, namely VECM. The cointegration test results are presented in Table 2 below.

Table 2. Cointegration test results

No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.821186	2.772.361	1.595.297	0.0000
At most 1 *	0.721373	1.963.298	1.256.154	0.0000
At most 2 *	0.591443	1.362.695	9.575.366	0.0000
At most 3 *	0.470327	9.419.872	6.981.889	0.0002

Trace test indicates 3 cointegrating eqn(s) at the 0.05 level

Source: Data processed form E-views 12

The results in Table 2. Show the existence of cointegration in the variables studied, that is, the variables of total bank assets, BI-RTGS and economic growth rate, indicating a long-term relationship. The next test is the causality test (Table 3), namely the Granger causality test at Lag 1.

Table 3. Lag 1 Granger causality test results

Null Hypothesis	Obs	F-statistic	Prob.
DELEK1 does not Granger cause DRTGS	49	527.474	0.0262
DRTGS does not Granger cause DELEK1		0.15713	0.6936

Source: Data processed form Eviews 12

The complete results of the Granger causality test at lag 2 can be seen in Table 4.

Table 4. Lag 2 Granger causality test results

Null Hypothesis	Obs	F-statistic	Prob.
DLAJU does not Granger cause DASBANK	49	481.417	8.E-12
DASBANK does not Granger cause DLAJU		378.557	0.0304
DELEK1 does not Granger cause DRTGS	48	289.425	0.0662
DRTGS does not Granger cause DELEK1		114.834	0.0001

Source: Data processed form Eviews 12

In lag 2, there is a two-way causality, that is, the electronic money transactions influence BI-RTGS transactions, and vice versa, that is, BI-RTGS transactions influence electronic money transactions. From these results it is suspected that Indonesia people have started to make more use of these two payment methods to complete their transactions. The increase in volume in the use of electronic money through mobile banking, especially for e-commerce transactions, was triggered by the Covid-19 pandemic, which restricted people from leaving home to do their shopping (Walfajri & Dewi, 2021). Digital economy and finance transactions continue to grow driven by Bank Indonesia's policy to accelerate the digitization of payment systems to support national economic recovery. Recent developments show that the development of digital economy and finance continues to increase rapidly supported by the increasing acceptance and preference of the public in online shopping, expansion and convenience of digital payment systems, and acceleration of digital banking. Electronic Money (EU) transaction value in 2022 grows 36.0% (yoy) or approximately 400 trillion rupiahs. (Bank Indonesia, 2022).

Table 3. Lag Length Criteria Results

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-3.994.533	NA	3.70e+62	1.667.722	167.0841*	1.668.901
1	-3.906.266	1.434.342	1.40e+62	1.657.611	1.685.679	1.668.218
2	-3.807.117	128.0675*	4.02e+61*	164.2965*	1.695.983	166.3001*

Based on the results from the output of AR Roots table with a range of modulus values 0.188020-0.818580. The AR Roots Table test results with the e-views application showed that the VAR model has stabilized at lag 2. This result is further strengthened through the lag length criteria test. The lag length criteria could be seen in Table 3, the maximum lag is two (2). In the next process, the results of the lag length criteria (indicated in asterisks), the candidate interval by LR, FPE, and AIC is 2. The selection criteria used in this study is based on the smallest AIC value. The optimal lag obtained is 2 (2 quarterly months).

Using the two VAR properties—the variance decomposition and the impulse response function—is the next stage in the analysis. Within a standard deviation of the system's variables, the model's impulse response function validates the projected dynamic response of every variable. The taking after is the reaction of economic growth to the shock of the variable total assets, electronic money and BI-RTGS as seen in Figure 4.

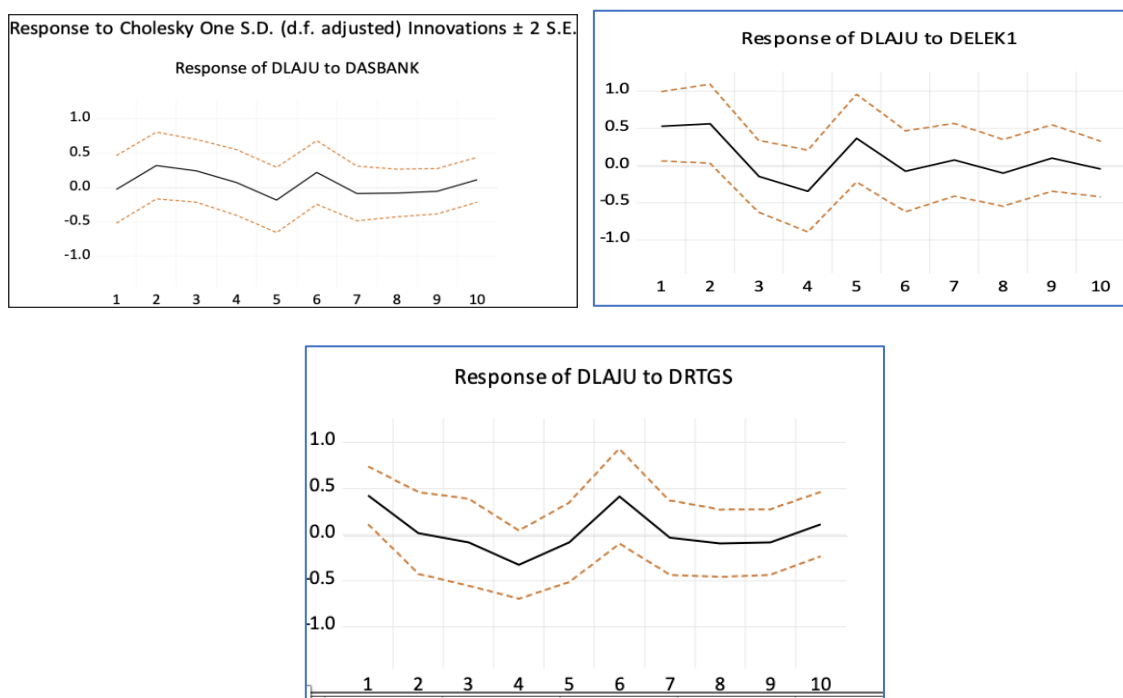


Fig.4: Shock of variable assets, electronic money and BI-RTGS to economic growth.

Based on Figure 4, it can be concluded that the shock of assets and electronic money is getting a positive reaction from economic expansion in the first month. This means that all three variables affect economic growth, and that all hypotheses in this study are accepted. This result supports the theory put forward by Todaro and Smith (2015) financial development that technology is one of the important factors for economic growth. The results of this study are in line with Levine (1997), Levine, Loayza and Beck (2000), Kar and Pentecost (2000), Inggrid (2006), Chung, Sun and Vo (2019), Zakaria and Basah (2021), and Mashabi and Wassiaturahma (2021) that financial development has an impact on economic growth.

The electronic money variable responded positively to the economic expansion rate in the first and second quarters. This shows that people are enthusiastic about using electronic money as a tool for transactions and widely chosen by Indonesians for transactions (Walfajri & Dewi, 2021). This is reinforced by Bank Indonesia in the 2022 Economic Report that the value of digital economic and financial transactions in Indonesia continues to grow in the face of the return of offline shopping patterns e-commerce transactions, and electronic money transactions are growing rapidly with Compound Annual Growth Rate (CAGR) values from 2018-2022 reaching 35.1% (e-commerce) and 53.3% (electronic money). Electronic money payment instruments continue to grow above 30% as the ecosystem becomes more connected to e-commerce, ride-hailing and food delivery. By 2022, the value of electronic money transactions has grown by 36% (yoy) (Bank Indonesia, 2022). However, the negative response is seen in the third and fourth quarters, as indicated by the decreasing trend during that period.

Almost the same condition also occurs with the BI-RTGS. The decline in BI-RTGS transactions occurred during the Covid-19 pandemic. Bi-RTGS transactions are usually carried out by going directly to the bank. This due to the large-scale social restrictions (PSBB) imposed by the government so that people cannot make bank transactions with BI-RTGS. The decline in BI-RTGS transactions reached 895 billion rupiah (Kandipi, 2020). However, BI-RTGS transactions as one of the payment systems at Bank Indonesia still showed a relatively high growth percentage of 15.3% or around 98,247 trillion rupiahs. The BI-RTGS variable shock in the first and second quarters showed a negative response as shown in Figure 4.

The following step is the examination of variance decomposition. Typically to demonstrate the relative significance of each variable within the VAR system based on the shock experienced. The percentage contribution of the expected economic growth variable changes in terms of electronic money, variable assets, and BI-RTGS of economic growth is shown in Table 4.

Table 4. Variance Decomposition Result

Period	SE	Dasbank	Delek1	Drtgs	Dlaju
1	1.69404	0.03006	9.63311	6.26814	3.78626
2	1.83662	3.00340	1.75734	5.35765	3.23437
3	1.90059	4.39648	1.70034	5.20182	3.06090
4	2.10464	3.69907	1.65772	6.68743	2.52616
5	2.18828	4.12330	1.81340	6.32978	2.37092
6	2.24933	4.83464	1.72905	9.40038	2.257.117
7	2.27676	4.87215	1.69916	9.19945	2.232.018
8	2.29011	4.94158	1.69861	9.26195	2.223.959
9	2.29897	4.96636	1.70590	9.33011	2.211.140
10	2.30685	5.16356	1.69855	9.49957	2.195.894

Table 4 provides information that economic growth can be explained or influence by economic growth itself by 3.78%. Almost all variables showed a decreasing percentage in the second quarter, with regards to, electronic money, and BI-RTGS variables. Nevertheless, variables that show a percentage increase when compared to first quarter are total bank assets. In the first quarter, the shock from the electronic money variable immediately provided a positive response to economic growth, with quite a significant percentage of 9.63%. This percentage is the largest within all quarters in the table. However, in contrast, in the second quarter there was quite a drastic decline, being only 1.75%. The effect of the electronic money on GDP is positively related because it is driven by the ease of using electronic money, thus increasing public spending. This boosts country’s economy (Mashabi & Wasiaturrahma, 2021), and it has a long term effect (Tee & Ong, 2016). On the opposite, another condition that occurs is that, overall economic conditions tend to moderate down as shown by a diminish within the export performance in Indonesia. However, domestic demand is still solid. Therefore, the Indonesian economy is still upheld (Bank Indonesia, 2022).

Different conditions occur in the variable-total assets of the bank. In the first quarter, the response to the shock of the asset variable was positive, but only with a relatively small percentage of 0.030%. Second largest percentage can be seen in the assets variable, i.e 3.0%, 5.35% of BI-RTGS and 1.75% of electronic money. As the fifth quarterly month, the percentage contribution of total assets of bank slightly increased and continued to increase until the ninth quarter.

According to Wong et al. (2020), cashless could increase economic growth through three transmission channels, namely the consumption channel, investment channel, and government expenditure channel. Based on Figure 5, payments without cash will impact providing direct credit to consumers, thereby increasing purchasing power and spending for purchasing goods and services (Zandi, Singh & Irving, 2013; Zandi, Koropecjy, Singh & Matsiras, 2015).

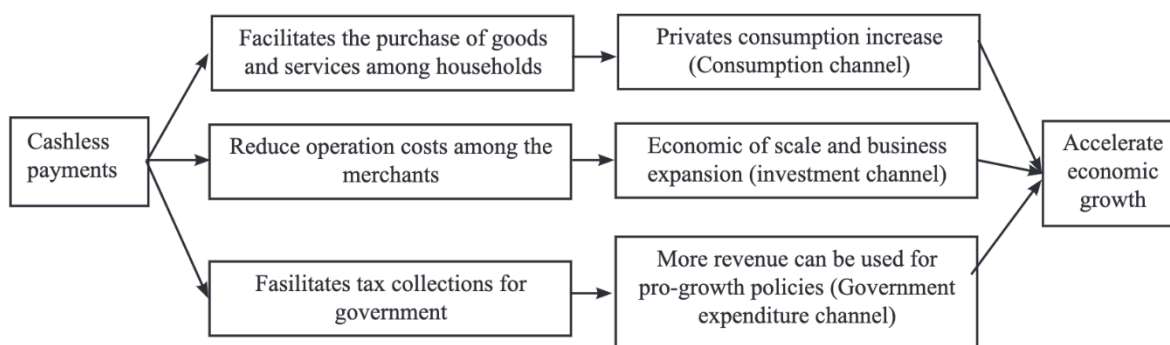


Fig.5: Non cash transmission channel on economic growth

This study's use of the BI-RTGS variable is consistent with previous research conducted by Medyawati and Yunanto (2014) in terms of reliability. As of the ninth quarter, the BI-RTGS variable's contribution percentage to economic growth is 9.4%, which is moderately expanding. But when looking back at earlier research, the optimal latency found in that study was the same; however, the lag duration was just two quarters of a month as opposed to eight months for the previous VAR models (Medyawati & Hermana, 2010). The BI-RTGS system provides many benefits in addition to increasing the certainty of settlement finality for each payment transaction. This minimizes settlement risk. The BI-RTGS system is also a practical, fast, efficient, safe and reliable means of inter-bank fund transfer. In addition, the BI-RTGS system, which is equipped with a centralized checking account mechanism, is a reliable means to increase the effectiveness of fund management for both participants, monetary and banking authorities. For the authority, information on the management of banking funds support information related to carrying out monetary operations and early warning system for bank supervision (Bank Indonesia, 2023).

5. Conclusion

This study contributes to the literature on the relationship between banking technology and economic growth by providing empirical evidence from Indonesia, one of the largest emerging economies in the world. The findings suggest that electronic money transactions have a positive impact on economic growth, while BI-RTGS transactions have a negative impact in the short run but a consistent influence in the long run. The study also highlights the increasing adoption of these payment methods in Indonesia, as evidenced by the two-way causality between electronic money and BI-RTGS transactions. These results have important implications for policymakers and industry stakeholders, emphasizing the need to promote the development and adoption of banking technology to support economic growth. Digital economic and financial transactions continue to grow and have been encouraged by Bank Indonesia's policy to accelerate the digitization of payment systems to support national economic recovery (Bank Indonesia, 2022). However, the study has limitations, such as the lack of dummy variables to account for the Covid-19 pandemic and the focus on a specific set of banking technology indicators. Future research could address these limitations by incorporating additional variables, such as mobile banking and internet banking, and examining the impact of banking technology on different sectors of the economy. Despite these limitations, the study provides valuable insights into the role of banking technology in promoting economic growth and contributes to the ongoing debate on the digital transformation of the financial sector in emerging economies.

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