UNIVERSITAS ANDALAS

ANALYSIS OF THE RELATIONSHIP BETWEEN NON-CASH PAYMENT AND OUTPUT IN INDONESIA

THESIS

RAISSA SALSABILA

1710512027

Thesis Advisor:
Yessy Andriani, SE, M.IDEC

DEPARTMENT OF ECONOMICS

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ANALYSIS OF THE RELATIONSHIP BETWEEN NON-CASH PAYMENT AND OUTPUT IN INDONESIA

by

Raissa Salsabila
1710512027

Submitted to the Department of Economics
in partial fulfillment of the requirement for the degree of
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Author .....
Department of Economics
August 24th, 2022

Certified by .....
Yessy Andriani, SE, M.IDEC
Thesis Advisor

Accepted by .....
Hadi Rahadian, SE, M.Si
Head of SI International Economics Study Program

Approved by .....
Dr. Fajri Muharja, SE, M.Si
Head of Economics Department

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Abstract

The rapid development of science and technology impacts all sectors of the economy, which causes changes in the payment system and how people view transactions. In the current era of digitization, any technologically oriented economic activities can make it easier for the community to trade, raising consumption and, ultimately, increasing output. The purpose of this study is to analyze of the relationship between non-cash payments and output (GDP) in Indonesia for the period 2010-2021, and the variables used in this study are the number of transactions from credit cards, ATM/debit cards, electronic money, and gross domestic products. This study uses Vector Error Correction Model (VECM) analysis using quarterly time series data. The results of this study indicate that the use of non-cash payment instruments in the community, which includes APMK (credit card and ATM/debit card) and e-money, has a positive impact on increasing GDP both in the long and short term. Utilizing this instrument can positively impact transactional efficiency, community consumption, and productivity, all of which can lead to a rise in GDP.

Keyword: Non-Cash Payment, Credit Card, ATM/Debit Card, E-Money, GDP
Thesis Advisor: Yessy Andriani, SE, M.IDEC

DECLARATION OF ANTI-PLAGIARISM

I hereby declare that this thesis entitled **"Analysis of the Relationship between Non-Cash Payment and Output in Indonesia"** is written by myself, and there is no part that contains the phrase, idea, or opinion from another source without giving acknowledgment to the original author. The parts that are sourced or taken from other people's work have included the source in accordance with the norms, ethics, and rules of scientific writing. If anyone finds plagiarism in this thesis, I am willing to accept the sanction of revocation of academic degrees that I have gained.

Padang, August 24th, 2022

The giver of statement,

Raissa Salsabila

1710512027

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CHAPTER I

INTRODUCTION

1.1. Background

Human life essentially always follows the developments of the times that occur at that time. It can be seen that the dynamics of today's society have changed the pattern of life and have developed a new life order that leads to social, economic, cultural, defense, security, and law enforcement changes, as well as new thinking patterns influenced by scientific and technological advancements. Science and technology have extended throughout numerous aspects of life, one of which impact on economic activities, namely the financial and banking industry. Financial innovations have emerged in this industry, resulting in modifications to the payment system.

The payment system has evolved to follow the evolution of money due to several driving elements such as technological innovation and business models, community traditions, and authority rules. Payment technology innovations emerge at a rapid pace when a payment mechanism is required to meet every need of the community in terms of transferring funds quickly, safely, and efficiently, leading to efforts to strengthen infrastructure and develop systems based on advances in information technology.

This development was also observed by Bank Indonesia, which, in line with the Bank Indonesia Act No. 3 of 2004, has the ability and responsibility to control and maintain stable payment methods for both cash and non-cash payment systems. One of the most crucial components of a nation's financial infrastructure is a reliable and efficient payment system, which can help prevent financial crises, provide financial assistance, and stimulate economic activity by streamlining and simplifying the payment process (Taghiyev, Eminov, & Guliyev, 2016).

The payment system's importance in the economy is growing in tandem with the volume and value of payment transactions. To ensure the smoothness and security of the payment system, Bank Indonesia has implemented policies that focus on four main aspects: increasing security, and efficiency, expanding access to the payment system, and paying attention to consumer protection. The ease with which transactions may be completed through a seamless, efficient, rapid, and secure payment system has an impact on financial system stability, monetary policy implementation, and the smooth functioning of economic operations.

One standard means of payment used by the public is currency, namely banknotes and coins. Money has a significant impact on the economy since it, among other things, can boost consumer and producer efficiency as well as overall economic activity. The demand for money in Indonesia could, however, change as it develops. Because it has to do with how important money is as a medium of exchange and how important it becomes as the economy expands, the symptom of rising demand for money is an economic reality. A growing and developing economy has the consequence of increasing transactions that require money to facilitate the payment process; by using money as a means of payment in transactions, the economy of a country will run well so that the goal of the state is achieved, namely realizing a just and prosperous society. Bank Indonesia, as the monetary authority, has to always maintain the stability of the Indonesian economy, one of which is through the amount of money in circulation which is usually determined by the level of prices of goods and services available. The amount of money circulating in the community needs to be regulated as well as possible so as not to have a negative impact on monetary objectives.

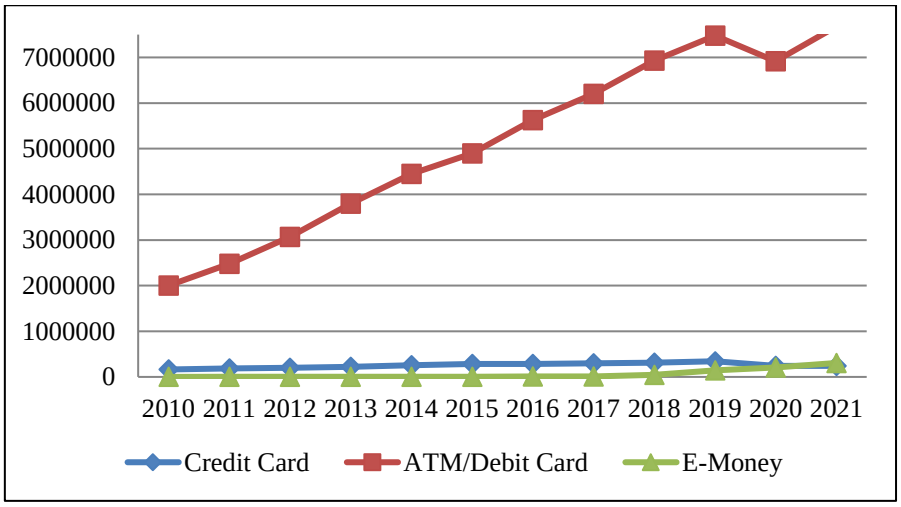
The usage of currency, however, eventually led to issues. It is acknowledged that the high proportion of cash used in payment transactions has various flaws, including the case of impracticality, the high cost of money management, and chances for criminal activity, specifically seizure and money laundering. In order to make payments more efficient, it is therefore required to build new payment systems.

Technology advancements are gradually displacing cash payments in transactions in favor of non-cash payments. Bank Indonesia also supports this; the country's central bank, on August 14, 2014, launched the Gerakan National Non Tunai (GNNT) to increase the value of non-cash payment transactions to reduce cash in circulation and also reduce the cost of printing money circulating in the community and will strengthen public understanding of the importance of using non-cash transactions. Bank Indonesia will also improve the quality of electronics as a means of non-cash payment transactions and enhance infrastructure in carrying out economic activities when transacting to encourage the replacement of the cash payment tradition with non-cash payments.

The scope of non-cash payment instruments consists of APMK (credit card and ATM/debit card), payments using checks, credit and debit notes, and e-money. Still, in this study, the author will focus on the proportion of non-cash payments using APMK (credit card and ATM/debit card) and e-money as transaction tools used by the community for economic activities that can directly affect the volume of transactions and the velocity of money in the Indonesian economy. The encouragement of this payment system will cause a multiplier effect on economic activity, directly related to the velocity of money.

According to Irving Fisher's theory, this phenomenon shows the connection between the quantity of money demanded and the number of transaction levels that offer the speed of money transfer. The size of the demand for money can be seen from the composition of liquid base money, namely currency and demand deposits, for example, APMK and e-money. Therefore, this non-cash transaction variable can be related to the output, as seen in Indonesia's total Gross Domestic Product (GDP).

Figure 1.1 Transaction Value of Non Cash Payment for 2010 – 2021



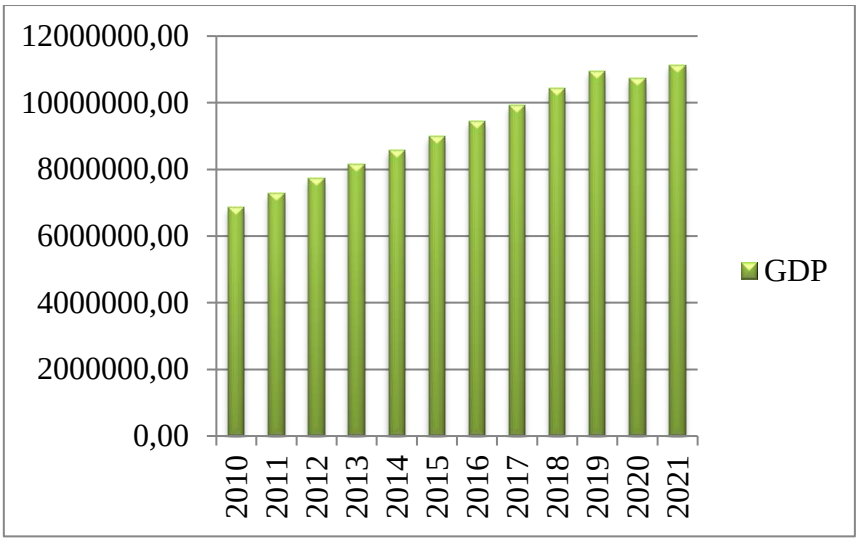
Source: Bank Indonesia (data processed)

According to the data in the figure above, the value of transactions made with credit cards, debit cards, and e-money tends to rise annually; however, in 2020, it fell as a result of the COVID-19 pandemic, which led to some regulations that restricted people's ability to engage in economic activity. This is due to developing secure, helpful, and effective non-cash payment methods that have gained widespread acceptance in society (Syarifuddin, Hidayat, & Tarsidin, 2009). The development of non-cash payment methods cannot be separated from Bank Indonesia's initiatives to make payments more convenient and from incorporating electronic money in a rapidly expanding digital environment. To facilitate the growth of the digital economy and finance, Bank Indonesia will continue to enhance the functionality of the payment system.

The presence of the non-cash payment instruments stated above is not just a result of innovation in the banking industry. Still, it is also a result of the public's demand for useful payment methods that may make transactions more convenient. The ease of transactions can encourage a decrease in transaction costs and, in turn, can stimulate economic growth. The non-cash payment system's function will significantly impact a nation's economy, especially given the large value payment

system's growing dominance over the small value payment system. The effectiveness and ease of the non-cash payment system will help the overall national financial system and directly influence the people who use it. The graph below shows Indonesia's output from 2010 to 2021 based on Gross Domestic Product:

Figure 1.2 Gross Domestic Products for 2010 – 2021



Source: Central Bureau Statistics (data processed)

From the data above, it can be seen that Indonesia's gross domestic product has increased from 2010 to 2021, and it can be seen from 2010 to 2019 that it continues to grow. Only in 2020, there is a dip because of numerous regulations in community activities, but in 2021, it increased again. As can be observed, Indonesia's gross domestic product rose concurrently with the growth of the non-cash payment system.

The above phenomenon of non-cash transactions shows Indonesia's market efficiency, which raises the velocity of money and offers a way for the real sector of the economy to become financially included by managing and regulating the money supply. As the velocity of money rises through economic activities, the demand for money supply decreases. Non-cash transactions are expected to be utilized indefinitely to influence consumers' economic decisions to keep transacting, and producers can lower manufacturing and distribution costs to boost Indonesia's

economic growth (Arner, Buckley, & Barberis, 2016). According to Irving Fisher's theory of money demand, if the velocity of money is higher, the money supply will fall, as seen graphically by the shift in the LM and AD curves, resulting in a reduction in income.

The presence of non-cash payment instruments can encourage economic growth and stimulate various business activities. Economic actors will be encouraged to transact along with reduced barriers to transactions in terms of cost, effort, and time. This will undoubtedly contribute to an increase in economic activity and GDP. How big the contribution, in this case, will depend on its share of the total cost, effort, and time of business activity. If the expenses, energy, and time reduction from the non-cash payment transactions are significant, this can stimulate business activities. However, if it is relatively small, the impact on increasing economic activity and GDP is also insignificant.

Several recent studies that many international organizations have carried out illustrate that the existence of an electronic payment system will have a positive effect on consumption levels, where a 1% increase in the value of non-cash payments will affect an increase in real GDP of 0.08% in developed countries and 0.08% in developed countries 0.11% in developing countries (Zandi, 2013). According to Pramono et.al (2006) the presence of non-cash payment instruments for the economy offers the benefits of increased financial efficiency and productivity, which encourages real activity and can further encourage economic growth and improve people's welfare as indicated by an increase in money velocity. Furthermore, research on the impact of non-cash payments on the economy has been carried out by Nirmala & Widodo (2011), Syarifuddin et al. (2009), Oyewole et al. (2013), Nwankwo & Eze (2012), and Hasan (2012). The results of this study conclude that an increase in non-cash payments will stimulate economic growth and shift the role of cash payments. Therefore, further advancement is required to enable non-cash payments to continuously increase, to increase the output, and provide a better improvement in economic growth.

The evolution of the phenomena demonstrates the importance of APMK (credit card and ATM/debit card) and e-money as non-cash transaction tools for ensuring financial stability and economic prosperity. Several studies have found that the number of transactions using non-cash (APMK and e-money) impacts the monetary amount of the money supply (M1). Still, this study examines the causal relationship between non-cash payment and output as seen from the total Indonesian Gross Domestic Product (GDP) and also explains quantitatively and qualitatively the relationship between non-cash transactions (APMK and e-money) and Indonesia's output based on Gross Domestic Product (GDP).

Based on the explanation above with the phenomenon of increasing non-cash payments in Indonesia and the findings of earlier studies, this study will investigate **"Analysis of the Relationship between Non-Cash Payment and Output in Indonesia"** in the latest year to prove the theory and to add literature for further research.

1.2. Research Problem

Increased transactions using non-cash payments (APMK and e-money) can increase gross domestic product by increasing the output produced due to increased public consumption with the ease of transactions, but if it is a gross domestic product that influences the increase in non-cash payments (APMK and e-money) because the higher the value of the gross domestic product can increase the amount of non-cash payments. Therefore, to see the analysis of the relationship between non-cash payments and output based on gross domestic product, the problem formulation of this study is as follows:

a. What are the non-cash payments (APMK and e-money) effect on output based on the gross domestic product in the long term?

b. What are the non-cash payments (APMK and e-money) effect on output based on the gross domestic product in the short term?

1.3. Research Objectives

Based on the description of the background and the formulation of the problem that has been described, it is necessary to know the objectives of this study are as follows:

a. To determine how the long-term relationship between non-cash payments (APMK and e-money) affects output (GDP).

b. To determine how the effect of the short-term relationship between non-cash payments (APMK and e-money) and output (GDP).

1.4. Research Benefits

The relationship of non-cash payments (APMK and e-money) and output (GDP) is investigated in this study. The final results to be achieved in this study are the benefits that include:

1.4.1. For the author

It was enriching scientific insights and honing the skill of writing scientific things. Furthermore, the step of writing this thesis can also upgrade the writer's soft skills along the process.

1.4.2. For readers

It can provide knowledge for readers and can be used as references and illustrations for further research in the same field. The reader also included government and any institutions which can be a reference for them in increasing policy in the area of the payment system.

1.5. Limitation of Study

Although this study has achieved its objectives, it only looked at the relationship of non-cash payments (APMK and e-money) and output based on the

gross domestic product. The non-cash payments analyzed were only credit cards, ATM/debit cards, and electronic money. Secondary data was acquired from Bank Indonesia's Payment System Statistics and the Central Bureau of Statistics. The data used in this study is quarterly time series data from 2010Q1 to 2021Q4.

1.6. Systematic Writing

The systematic writing aims to give an overall picture of this research. The following systematic writing:

CHAPTER I: INTRODUCTION

There is consists of six sub-chapters, among of that is background, research problem, research objectives, research advantages, limitation of study, and systematic writing.

CHAPTER II: LITERATURE REVIEW

This chapter discusses about non cash payment and economic growth theoretical framework that supports and relates to the variables studied which are also supplemented by previous research which is related to the title of the study and hypothesis.

CHAPTER III: RESEARCH METHODOLOGY

This chapter contains type and sources of data, definition of variables, and research model.

CHAPTER IV: EMPIRICAL RESULTS AND ANALYSIS

This chapter explains about the output of the research and the analysis from the processed of data found in the statistical descriptive analysis.

CHAPTER V: CONCLUSION

This chapter is the final part of the research which contains conclusions and recommendation obtained from the publications in the previous chapters.

CHAPTER II

THEORETICAL FRAMEWORK AND LITERATURE REVIEW

2.1. Theoretical Framework

2.1.1. Payment System

The payment mechanism is crucial for moving payments from one party to another. According to article 1, paragraph 6 of Bank Indonesia's Act No. 23 of 1999, a payment system is a collection of rules, institutions, and processes utilized to carry out financial transfers to meet an obligation arising from economic activity.

The payment system is an integral aspect of the economy and financial infrastructure. The effectiveness of the payment system in processing payments promptly, safely, and efficiently will help the financial and banking systems develop. However, a central bank's role in developing, regulating, and supervising various parts of payments is required to do this. According to Hancock and Humphrey (1998), the payment system is the backbone of the economy and the primary transaction infrastructure. The payment system is a design that enables financial markets to function and become real and provides facilities for completing deals by facilitating the exchange of value through various media.

The payment system also forms a specialization that occurs in production; when multiple payment media substitute a good, indirectly, it can increase the specialization of goods. As a result, financial markets and economies rely extensively on payment systems to allow commerce in the products and services market, impacting economic growth and money market efficiency. Simply put, a payment system is a mechanism for regulating economic transactions (Mishkin, 2008). As a result, a payment system is a design or payment mechanism that can drive economic activity and utilizing one will boost efficiency and minimize the number of transactions.

2.1.1.2. Evolution of Payment System

The payment system continues to evolve in line with the evolution of money, driven by three salient factors: technological innovation and business models, public traditions, and the policies of the respective authorities. The barter system of trade once dominated payment methods. Only when two parties who were willing to trade could not agree on a value of the exchange or if the two parties' simultaneous needs were not satisfied did problems arise.

Seeking to overcome those limitations, humans developed commodity money. Basic commodities with the intrinsic worth everyone needs, like salt, tea, tobacco, and different grains, make up commodity money. Between 900 and 6000 BC, livestock was also employed as commodity money. After agriculture developed, wheat, vegetables, and plants were used as commodity money.

Around 1200 BC, shells served as the earliest form of currency. The Chinese started making copper and metal cowrie shell replicas. The earliest known paper money dates back to white deerskin coinage that was colored in various ways and circulated circa 100 BC. The most common form of payment is now paper money. After Spain built a paper industry in 1150, Sweden became the first European nation to utilize paper money in 1661.

The transition from cash-based to cashless payment methods has been swift in Indonesia. These methods now include paper-based ones like checks and money transfers through clearing and settlement, as well as paperless ones like electronic funds transfers and card-based ones (ATM/debit cards, credit cards, and pre-paid cards).

Over the past ten years, a wave of digitalization that has permeated people's daily lives has resulted in a significant behavior change. The introduction of chip-based and server-based electronic money has increased the variety of payment instruments. Additionally, there is a demand for quick, safe, and mobile payments

using a variety of platforms, including the web, mobile, unstructured supplementary service data (USSD), and SIM Toolkit. The pattern of public consumption has also started to change (STK).

2.1.1.2.1. Cash Payment System

The earliest payment instrument invented by humans for buying and selling transactions was currency. Furthermore, the cash payment system uses cash currency in the form of banknotes and coins. The rupiah is the Indonesian currency created by Bank Indonesia.

The cash payment system is the most traditional and widely used method of payment in everyday life since it is simple to use for small-value transactions and can be transmitted instantaneously without incurring additional costs such as time, commerce, and so on (Listfield & Montes-Negret, 1994). However, the currency has various flaws, including high money procurement or printing costs, time inefficiency in use which takes a long time, and the possibility of money theft and counterfeiting. As a result, Bank Indonesia recommends converting cash payment instruments to non-cash payment instruments to reduce this risk. The most important aspect of cash circulation policy is how to provide the community's money demands in a sufficient nominal quantity, the appropriate denomination, on time, and under circulation-friendly conditions.

2.1.1.2.2. Non Cash Payment System

A non-cash payment system is made without money in circulation or cash. Non-cash payment systems can be used for the delivery, ratification, and instruction of goods and services between individuals and other parties, such as banks or domestic and foreign institutions, as long as the payment system has contracts, technology, and facilitation requirements.

Non-cash payments are made with the help of financial services and institutions other than banks. As corporate companies that receive funds from the public, banks or institutions other than banks typically provide payment traffic services to their clients. The BI-RTGS (Real Time Gross Settlement) system and the clearing system for large-value payments are among the payment traffic services supplied.

Non-cash payment instruments, such as BI-RTGS and the clearing system, have become more diverse as technology has progressed. ATM cards, debit cards, credit cards, and other electronic money forms have evolved as card-based payment tools. To make it easier for the public to use the card, the government offers facilities such as ATMs, EDC machines, and e-money reader machines in addition to payment instruments.

The development of the non-cash payment system began with paper-based payment instruments such as cheques, bilyet giro, and other slips. Since banks have promoted electronic systems and card-based payment instruments in all forms, the use of paper-based payment instruments has steadily decreased. Particularly now, electronic systems like transfers and clearance systems are becoming more commonly used.

a. Cheque

A cheque is an unconditional command from the issuer to the bank that maintains the issuer's checking account to withdraw a specified amount of money to the holder or to the person whose name is already written on the check, as defined by the Commercial Code (KUHD). Check is one of the innovations in the payment system and as a legal means of payment to overcome problems in terms of difficulties in transferring large amounts of banknotes and facilitating transactions in large quantities. Unlike cash payment systems, there are two processes in using checks: the physical flow

of checks and the transfer of funds used in the transaction (Listfield & Montes-Negret, 1994).

b. Bilyet Giro

Bilyet giro is an order from the customer to the bank that maintains the customer's current account (interested bank) to make book-entry of a sum of money from the account concerned to the named beneficiary at the same bank or another bank. The use of bilyet giro is beneficial in banking transactions, one of which is the ease of conducting transactions in large quantities. Bilyet giro holders cannot make nominal cash withdrawals because the orders only transfer funds from the checking customer's account to the beneficiary's.

c. Credit Card

Credit cards are a type of non-cash transaction that uses bank funds and has overgrown popularity in Indonesia during the 1990s. They are used mainly by the middle and upper classes. According to Bank Indonesia Regulation No. 14/2/PBI/2012 concerning the Implementation of APMK, credit cards are APMK that can be used to pay for obligations arising from economic activity, such as shopping transactions and cash withdrawals where the issuer fulfills the cardholder's payment obligations first. The cardholder must pay off the payment at the agreed time, either in lump sum or installments.

Transactions in credit cards involve several parties who have their respective roles and interests in an agreement in which the bank or financial institution is the issuer and payer of the credit card billed by the merchant. A merchant is a place of shopping for credit card holders who have been bound by an agreement with the bank or a financial institution. In contrast, the credit card holder is the customer whose name is listed on the credit card, and the party is entitled to use the credit card.

d. ATM/Debit Card

A debit card is one of the account-based card categories, where there are also other types of cards such as ATM cards and a combination of ATM and debit cards. At first, the cards circulating in the community were ATM cards. Still, with the development of ATM network infrastructure, banks innovate in issuing debit cards to create a payment system that makes transactions easier for the public. However, with the development of technology and knowledge, there are debit cards that also function as ATM cards, or what can be called debit/ATM cards.

A debit card is an APMK card that can be used to make payments for payment obligations such as shopping transactions in which there is a payment obligation and is borne by the cardholder from the cardholder's savings or savings to the bank or authorized institution, according to Bank Indonesia Regulation No. 14/2/PBI/2012. The transfer of rights possessed by the card user to another party, carried out by the bank on the card user's direction, is the status of the use of a debit card, not from the cardholder to the bank.

e. Electronic Money

Electronic Money (E-money) is a prepared card or stored value product in which the amount of money is held in an electronic card, which can also be referred to as electronic equipment. The money on the card is gained by depositing a specified amount of cash in a bank and then sending it to the owner via a funds transfer mechanism. After that, the card's owner can buy and sell items using the card. However, keep in mind that the card's balance can go down or up since the owner uses the balance to make transactions and top it up.

Electronic money (e-money) is a form of payment that meets several criteria, including being issued on the basis of the value of money deposited by the holder to the issuer, the value of money stored electronically in a medium, and the value of electronic money deposited by the holder to the issuer is not a deposit, according to Bank Indonesia Regulation No.11/12/PBI/2009 concerning electronic money (e-money).

The usage of innovative and practical electronic money is one of the non-cash payment tools that may be used to reach those who do not have access to the banking system (e-money). The purpose of issuing e-money is to make public transactions easier, more practical, and safer. There are various advantages and benefits to having e-money, including that transaction are faster and more convenient because users do not need to change and may avoid making mistakes when calculating change. The time required is significantly reduced, and the value of money or balance can be increased using the issuer's facilities and services.

2.1.2. The Concept of Money

2.1.2.1. Definition of Money

According to Mankiw (2007), economists think that money is just one type of wealth and that all wealth does not just refer to the amount possessed. Additionally, money is described as anything that may be used as a form of payment in a particular region, a way to pay off debts, and a tool for making purchases of goods and services. It can also be used as a general trade medium or a way to calculate the value of commodities or riches. Economists claim that money is a stock of assets used in all transactions. Money is an object that serves as a unit of account, a way to store value, and a medium of trade (Mishkin, 2008).

2.1.2.2. The Role of Money in the Economy

Money is a crucial tool in the economy. This device is vital to almost all economic activities. As money is always involved in current economic activities like production, investment, and consumption, the role and close relationship between money and an economy may be seen as a natural occurrence. Money has evolved to the point where it may now be sold as a commodity in the money market and used to enable trade transactions in the product's market (Lestari, 2008).

The development of economic activity can be observed from two interrelated sectors, namely the real sector (goods and services) and the monetary sector (money). The real and financial sectors are not only related; the two are like two sides of one coin that cannot be separated. Theoretically, one sector is a reflection of other sectors.

The role of money in the economy, among others, can increase efficiency for producers, consumers, and economic activity in general. However, in its development, the demand for money in Indonesia can increase or decrease. The symptom of the growing demand for money is an economic phenomenon because it is related to the function of money as a medium of exchange, which is increasingly needed when the economy is growing. A country's economy will function well and help it reach its objective of creating an equitable and prosperous society by employing money as a means of payment in transactions. An expanding and developing economy has the effect of increased transactions, which call for money to simplify the payment process.

In Indonesia, the demand for money is constantly changing every year. An out-of-control demand for money can have dire consequences for the economy. The results or harmful effects of the uncontrolled demand for money can be seen, among others, in the unchecked development of the main economic variables, namely the level of production (output) and prices.

The money supply is one of the instruments used by Bank Indonesia to spur economic activity. The money supply can also affect economic growth in a country. Money, which functions for transactions, will affect economic activities in a country, so the economy must manage the money supply properly. Bank Indonesia, as the monetary authority, must always maintain the stability of the Indonesian economy, one of which is through a large amount of money in circulation which is usually determined by the level of prices for goods and services available. The amount of money in circulation in the community needs to be regulated as well as possible so that the development of non-cash payments does not have a negative impact on monetary objectives.

The financial system is crucial to the health of the economy. The financial system works as a component of the economic system to transfer money from those in a surplus to those in a deficit. The allocation of funds will not function correctly if the financial system is unstable and inefficient. This can impede economic progress and lead to a crisis that necessitates exorbitant spending for rescue attempts.

2.1.2.3. Theory of Money

1. The Quantity Theory of Money

Classical economics established the quantity theory of money in the 19th and early 20th centuries. The quantity theory of money is a theory that describes how changes in the money supply affect changes in the price of goods. The quantity theory of money applies a more proportionate analysis to the concept of money demand and is based on Irving Fisher's and A.C. Pigou's Cambridge approaches.

a. Irving Fisher

This theory of money demand was established in the early twentieth century based on a classical school of thought known as the quantity theory of

money, which explains the role of money in the economy. Irving Fisher first proposed the notion in 1911 in his book "The Purchasing Power of Money," titled "The Quantity of Money." This theory states that the money supply's growth and the money's velocity have a direct link that can affect output or economic growth. The following equation expresses Fisher's analysis:

$$\mathbf{MV = PT}$$

Where:

M	: Money	P	: Price
V	: Velocity of Money	T	: Transaction

Fisher is interested in the relationship between the quantity of money (money supply) and nominal GDP in this theory. The velocity of money is a notion that connects money, pricing, and transaction. According to Irving Fisher, the velocity of money is governed by economic institutions, which impacts how people conduct transactions. Institutional elements are difficult to change in the near term. As a result, the velocity of money will remain unchanged in the short term. Because of Fisher's belief that the velocity of money is constant in the short run, the equation of exchange has been changed into the quantity theory of money, in which changes in the quantity of money govern nominal income.

People will use cash less frequently if they utilize various cards to complete transactions, resulting in a decrease in the money supply relative to national income and an increase in the velocity of money. In contrast, if consumers are more comfortable making cash payments, they will use more money to do transactions with the same nominal income level, lowering the velocity of money and increasing the money supply (M). As a result, the preceding equation demonstrates that as the money supply (M) changes, the nominal income also changes.

b. Cambridge Models

The Cambridge model is a money demand model developed by Cambridge economists, particularly Marshall and Pigou. They view money as a medium of exchange, but the Cambridge model also recognizes that money serves as a store of wealth. Therefore, humans have two choices in storing their assets: cash and securities or goods.

This method highlights the role of money demand in describing how money supply affects the price level. According to this Cambridge model, the demand for money is driven not just by the level of transaction volume (real GDP) but also by the level of a person's wealth, interest rates, and people's future expectations. The demand for money had a proportional relationship with nominal income, according to the Cambridge economists, because the value of assets was determined at face value, as follows:

$$\mathbf{Md = bPY}$$

Where:

Md	: Money Demand	Y	: Real output level (real GDP)
P	: Price Level	b	: Constant

Based on the equation above, parameter b can fluctuate along with people's behavior in using money to save wealth. People's behavior is also influenced by the expected acceptance of using other stores of wealth, such as stocks and bonds.

2.1.2.4. Financial Innovation

Money is a legal form to exchange many goods and services in an economic system. Money comes in various forms, affecting purchasing power differently over time. Money can be separated into multiple different forms historically. M0, M1, and M2 all exist. M0 refers to societal money or currency used outside urban and rural

commercial banks. M1, which also contained M0, demand deposits, and other checkable deposits, comes next. The final one was M2, which also featured money market deposit accounts, money market mutual funds, time deposits, savings deposits, and money market mutual funds.

Financial innovation will replace traditional money as we know it and impact both the supply and demand for money. Over a specific period, different forms of money will affect purchasing power. The divide in monetary levels would follow the advent of financial innovation.

Financial innovation is the appearance of new ideas or improvements put into practice to alter company settings and enhance situations (Blach, 2011). In their 1987 article, Pantalone and Welch discuss the variables affecting financial innovation. There are two circumstances in which financial innovation can be distinguished and used. First, when the conventional financial solution is no longer available, and second when the costs of introducing new financial innovations are less than those of traditional legacy solutions.

2.1.3. Velocity of Money

The average number of times per year (turnover) that one unit of currency is used to buy total products and services in the economy is known as the velocity of money (Mishkin, 2008) and is also a measure of the economy's money exchange rate. Meanwhile, Mankiw (2006) distinguishes between two types of money velocity:

1. Transactions Velocity of Money, which quantifies the pace at which money circulates in the economy and is defined as the number of times money changes hands in a given period of time.

2. Income Velocity of Money is the number of times money enters a person's income over a specific period.

The velocity of money is a measurement of the rate at which the money supply is used to buy goods and services. Economists and investors use it to evaluate the economy's health and vitality. When the speed of money circulation increases, transactions between economic actors also increase, which is usually associated with a healthy and developing economy. Conversely, when money circulation's velocity decreases, economic actors' transactions also decrease; this is generally associated with recession and contraction.

2.1.4. Gross Domestic Product (GDP)

2.1.4.1. Definition of Gross Domestic Product (GDP)

The initial concept of GDP came from the idea of an English economist named William Petty, which was developed between 1654-1676. American economist Simon Kuznets created the standard definition of GDP in 1934. After the 1944 Bretton Woods conference, GDP became a popular metric for gauging a nation's economic health.

In a country's economy, an indicator is used to assess whether the economy is going well or poorly. The total income earned by everyone in the economy must be calculated using hands when examining the economy. The right and appropriate hand in carrying out these measurements are Gross Domestic Product (GDP). GDP is the most important economic statistic because it is considered the best measure of people's welfare. GDP is the total added value produced by all business entities in a nation over a specific period. The final goods and services provided from production must equal the value of the goods used. According to Sukirno, GDP is the national product produced domestically in a nation and held by both citizens and foreigners. A country's capacity to generate goods and services in a given year is gauged by its GDP.

In an economy, whether in developed or developing countries, the production of goods and services comes not only from that country but also from other countries.

It is always found that production elements with international origins contribute to national production. Multinational corporations operating in numerous nations will contribute to raising the value of the goods and services produced in these nations. These international corporations support the countries where they do business by donating finance, technology, and knowledge. The nation's operations have more goods and services, use more labor, generate wealth, and frequently increase exports. These operations play a significant role in a nation's economic activities. It is necessary to convert the value of contributed production into national revenue expressed as GDP. Thus, GDP can be interpreted as the value of a country's goods and services produced by the citizens of that country and foreign countries in that country.

Consumption may increase at this time, while the increase in production capacity can only be realized in the future. Therefore, economic growth that enables a nation to fulfill its economic goals is required to lessen the burden of scarcity. In order to meet customer demand and end scarcity, new business models can be developed that can increase the number of goods and services.

The Gross Domestic Product (GDP) growth rate is used as an indicator to determine economic growth. The economy is said to be growing, namely, when the real income of the community in a specific year is greater than the real income of the community in the previous year. Therefore, economic growth may also be defined as the expansion of a nation's economic activities as measured by Gross Domestic Product (GDP). Additionally, GDP measures the total governmental spending on the goods and services produced by the economy and the aggregate income of all people participating in it. GDP can measure total income and expenditure because, for an economy as a whole, income must equal expenditure.

It is required to give GDP numbers that can illustrate the occurrence of these occurrences to describe various economic changes. GDP is the total added value produced by all business entities in a nation over a specific period. The value of the

products used must match the overall worth of the finished goods and services that were produced. GDP at constant prices depicts the additional value of these products and services, determined using prices that were in effect in one specific year as the base year. GDP at current prices portrays the added value of goods and services that are computed using the prevailing prices yearly. A country's economic structure and shift are assessed using its GDP at current prices. The ability of resources to promote real economic growth from year to year or economic growth unaffected by pricing considerations, on the other hand, is assessed using constant GDP. By computing the GDP deflator, price changes can be estimated using GDP (implicit index change). The implied price index is the difference between GDP at current prices and GDP at constant prices.

2.1.4.2. Gross Domestic Product (GDP) by Expenditure Method

The calculation in this way is by adding up all expenditures from all levels of society. All types of income are either spent on various goods and services or saved. Expenditure in this method is divided into:

a. Personal consumption expenditure and household expenditure, which consists of durable and non-durable goods. This expenditure is commonly abbreviated as C.

A household is defined as an individual or group living together in a residential building, collecting some or all of their income and wealth, and collectively consuming goods and services, mainly food and housing. Spending by resident households on goods and services with the intention of final consumption is known as household consumption expenditure.

Final consumption refers to using products and services to satisfy domestic requirements. The value of goods and services derived from purchases, the estimated value of goods and services derived from barter transactions, the estimated value of goods and services originating from

employers as part of labor compensation, and the estimated value of goods and services produced for own consumption all fall under the category of final household consumption.

b. Government consumption spending, sometimes known as government expenditure or G.

The government is an institutional unit created through a political process that has jurisdiction over other institutional units within a nation or region in legislative, judicial, and executive institutions. Governmental entities participate in economies as producers, consumers, and regulators who establish different fiscal and monetary policies. The government will engage in consumption actions for finished goods and services. Meanwhile, the government acts as a producer, offering goods and services to people or communities for nothing or at negligible cost.

Government consumption expenditures, which include individual and collective expenditures on goods and services, are made for final consumption. All costs expended by the government to produce goods and services that are not limited in quantity and may be used by the entire community, such as defense and security services provided by the TNI/Polri, are referred to as collective consumption expenditures. Individual consumption expenditures, on the other hand, are all the costs that the government incurs to produce goods and services that are produced in limited quantities and can only be consumed under specific circumstances (typically prices), such as health services in hospitals and health centers and educational services in schools and universities.

c. Gross domestic investment includes new construction, sturdy production equipment, and corporate inventories. Investment is commonly abbreviated as I.

Inventory is defined as assets in the form of goods and services that are kept on hand for future sale, usage in production, or other purposes are referred to as inventory. Five categories categorize inventory: raw materials, auxiliary materials, finished items, goods/services for resale, and military inventory.

Inventory changes show transactions that occur in inventory. A drop (negative sign) or an increase (positive sign) in the position of inventory items can be explained by changes in inventory (negative sign). The value of products entering the inventory is subtracted from the value of goods leaving the inventory, and the value of losses from frequent inventory items is subtracted, excluding substantial losses, such as those caused by fire, theft, and insect assaults.

d. Exports (X) minus Imports (M)

Export-imports are defined as a transfer of ownership (economy) of products and services between citizens of an economy and non-citizens. An institutional unit is considered to be a resident in a country's economic region if it has a significant center of economic interest there and participates in economic activities or transactions there for an extended period, often at least one year. When recording on an accrual basis, which is how export-import works, items are recorded when there is a transfer of ownership using the approach used for customs paperwork. In contrast, services are recorded when the service is delivered or provided.

According to the expenditure approach, GDP (abbreviated as Y) is the sum of all components of final demand. The calculation is as follows:

$$\mathbf{Y = C + I + G + (X-M)}$$

2.2. Literature Review

Recently, many studies have been explaining the relationship of non-cash payments (APMK and e-money) on economic growth in Indonesia based on the value of Gross Domestic Product (GDP) and have been studied extensively and determined theoretically in the economic literature. However, the empirical results of some of these studies are still ambiguous. Syarifuddin, Hidayat, & Tarsidin (2009) examined the impact of increasing non-cash payments on the economy and its implications for monetary control in Indonesia. He uses Structural Cointegrating Vector Autoregression (SCVAR) to describe the simultaneous relationship between variables. The empirical result shows that increased non-cash payments will have a substitution effect and an efficiency effect. The increase in non-cash payments that occurred in the substitution effect will be seen in a decrease in demand for currency and an increase in M1 and M2, and also a decrease in prices due to lower transaction costs. In contrast, in the efficiency effect, there was an increase in GDP, which also impacted lower prices. Both of these effects are expected to affect increasing GDP.

Tee & Ong (2016) investigated the effect of adopting cashless payment on economic growth in five European Union (EU) countries: Austria, Belgium, France, Germany, and Portugal, from 2000 – 2012. The Pedroni residual cointegration and panel Vector Error Correction Model were used in this study (VECM). According to the findings of this study, the presence of non-cash payments in five European Union (EU) countries demonstrates that non-cash payments will affect other types of payments in the short term and then affect economic growth in the long term. As a result, non-cash payments will not directly impact the economy.

Amujiri & Chris (2015) explained the effects of the cashless policy on the Nigerian economy. The results of this research are that the implementation of non-cash payments will have an impact on reducing money laundering, the effectiveness of a monetary policy, creating new jobs in the financial sector, and providing evidence for the givers and recipients of bribes that occur, especially among civil

servants and politicians, and will increase growth in the real sector of the economy which will ultimately have a positive impact on the Nigerian economy.

Taghiyev, Eminov, & Guliyev (2016) examined the impact of cashless payments on economic growth in Azerbaijan. This study aims to demonstrate the link between electronic payments and economic growth in Azerbaijan using the Ordinary Least Square (OLS) method and only using card payments to quantify the effect on growth from 2008 to 2015. The findings of this study show that efficient use of electronic retail payments stimulates overall economic growth and consumption and that this research has taken the initiative to integrate and harmonize the non-cash payment market, which promotes consumption and will positively impact the economy in the future.

Yusuf (2016) examined the cash-less policy and economic growth: evidence from Nigeria. This research aimed to boost economic growth by modernizing the payment system, lowering credit costs, and increasing the effectiveness of the monetary policy. This research uses Ordinary Least Square multiple regression models and the Chow test of structural change. This research examines the cash-less policy period before (2008 to 2011) and after (2012 to 2015). This study discovered that non-cash payments, as an alternative to cash payments, contribute significantly to economic growth by lowering inflation, increasing foreign direct investment, reducing unemployment, and increasing government revenue, among other benefits that will aid in the economy's growth.

Research conducted by Sreenu (2020) in the title "Cashless Payment Policy and its Effects on Economic Growth of India: An Explanatory Study," the influence of a cashless payment policy on economic development and the gradual transition to a cashless economy in India from 2010 to 2018 is the topic of this study. The panel error correction model, padroni residual cointegration, and the theoretical approach are used in this study to look at the short- and long-term consequences of cashless adoption. Introducing a cashless policy has long-term positive benefits on India's

economic growth, but it would have a detrimental impact in the short term. As a result, any economic strategy targeted at building a cashless society will immediately impact the economy.

E. Bot (2020) examined the impact of the cashless banking policy on the economic growth of Nigeria (2010 - 2018). Implementing the cashless banking policy by the Central Bank of Nigeria (CBN) aims to reduce the use of cash and encourage more electronic-based transactions to fulfill the requirements of Nigeria's vision transformation agenda 2020. This study used ordinary least square (OLS) regression analysis to discover a link between the variables. Because most Nigerian investors use telephone lines for transaction activity, there is a strong link between internet banking and economic growth. Cashless banking also has a good association with banking performance, resulting in more effective and efficient employee performance. The cashless policy also facilitates economic exchanges between economic actors in the market, resulting in a considerable increase in the Nigerian economy.

Nirmala & Widodo (2011) examined the effect of the increasing use the card payment equipment on the Indonesian economy. This research use Vector Error Correction Model (VECM) with real GDP variables, prices, M1 and M2, international interest rates, international prices, and BI Rate. The results of this research are that cash holdings will decrease if there is an increase in non-cash payment transactions that affect the rise in demand for M1 and M2 money. This will encourage economic growth and reduce prices slightly.

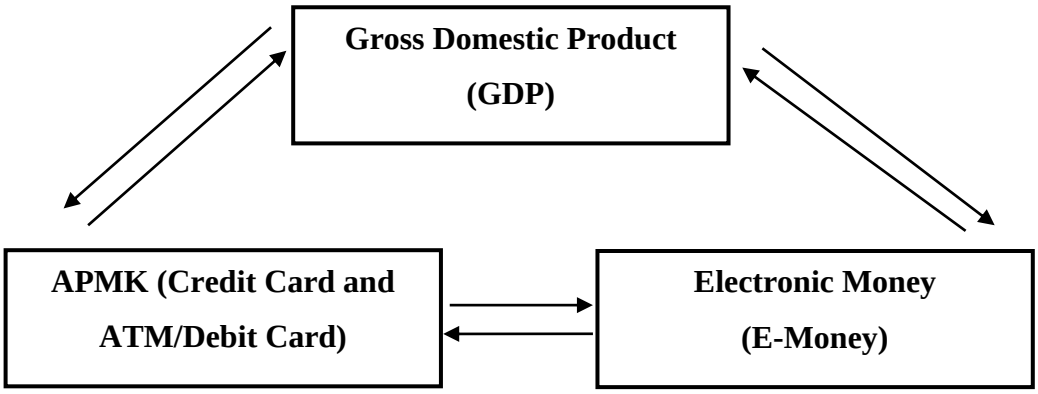
2.3. Conceptual Framework

This study aims to see how the relationships of using non-cash payments (APMK and e-money) in public transactions affect on output in Indonesia based on the value of Gross Domestic Product (GDP). To find out, non-cash payment instruments closest to the community are used: credit cards, ATM/debit cards, and e-money. The community's needs are made easier with non-cash payment system

services, are considered more effective as payment transactions, and are the primary driver to increase the output.

Based on the background and theoretical basis that has been described, the conceptual framework can be described as follows:

Figure 2.1 Conceptual Framework



2.4. Hypothesis

The hypothesis is a short-term solution to the research problem's formulation. It is described as transient since the answers are based solely on pertinent beliefs rather than facts gathered through data collection. Based on the identification of the problem, the formulation of the problem and the theoretical framework above, it can be concluded that the hypotheses shown in this study are:

a. Non-cash payments (APMK and e-money) have a positive relationship with output, as seen from the value of the gross domestic product.

b. Non-cash payments (APMK and e-money) are positively related to output as seen from the value of the gross domestic product in the short or long term.

CHAPTER III

RESEARCH METHODOLOGY

3.1. Scope of Research

This study analyzes time series data from the first quarter of 2010 to the fourth quarter of 2021 to analyze the relationship between non-cash payments (APMK and e-money) and output in Indonesia as seen from the value of Gross Domestic Product (GDP). This period was chosen based on information provided by Bank Indonesia and other relevant organizations.

3.2. Type and Sources of Data

This study uses secondary data, the type of data obtained from previous research and collected by researchers indirectly from various parties. In this study, the researcher uses secondary data using time series data from 2010Q1 to 2021Q4 from data from Bank Indonesia, the Central Bureau of Statistics, and any other relevant organizations. The information and its source are clarified in the following table:

Table 3.1

Data and Source of Data

Data	Description	Source
Gross Domestic Product	The value of GDP of Indonesia in billion rupiah	Central Bureau of Statistics in Indonesia
Credit Card	The value of the transactions using a credit card in billion rupiah	Payment System Statistic of Bank Indonesia

ATM/Debit Card	The value of the transactions using a debit card in billion rupiah	Payment System Statistic of Bank Indonesia
Electronic Money	The value of the transactions using an electronic money in billion rupiah	Payment System Statistic of Bank Indonesia

3.3. Data Collecting Technique

The data collection technique carried out in this writing is library research, which is data collected from various sources of information related to the writing of this research through literature or library references. The data collection technique that the researcher used in this study was the direct recording method in the form of time series data.

3.4. Variables Operational Definition

a. Gross Domestic Product

Gross Domestic Product is a numerical indicator of a nation's economic progress that shows a rise in output per person. Information gathered from the Indonesian Central Bureau of Statistics quarterly from 2010Q1 to 2021Q4 in billions of rupiah extracted from changes in the value of the Gross Domestic Product (GDP) at constant prices.

b. Credit Card

Credit cards are one type of APMK whose funds come from banks. In this study, the variable used is the value of credit card transactions which is the value/nominal used by the customer for each withdrawal and purchase transaction made using a credit card. Data are collected quarterly from the period 2010Q1 to 2021Q4.

c. ATM/Debit Card

The ATM/debit card is one of the APMK and is included in the account-based card category, which only transfers funds owned by card users to other parties by the bank. Data was collected quarterly over the period 2010Q1 to 2021Q4 of the value/nominal of cash withdrawals, purchases, intrabank, and interbank fund transfers made using ATM/debit cards.

d. Electronic Money

Electronic money makes transactions made by the public more accessible, more practical, and safer, and electronic money will reduce the amount of money supply in public. The indicator for e-money is seen from the value/nominal value of shopping transactions made using electronic money, and data were collected quarterly over the period 2010Q1 to 2021Q4.

3.5. Research Model

This research refers to the research conducted by Nenavath Sreenu (2020) entitled "Cashless Payment Policy and Its Effect on Economic Growth of India." The method used in this study is the Vector Error Correction Model (VECM) using time series data. Granger Causality is applied to determine the relationship between non-cash payments and GDP. We can use Granger causality tests in the vector error correction framework once co-integration has been established using the Johansen and ARDL procedures for co-integration. Co-integration in the bivariate model suggests that Granger causality will occur in both directions or at least in one of them, and the Wald test can be used to assess this, given some restrictions. To identify short and long-term causality, the bivariate vector error correction model can be rewritten for non-cash payments and gross domestic product as follows:

$$\Delta \ln GDP_t = \alpha + \Sigma^n_{i=1}\, a\, i\, \Delta \ln GDP_{t-1} + \Sigma^n_{i=1}\, d\, i\, \Delta \ln CC_{t-1} + \Sigma^n_{i=1}\, e\, i\, \Delta \ln DBC_{t-1} + \Sigma^n_{i=1}\, f\, i\, \Delta \ln EM_{t-1} \quad \ldots\ldots \quad (1)$$

$$\Delta CC_t = \alpha + \Sigma^n_{i=1} a\,i\,\Delta lnGDP_{t-1} + \Sigma^n_{i=1} d\,i\,\Delta lnCC_{t-1} + \Sigma^n_{i=1} e\,i\,\Delta lnDBC_{t-1} + \Sigma^n_{i=1} f\,i\,\Delta lnEM_{t-1} \quad \textbf{(2)}$$

$$\Delta DBC_t = \alpha + \Sigma^n_{i=1} a\,i\,\Delta lnGDP_{t-1} + \Sigma^n_{i=1} d\,i\,\Delta lnCC_{t-1} + \Sigma^n_{i=1} e\,i\,\Delta lnDBC_{t-1} + \Sigma^n_{i=1} f\,i\,\Delta lnEM_{t-1} \quad \textbf{(3)}$$

$$\Delta EM_t = \alpha + \Sigma^n_{i=1} a\,i\,\Delta lnGDP_{t-1} + \Sigma^n_{i=1} d\,i\,\Delta lnCC_{t-1} + \Sigma^n_{i=1} e\,i\,\Delta lnDBC_{t-1} + \Sigma^n_{i=1} f\,i\,\Delta lnEM_{t-1} \quad \textbf{(4)}$$

The model above shows several relationships between variables, with the following definitions:

1. ΔGDP_t is the first derivative ln of the value of the gross domestic product.

2. ΔCC_t is the first derivative ln of credit card.

3. ΔDBC_t is the first derivative of ln from ATM/debit card.

4. ΔEM_t is the first derivative ln of electronic money.

Where the variables a*i*, d*i*, e*i*, f*i*, are constant for each variable in the equation concerning time (t). α is the intercept, where *i* is 1, 2, 3, 4 is the assumption for white noise, also included in each variable.

3.6. Diagnostic Test

3.6.1. Unit Root Test

The first step in estimating the economic model represented by time series data is to determine whether or not the time series data is stationary. Economic time series data tend to be stochastic (having a trend that is not stationary or has a unit root). If a dataset does not contain any unit roots, it is considered stationary; yet, a dataset is said to be non-stationary if its mean, variance, and covariance remain constant across time. This test is crucial because if the data is not stationary, the result will be a false regression.

The stationary test of the data can be done through the ADF (Augmented Dickey-Fuller) unit root test. The data is stationary if:

a. Probability is less than 5%
b. ADF t-statistic is less than critical value

If the data is fulfilling the term, the data is stationary with the hypothesis:

H0 : B1 = 0 (containing the unit root, not stationary)
H0 : B1 ≠ 0 (does not cointaining the unit root, stationary)

3.6.2. Optimal Lag Length Test

The optimal lag length needs to be chosen next. The optimal lag test measures the amount of lag that significantly affects the cointegration test, which is the following stage. In order to understand the behavior and correlations between the variables, the best lag needs to be determined.

Determination of the optimal lag for each variable can be found by using the criteria of Akaike Information Criterion (AIC), Schwarz Information Criterion (SC), or Hannan Quinnon (HQ). How to choose the optimal lag is to see how many stars are on each criterion. The lag with the most stars is the optimal lag.

3.6.3. VAR Stability Test

For further analysis, we should continue to VAR Stability Test. This test checks whether the model and the data are valid. By employing an ideal lag, the VAR stability test will show whether or not the data is stable. The AR Roots Table and AR Roots Graph allow users to view the results of the VAR stability test. The data will be stable if the inverse value of the AR Root is less than one and all of the dot roots (inverse roots) are able in the unit circle in the

AR root graph. The test model is unstable if the modulus value exceeds one and the dot root is outside the unit circle.

3.6.4. Granger Causality Test

Granger Causality Test is used to know the relationship between variables. Assume that there are two variables, x and y. The results of the Granger Causality Test can indicate a one-way relationship, a two-way relationship, or no relationship at all. The null hypothesis will be rejected when the t-statistic is smaller than the level of the hypothesis, which is 1 percent, 5 percent, or 10 percent. This indicates that there is a causal relationship between the variables. Gujarati (2004) states that the following results from the Granger causality test are possible:

a. Unidirectional causality, when only one variable significantly influences,
b. Bilateral causality, if all variables significantly influences
c. No causality, when all of those variables are not significantly influence.

3.6.5. Co-Integration Test

The cointegration test determines whether there is a long-term relationship between two variables. It can be assumed that the variables in the model have a long-term relationship if they are cointegrated. Cointegration can be tested using the EngleGranger cointegration test, the Johansen cointegration test, and the Durbin Watson cointegration test. We can determine the determination outcome by comparing the trace statistic value to the maximum statistic or critical value. The data will be cointegrated if the t-statistic value is higher than the critical value. If the t-statistic value is less than the critical value, the data are not cointegrated. A cointegration test will decide whether to use VAR or VECM models. If cointegration happens, the

VECM model is employed. On the other hand, the study should use the VAR model if there is no cointegration.

3.6.6. Vector Error Correction Model (VECM) Test

VECM is the derivative method of VAR, and the VECM model considers all the variables endogenous. VECM model is chosen after we run the data in the stationary and co-integration tests. The VAR model must be used if the variables are stationary at the level degree and have not co-integrated. On the other hand, the VECM model must be used if the variables are stationary at the first or second difference level and co-integrated. This model can illuminate both the short- and long-term relationships between variables. The VECM specification maintains short-term dynamics while preventing long-term endogenous variable interactions from converging into co-integration relationships.

3.6.7. Impulse Response Function (IRF)

The IRF test is a technique for evaluating how endogenous variables react to shocks from other endogenous variables. The IRF monitors the effects of one standard error of an endogenous variable being innovated against another. We can learn details about the dynamics of shocks to the understudied variables from this IRF test. By examining the positive or negative standard deviation values, we can determine how one variable responds to another.

3.6.8. Variance Decomposition

Variance Decomposition Analysis can be used to predict the percentage contribution of each variable's variance due to changes in specific variables in the VAR (Vector Autoregression) system, as well as to show the relative importance of each variable in the VAR (Vector Autoregression)

system due to surprise. The Forecast Error Variance Decomposition represents the fraction of subsequent fluctuations caused by the shock and other variables (FEVD).

3.7. Post Diagnostic Test

3.7.1. Normality Test

The normality test is used to determine whether residual dependent and independent variables are normally distributed or not. The testing for normality in this research uses the Jarque-Fallow test, Skewness test, and Kurtosis test. We can do the statistical tests by looking at the kurtosis value and residuals' skewness. If the probability value is greater than $\alpha = 5$ percent, the data is normally distributed, and there is no normality problem.

3.7.2. Autocorrelation Test

The autocorrelation test determines the relationship between one period's error terms and another period's error terms. There are two techniques for figuring out autocorrelation: the Durbin-Watson Test (DW-Test) and the Breusch-Godfrey Serial Correlation LM Test.

CHAPTER IV

EMPIRICAL RESULT AND ANALYSIS

This chapter describes the empirical results and analysis of the processed model and data. This study employs the Vector Error Correction Model (VECM) using time series data from 2010Q1 to 2021Q4. This model has several steps of tests, which are: Stationary Test, Optimum Lag Length, Vector Autoregression (VAR) Stability Test, Granger's Causality Test, Cointegration Test, Vector Error Correction Model (VECM), VECM Stability Test, Impulse Response Function (IRF) Test, and Variance Decomposition (VD) Test. This model also requires a classical assumption test, Normality Test and Autocorrelation Test.

4.1. Result of Regression

4.1.1. Unit Root Test

Unit root test is a test used to know whether the data is stationer or not. The Philips-Peron Test and the Augmented Dickey-Fuller Test are two approaches that can be used to test the unit root test. The ADF test was employed in this study to check whether the data were stationary. The ADF test improves higher-order serial correlation by adding the time difference on the right side. The stationary test result and test at the level can be seen in table 4.1:

Table 4.1

Unit Root Test in Level

Variable	Test Statistic	MacKimmon			Prob.	Explanation
		1%	5%	10%		
LNGDP	-1.93	-3.58	-2.92	-2.60	0.31	Not Stationer
LNCC	-2.28	-3.57	-2.92	-2.60	0.18	Not Stationer
LNDB	-3.23	-3.58	-2.92	-2.60	0.02	Stationer
LNEM	0.72	-3.57	-2.92	-2.60	0.99	Not Stationer

Source: processed data, 2022

The data can be stationer if the p-value is less than 5% in the alpha level and the ADF t-Statistic is less than a critical value. From table 4.1, it could be seen that the probability of almost all the variables is greater than 5%, and the ADF t-statistic also greater than a critical value, except variable ATM/debit card. It can be seen that almost the variables are not stationer in the level. Since nearly all the variables are not stationary in the level, the study cannot be continued to the next step before all the variables are stationer. So, the variables had to do the 1st difference test.

Table 4.2

Unit Root Test in 1st Differences

Variable	Test Statistic	MacKimmon			Prob.	Explanation
		1%	5%	10%		
LNGDP	-11.86	-3.58	-2.92	-2.60	0.00	Stationer
LNCC	-6.70	-3.58	-2.92	-2.60	0.00	Stationer
LNDB	-8.12	-3.58	-2.92	-2.60	0.00	Stationer
LNEM	-5.88	-3.58	-2.92	-2.60	0.00	Stationer

Source: processed data, 2022

From table 4.2, all variables are stationary at the first difference level. It means that all variables fulfill the term of stationary data p-value is less than 5% at a level of alpha, and the ADF t-Statistic is less than the critical value. After the entire unit root test is done with the result, all variables are stationer. Then the estimation can continue to the next step.

4.1.2. Optimum Lag Length Test

The optimum lag length test is an essential step in the VECM model. This test shows how accurate the data produced by the VECM model estimation will be. Determination of the optimal lag is needed to continue the next stages, which are the cointegration test. The approaches that can be used for optimal lag length are Likelihood Ratio (LR), Final Prediction Error (FPE), Akaike Information Criterion (AIC), Schwarz Information Criterion (SC), and Hannan Quinnon Criterion (HQ).

Table 4.3

Result of Optimal Lag Length Test

Lag	LogL	LR	FPE	AIC	SC	HQ
0	228.2904	NA	2.08e-10	-10.94100	-10.77382	-10.88012
1	240.5983	21.61390	2.51e-10	-10.76089	-9.925005	-10.45651
2	279.9355	61.40435	8.22e-11	-11.89929	-10.39469	-11.35140
3	320.4255	55.30349	2.65e-11	-13.09393	-10.92062	-12.30253
4	350.3260	35.00537*	1.52e-11	-13.77200	-10.92998*	-12.73709
5	364.3983	13.72906	2.07e-11	-13.67796	-10.16723	-12.39955
6	394.6427	23.60544	1.48e-11*	-14.37282*	-10.19337	-12.85089*

Source: processed data, 2022

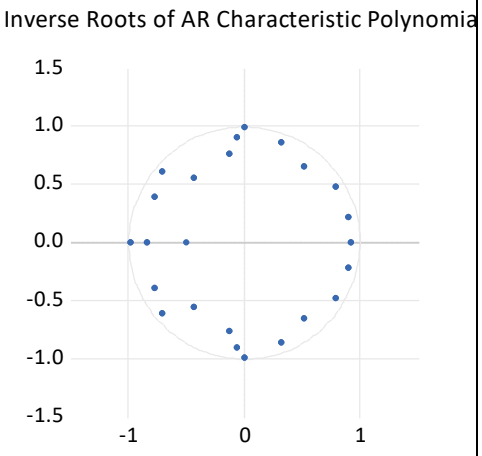
The way to choose the optimal lag is to look at how many stars are on each criterion. The optimal lag is the criterion with the most stars. From the results obtained, lag 6 has more stars than the other lags. Therefore, lag 6 is the optimal lag.

4.1.3. VAR Stability Test

After we get the optimum lag, the next step is the VAR stability test. In this estimation, VAR stability is tested by using the optimum lag. VAR stability is used to determine whether the data is stable and to ensure the validity of the Impulse Response Function (IRF) and Variance Decomposition (VD). VAR stability test in this study applies AR Roots Table and AR Roots Graph. VAR stability results are stable when the modulus of all variables is less than one. While in AR Roots Graph is stable when no dot is out of the circle. The results of the VAR stability test can be seen in table 4.4.

Table 4.4
Result of VAR Stability Test

Root	Modulus	Table
0.008518 – 0.987862i	0.987898	
0.008518 + 0.987862i	0.987898	
-0.981856	0.981856	
-0.709876 + 0.615911i	0.939824	
-0.709876 - 0.615911i	0.939824	
0.793157 + 0.482777i	0.928532	
0.793157 - 0.482777i	0.928532	
0.898900 + 0.213629i	0.923937	
0.898900 - 0.213629i	0.923937	
0.922356	0.922356	
0.319234 – 0.859157i	0.916549	
0.319234 + 0.859157i	0.916549	
-0.060196 + 0.905945i	0.907942	
-0.060196 - 0.905945i	0.907942	
-0.768123 – 0.396751i	0.864537	
-0.768123 + 0.396751i	0.864537	
0.525368 – 0.658243i	0.842197	
0.525368 + 0.658243i	0.842197	
-0.836059	0.836059	
-0.123069 + 0.765200i	0.775034	
-0.123069 - 0.765200i	0.775034	
-0.430143 + 0.551637i	0.699519	
-0.430143 - 0.551637i	0.699519	



-0.499410	0.499410	

Source: processed data, 2022

From the results, in the AR root table, the value of the modulus at all roots is less than 1. For the AR root graph results, the dot is also inside the circle. It means the data in this model is stable. The estimation cannot proceed using the VAR approach since the data is not stationary at a level. So, this research can continue using the Vector Error Correction Model (VECM).

4.1.4. Granger Causality Test

The Granger Causality Test determines whether there is a significant causal relationship between the two and the other variables. These variables are initially handled as variables without cointegration to perform Johansen's cointegration test between them. As a result, the causality test is added to the estimating process. Causality tests have three possible outcomes: a one-way relationship, a two-way relationship, or no relationship. The Causality relationship occurs when the t-statistic is less than the level of the hypothesis, which is 1 percent, 5 percent, and 10 percent. This study uses the Pairwise Granger Causality test since the variables are stationary at the first difference level.

Table 4.5

Result of Granger Causality Test

Null Hypothesis:	**Obs**	**F-Statistic**	**Prob.**
LNDB does not Granger Cause LNCC	42	1.81176	0.1316
LNCC does not Granger Cause LNDB		1.71016	0.1542
LNEM does not Granger Cause LNCC	42	0.50684	0.7981
LNCC does not Granger Cause LNEM		0.20168	0.9735

LNGDP does not Granger Cause LNCC	42	1.32725	0.2769
LNCC does not Granger Cause LNGDP		1.90026	0.1147
LNEM does not Granger Cause LNDB	42	0.20400	0.9728
LNDB does not Granger Cause LNEM		0.51367	0.7930
LNGDP does not Granger Cause LNDB	42	3.69246	0.0076
LNDB does not Granger Cause LNGDP		3.45426	0.0107
LNGDP does not Granger Cause LNEM	42	0.40437	0.8700
LNEM does not Granger Cause LNGDP		0.57209	0.7492

Source: processed data, 2022

The Granger causality test results show that variables with a causal relationship have probability values smaller than alpha 0.05, indicating that the null hypothesis would be rejected later and suggesting that one variable might affect other variables. Based on the Granger test, the reciprocal relationship or causality is as follows:

The two-way relationship's effect is seen in the GDP and ATM/debit card data because it occurs when each variable's probability value is less than 0.05. The probability value is greater than 0.05 for ATM/debit card and credit card, electronic money and credit card, GDP and credit card, electronic money and ATM/debit card, and GDP and electronic money. It indicates that there is no correlation between the two variables.

4.1.5. Co-Integration Test

Cointegration analysis is a long-term relationship that is not stationary at the level stage of an investigation. Cointegration is also a linear combination of variables that are not stationary and have the same level of integration. The Cointegration test is used to eliminate the occurrence of false regression. The cointegration test will be used in this study using Johansen's approach. If there is no cointegration in the

results, the VAR approach is used to continue the investigation, but if cointegration exists, the VECM method will be applied.

Table 4.6

Result of Cointegration Test

Unrestricted Cointegration Rank Test (Trace)				
Hypothesized No. Of CE (s)	**Eigenvalue**	**Trace Statistic**	**0.05 Critical Value**	**Prob. ****
None *	0.566028	74.44474	47.85613	0.0001
At most 1 *	0.453542	38.05373	29.79707	0.0045
At most 2	0.238772	13.88185	15.49471	0.0862
At most 3	0.071537	2.968973	3.841465	0.0849

Unrestricted Cointegration Rank Test (EigenValue)				
Hypothesized No. Of CE (s)	**Eigenvalue**	**Max-Eigen Statistic**	**0.05 Critical Value**	**Prob. ****
None *	0.566028	33.39101	27.58434	0.080
At most 1*	0.453542	24.17188	21.13162	0.0181
At most 2	0.238772	10.91288	14.26460	0.1586
At most 3	0.071537	2.968973	3.841465	0.0849

Source: processed data, 2022

From table 4.6, the result of the co-integration test for Trace Statistic and Max-Eigen value on r = 0 is greater than the critical value with significant levels of 1

percent and 5 percent. From the result above, it can be seen that there are two co-integrating equations at the 0.05 level. It can be known by neither seeing the value of the trace statistic nor is Max-Eigen statistic bigger than the critical value of 5 percent. The model that will be employed in this study, based on the information above, is a Vector Error Correction Model (VECM). This can be proven by the existence of an equation with a long-term relationship using the variable stationarity in the first difference.

4.1.6. VECM Test

The VECM model was used in this study since the data were stationary at the first difference, and the Johansen cointegration test was used to find cointegration in the long-term relationship between the variables. The short- and long-term effects of the all variables are investigated using the VECM estimate results. In this study, the variables are credit card transactions, debit/ATM card transactions, e-money, and gross domestic product.

The result obtained will show the variables that have a significant or not significant effect by comparing the t-statistic value with the t-table value. There are VECM estimates that use lag 6. The lag was chosen because it shows more data stability in the VECM test and free classical assumptions. VECM test results can be seen in tables 4.7 and 4.8.

4.1.6.1. Short Run Relationship

Table 4.7

Result of VECM in Short Run Relationship

D(LN_GDP)		
Variable	**Coefficient**	**T-Statistic**
CointEq1	-0.023019	-0.21709
D(LNGDP(-1),2)	--2.702197	-4.23564***
D(LNGDP(-2),2)	-4.159503	-4.17197***
D(LNGDP(-3),2)	-4.082183	-3.90852***

D(LNGDP(-4),2)	-3.231493	-3.12786***
D(LNGDP(-5),2)	-1.092286	-1.57856
D(LNCC(-1),2)	0.204484	1.35569
D(LNCC(-2),2)	0.191427	1.31796
D(LNCC(-3),2)	0.218618	1.73581*
D(LNCC(-4),2)	0.186355	1.54817
D(LNCC(-5),2)	0.097705	1.05360
D(LNDB(-1),2)	0.140945	0.60266
D(LNDB(-2),2)	0.645331	2.33802**
D(LNDB(-3),2)	0.734385	2.76214***
D(LNDB(-4),2)	0.611289	2.48050**
D(LNDB(-5),2)	0.213091	1.42311
D(LNEM(-1),2)	0.038197	1.79907*
D(LNEM(-2),2)	0.043146	2.12174**
D(LNEM(-3),2)	0.075455	3.50411***
D(LNEM(-4),2)	0.031387	1.33522
D(LNEM(-5),2)	0.029603	2.32775**
C	-0.000553	-0.26341

Source: processed data, 2022

*** α (1%) = 2.69

** α (5%) = 2.01

* α (10%) = 1.68

Based on the results in table 4.8 of the short-term relationship above, it can seem that the effect of non-cash payments (APMK and e-money) on output in Indonesia based on the value of gross domestic product (GDP). The effect of credit cards on gross domestic product (GDP) is positive and significant at an alpha of 10 percent. The effect of ATM/debit cards on gross domestic product (GDP) is positive and significant at alpha 5 percent, which means that if there is an increase of 1 percent of ATM/Debit cards in the two years, it will increase GDP by 0.645 percent in the current year and so on. Then, the effect of electronic money on gross domestic product (GDP) is positive and significant at alpha 1 percent, 5 percent, and 10 percent, which means that if there is an increase of 1 percent of electronic money, it will increase GDP by 0.038 percent in the current year.

4.1.6.2. Long Run Relationship

Table 4.8

Result of VECM in Long Run Relationship

D(LN_GDP)		
Variable	**Coefficient**	**T-Statistic**
D(LNGDP(-1))	1.000000	
D(LNCC(-1))	-1.598132	-3.77488***
D(LNDB(-1))	1.759900	3.00604***
D(LNEM(-1))	0.182227	2.80638***
C	-0.077049	

Source: processed data, 2022

*** α (1%) = 2.69

** α (5%) = 2.01

* α (10%) = 1.68

From the estimation results of the long-term relationship above, the effect of non-cash payments (APMK and e-money) on gross domestic product (GDP) shows that the ATM/debit card and electronic money variables have a positive and significant effect on GDP at the 1 percent level by 3.006 and 2.806, which means that if there is an increase in ATM/debit cards of one percent in the previous period, the GDP will increase by 1.759 percent and also an increase in electronic money of one percent in the last period it will increase GDP by 0.182 percent. At the same time, the credit card has a negative and significant effect on GDP at the 1 percent level by -3.774, which means that if there is an increase in credit cards of one percent in the

previous period, it will reduce GDP by -1.598 percent, the t-statistic value evidence this in the table above is greater than t-table and the value is negative.

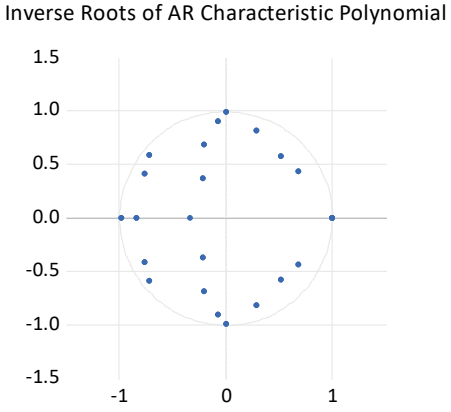
4.1.7. VECM Stability Test

After testing the short-run and long-run relationship, the next step is to estimate the stability of VECM. The purpose of checking the stability of the VECM model is to determine the validity of the model. If the data is stable, the research can continue to Impulse Respond Function (IRF) and Variance Decomposition (VD). But, if the data is unstable, the classical assumption test is first tested.

There are two ways to see the stability of the model by tables and graphs through the inverse root value of the polynomial AR characteristics. When the AR root value is less than one, and when there aren't any dots extending from the circle in the AR root graph, the VECM model is stable.

Table 4.9

Result of VECM Stability

Root	Modulus	Table
1.000000	1.000000	
1.000000	1.000000	
1.000000	1.000000	
0.008181 + 0.988582i	0.988616	
0.008181 - 0.988582i	0.988616	
-0.981650	0.981650	
-0.715223 + 0.593645i	0.929494	
-0.715223 - 0.593645i	0.929494	
-0.074533 – 0.910784i	0.913829	
-0.074533 + 0.910784i	0.913829	
0.292952 – 0.819359i	0.870155	
0.292952 + 0.819359i	0.870155	

-0.760642 – 0.417047i	0.867470	
-0.760642 + 0.417047i	0.867470	
0.833148	0.833148	
0.686185 – 0.434795i	0.812340	
0.686185 + 0.434795i	0.812340	
0.516663 – 0.582952i	0.778957	
0.516663 + 0.582952i	0.778957	
-0.201747 – 0.690815i	0.719671	
-0.201747 + 0.690815i	0.719671	
-0.217856 + 0.366268i	0.426153	
-0.217856 - 0.366268i	0.426153	
-0.330590	0.330590	

Source: processed data, 2022

From the result above, the VECM is not stable yet. This can be proven by the presence of 3 units of roots in the result because the modulus value equals 1. On the other hand, the graph shows an inverse root that is almost out of the circle. Because the VECM is not stable, so, it needs the classical assumption test in this study. The test included a normality test and an autocorrelation test.

4.1.8. Classical Assumption Test

Classical assumption aims to make sure the VECM model is stable or not and also to assess the data and whether it is feasible to be analyzed. The autocorrelation and normality tests are two classical assumption tests that must pass in this research.

4.1.8.1. Autocorrelation Test

The autocorrelation test is a test to determine the correlation among a series of observations sorted by time and space. The VECM residual serial correlation LM test method is used for the autocorrelation test in this study, as shown in the table below:

Table 4.10

Result of Autocorrelation Test

Lags	LM-Stat	Prob.
1	18.31841	0.3056
2	19.01709	0.2678
3	20.36157	0.2044
4	17.75460	0.3385
5	14.63932	0.5512
6	8.642099	0.9274
7	29.43937	0.0211
8	11.44477	0.7812
Probs. from chi-square with df 16.		

Source: processed data, 2022

Table 4.10 shows the results of the autocorrelation test by using lag 1 to 8. In this test, the probability value is higher than 1%. This study is free of autocorrelation issues because it uses a 99 percent confidence level.

4.1.8.2. Normality Test

The normality test checks whether the residual of confounding factors or the regression model has a normal distribution. This study used the Jarque-Fallow, Skewness, and Kurtosis tests to establish normality. A summary of the normality test is present in table 4.11.

Table 4.11

Result of Normality Test

Component	Skewness	Chi-sq	df	Prob.
1	-1.008270	6.946818	1	0.0084
2	-0.118582	0.096089	1	0.7566
3	-0.741308	3.755177	1	0.0526
4	-0.359428	0.882790	1	0.3474
Joint		11.68087	4	0.0199
Component	**Kurtosis**	**Chi-sq**	**df**	**Prob.**
1	4.076194	1.978579	1	0.1595
2	3.095391	0.015545	1	0.9008

3	3.139958	0.033463	1	0.8549
4	2.658865	0.198804	1	0.6557
Joint		2.226392	4	0.6942
Component	**Jarque-Bera**		**df**	Prob.
1	8.925397		2	0.0115
2	0.111634		2	0.9457
3	3.788640		2	0.1504
4	1.081594		2	0.5823
Joint	105.6405		8	0.0842

Source: processed data, 2022

From the table above, it can be explained that the data error has been normally distributed. This happens when three values of the probability are greater than = 5 percent. Three likelihood values are more than or equal to = 5 percent in both the Skewness and Jarque-Bera tests. Additionally, all probability values in the Kurtosis test are higher than = 5 percent. Thus, the normality test's criteria are met.

In conclusion, the autocorrelation test and normality test were both passed by this model. Therefore, we can say that this model is stable and may continue with the IRF and VD tests.

4.1.9. Impulse Response Function (IRF) Test

The Impulse Response Function (IRF) is tested as an innovation accounting used to analyze the shocks of the variable to a specific variable or variables themselves. The purpose of IRF is to examine the impact of the shock on the innovation variable's standard deviation on the endogenous variables' present and potential future values. The vertical line shows the shock of the variable, and the horizontal line shows the period of the shock. To see the response of each variable will show in figure 4.1.

Figure 4.1

Result of Impulse Response Function Test

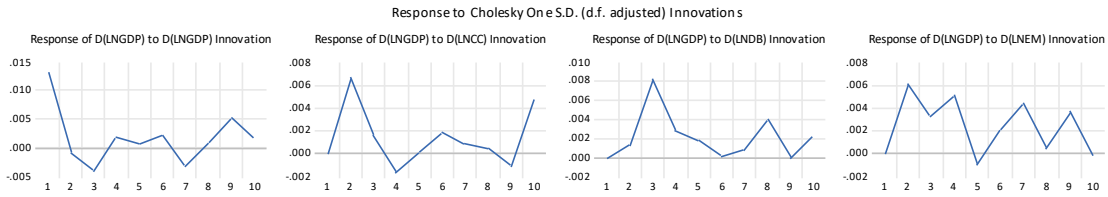


Figure 4.1 shows the response of non-cash payments and output (GDP). From the results of the IRF test above, the GDP response due to a credit card shock is shown in Figure 4.1, where the GDP response to credit cards shows a negative trend. The credit card variable response in the 2nd period shows a negative trend until the 9th period. This is indicated by the IRF line below the horizontal line. However, it can be seen that in the 9th to 10th period, the GDP response to the shock credit card has increased. This is indicated by the IRF line, which tends to rise above the horizontal line.

The GDP response due to the shock from the ATM/debit card is shown in Figure 4.1, where the GDP response to the debit/ATM card shows a positive trend. The response of the ATM/debit card variable, as seen from the 3rd- period, tends to decrease until the 6th period. Still, in the 7th to 10th period, the GDP response to the shock ATM/debit card has increased, showing a positive trend. This is indicated by the IRF line, which tends to rise above the horizontal line.

The GDP response due to the shock from e-money is shown in Figure 4.1, where the GDP response to e-money shows a positive trend. The response of the e-money variable can be seen from the 2nd to 10th period showing a positive trend. Only in the 5th period is the IRF line below the horizontal line showing a negative trend.

4.1.10. Variance Decomposition (VD) Test

The Variance Decomposition test evaluates each variable's relative strengths and weaknesses to other variables. The Variance Decomposition test aims to estimate the proportion of shocks of one variable to the other variables and determine the dynamic relationship between each variable in the long term. The result of variance decomposition is shown in table 4.12.

Table 4.12

Result of Variance Decomposition (VD) Test

Variance Decomposition of D(LNGDP):					
Period	S.E.	D(LNGDP)	D(LNCC)	D(LNDB)	D(LNEM)
1	0.013117	100.0000	0.000000	0.000000	0.000000
2	0.015978	67.71393	17.13443	0.644669	14.50698
3	0.018766	53.62738	13.17424	19.53890	13.65948
4	0.019792	49.05999	12.48464	19.61267	18.84270
5	0.019903	48.65413	12.35352	20.14916	18.84319
6	0.020219	48.22229	12.77769	19.53043	19.46960
7	0.020961	46.95741	12.05055	18.32938	22.66266
8	0.021356	45.42912	11.65457	21.04694	21.86936
9	0.022353	47.20615	10.88424	19.21451	22.69510
10	0.023033	44.95016	14.62615	19.04197	21.38172

Table 4.12 shows that the variance decomposition of GDP causes the shock of other variables. The shock of electronic money demonstrates that it has a greater contribution than other variables. The contribution of electronic money increased from 14.50 percent in the second period to 21.38 percent in the tenth period due to the increasing trend. Then, ATM/debit cards also contribute significantly to the change in GDP, with their contribution in the second period being 0.64 percent but rising to 19.04 percent from the third period through the tenth period. The other variable, credit cards, shows that the contribution to GDP decreases from the second period until the tenth period, from 17.13 percent to 14.62 percent.

4.2. Analysis and Implication

4.2.1. The Relationship of Credit Card and Gross Domestic Product (GDP)

According to the findings of data testing, the short-term impact of credit card transactions on Indonesia's GDP growth from the first quarter of 2010 to the fourth quarter of 2021 is significant and positive. This is based on research estimates that reveal a nominal credit card transaction coefficient of 0.218618, meaning that when the nominal credit card transaction value increases by one percent, the Gross Domestic Product (GDP) value increases by 0.218618 percent. Credit cards are having a good short-term impact because they are becoming a more and more common cash substitute and are even now integrated into Indonesian modern society's way of life. The growth of the credit card industry is supported by a variety of alluring programs provided by issuing companies, following the increasingly diverse tastes and needs of customers as well as the pattern of credit card usage by the consumer community, in addition to being sparked by lifestyle developments of people in big cities. People are impulsive buyers of things because of the convenience and flexibility of credit cards, ultimately affecting economic growth through increasing productivity.

In the long term, credit card transactions have a significant negative coefficient on output (GDP) in Indonesia in the 2010Q1 – 2021Q4 period. Long-term research findings also reveal that the credit card transaction coefficient is used at -1.5981, implying that when nominal credit card transactions rise by one percent, Indonesia's Gross Domestic Product (GDP) will fall by 1.5981 percent. This is consistent with research by Lintangsari et al. (2018), which found that credit card use negatively impacts Indonesia's output. According to Bank Indonesia, 2018 saw an increase in cash withdrawals made using credit cards as loan instruments. This will result in bad loans, which can slow produce output, as demonstrated by the fluctuating NPL value of Indonesian banking. Credit card ownership is just a new lifestyle pattern and is not a mainstay of people's transactions (Snellman, 2000).

Credit cards require users to pay consumer credit interest rates when they use them. Therefore the flexibility that results when buying goods and services will result in a significant buildup of household debt. Credit card usage continues to have issues, such as power abuse, and there is still a low degree of customer knowledge of the danger of fraud, leaving it open to the threat of crime. This is evident from customer complaints, which are primarily about using credit cards and are brought on by ethical issues with debt collection, double swipe credit cards, products used by others, and other issues.

4.2.2. The Relationship of ATM/Debit Card and Gross Domestic Product (GDP)

According to the outcomes of data testing, ATM/debit card transactions have a significant short-term impact with a positive coefficient on Indonesia's GDP from the first quarter of 2010 to the fourth quarter of 2021. This is based on study calculations that reveal the nominal coefficient value of ATM/debit card transactions to be 0.645, which means that for every one percent increase in nominal ATM/debit card transactions, the GDP value will raise by 0.645 percent. The positive and significant influence of the ATM/debit card is due to the ease in making transactions felt by the public. This positive effect also reflects an increase in GDP, which reflects an increase in people's income. According to Keynes, the higher an individual's income, the higher the individual's consumption. The positive effect of using an ATM/debit card can also reduce the opportunity cost of people holding money, following the innovation division theory where people are currently more interested in making transactions that are considered safe, fast, and efficient so that it will increase productivity which in turn encourages economic performance. This is also in line with banking efforts to raise funds through savings accounts that provide ATM/debit cards as an incentive to make transactions easier for customers. The positive and significant influence of the ATM/debit card is due to the ease in making transactions felt by the public. The increase in GDP, which also reflects an increase in people's income, is reflected in this favorable effect. According to Keynes, a person's consumption will increase as income increases. The advantage of utilizing an ATM or

debit card might also lower the opportunity cost of having money on hand. According to the innovation division idea, people are increasingly interested in conducting transactions that are regarded as secure, quick, and efficient because doing so would boost productivity, promoting economic performance. Additionally, this is consistent with banking initiatives to raise money through savings accounts that offer ATM/debit cards as a perk to encourage clients to use them for transactions.

In the long run, ATM/debit card usage has a positive coefficient and a significant impact on Indonesia's output between 2010Q1 and 2021Q4. Long-term research findings also reveal that the ATM/debit card transaction coefficient is 1.7599, which means that for every one percent increase in nominal ATM/debit card transactions, Indonesia's GDP will rise by 1.7599 percentage points. The efficiency gains from using ATM/debit cards for transactions will boost public transactions. Faster money circulation results from more transactions using ATM/debit cards, which also reflects higher levels of consumer spending. In order to meet consumer demand, rising public consumption will motivate producers to boost the output of products and services. This circumstance will increase production, which will lead to higher economic growth.

The findings of this study are consistent with those of Zandi et al. (2013), who found that expanding the usage of debit cards can boost GDP and consumption. It's because of the effect of efficiency caused by non-cash payments, thereby increasing output and economic growth (Syarifuddin, Hidayat, & Tarsidin, 2009) and also in line with research by Oyewole et al. (2013) that transactions using ATM/debit cards have a positive relationship to economic growth. The government's efforts to drive the cashless movement program significantly impact ATM/debit cards, both in the short and long term. The central bank endeavored to spread knowledge about using non-cash payment systems. Therefore, people began to switch to using ATM/debit cards and increasing the number of ATM/debit cards.

4.2.3. The Relationship of Electronic Money and Gross Domestic Product (GDP)

According to the findings of data testing, short-term electronic money transactions positively impact GDP in Indonesia from the first quarter of 2010 to the fourth quarter of 2021. Based on study estimates, it has been shown that the nominal value of electronic money transactions has a coefficient of 0.038, meaning that for every one percent increase in the nominal value of electronic money transactions, the GDP will increase by 0.038 percent. Since the introduction of e-money in Indonesia in 2007, transactions have been significant growth, surpassing those of the previous few years. This indicates that e-money is more popular with the general population than other electronic payment methods. This significant development was inextricably linked to Bank Indonesia's initiative to implement a non-cash movement program to raise public awareness of using non-cash instruments (Less Cash Society). Additionally, the government is actively promoting the usage of e-money; starting in October 2017, only users of toll roads will be permitted to enter them without using e-toll. E-money is used because it makes the transaction system more convenient, efficient, and secure.

In the long term, In Indonesia, between 2010Q1 and 2021Q4, electronic money transactions have a positive coefficient and a significant long-term impact on output. Long-term research findings also reveal that the coefficient of electronic money transactions is used at 0.1822, implying that when nominal electronic money transactions rise by one percent, Indonesia's GDP will increase by 0.1822 percent. Due to lower transaction costs and more effective use of time, adopting electronic money can help people earn more money. This results from how simple it is to transact in economic activity, which over time will increase demand for M2 money and ultimately affect economic growth. With this encouraging result, it may be concluded that greater e-money use will boost the velocity of money. This is consistent with study work done by Priyatama (2010), which demonstrates a clear correlation between the use of electronic money and the velocity of money. The emergence of startup companies in Indonesia that offer numerous public

conveniences for transacting, making it a unique attraction for the community, is one of the factors contributing to the growth in the value of e-money transactions. E-money issuers' convenience can boost consumption, which can increase the economy. Because e-money has no geographical restrictions and can be used anywhere, anytime, this convenience motivates people to buy more.

In Indonesia, the usage of e-money is still growing in large urban regions. However, it is still underutilized in small towns and rural areas due to a lack of infrastructure and amenities.

CHAPTER V

CONCLUSION

5.1. Research Summary

This study aimed to determine the relationship of non-cash payments (APMK and electronic money) and output in Indonesia based on the value of Gross Domestic Product (GDP) during the period 2010Q1 to 2021Q4. The VECM model estimates the short-term and long-term relationship of non-cash payments and output (GDP). This model was chosen because the variables are stationary at the first difference level and cointegrated. The results of non-cash payments can be seen through the Impulse Response Function (IRF) test. Furthermore, the Variance Decomposition (VD) test was also carried out to see the contribution of non-cash payments and Indonesia's GDP from time to time.

According to empirical findings from the VECM test, all non-cash payment variables have a short-term positive relationship on output based on the value of GDP; hence an increase in non-cash payment transactions will boost GDP in Indonesia. While, in the long term, credit cards have a negative and significant relationship on GDP in Indonesia, the increasing number of credit cards will reduce GDP in Indonesia. On the other hand, ATM/debit cards and electronic money have a positive and significant relationship on GDP. This is because using an ATM/debit card and electronic money will make it easier for the general public to transact and can lower the opportunity cost of the community keeping money on hand or just in case.

The Impulse Response Functions (IRF) test was used in this study to look for empirical evidence of the non-cash payment relationship. The findings of the IRF test indicate that a non-cash payment phenomenon accompanies Indonesia's economic expansion. The GDP response resulting from credit card use exhibits a negative trend. This is because, according to data from Bank Indonesia for 2018, there has been an

increase in cash withdrawals from credit cards used as debt instruments, leading to bad loans that may slow economic growth. The GDP response caused by an ATM/debit card exhibits a positive trend, which can be attributed to the fact that transactions carried out by the general public using ATMs or debit cards are becoming simpler and that these transactions can lower the opportunity cost of people holding money and acting as a safety measure. The final factor is the GDP response to e-money, which exhibits a positive trend and is predicted to improve the velocity of money as more people use e-money.

The use of non-cash payment instruments can contribute to GDP by increasing transaction efficiency and public consumption and output. The existence of a non-cash transaction support program can potentially have a growing impact that can be seen from time to time. The use of non-cash payment systems is increasing, shifting the role of cash, coupled with the continued development of digital technology that makes the use of non-cash payment systems very efficient. And the cause of significant influence is due to the psychology of someone who can spend money more easily and quickly compared to using cash payments. This illustrates the development of this non-cash payment system that can provide convenience and transaction speed.

5.2. Recommendation

Based on the exploration of the result of testing the hypothesis, put forward some suggestions that may be beneficial for:

1. Government – with non-cash payments, it provides convenience and efficiency for its users. This creates an opportunity for Bank Indonesia and banks to improve further services, innovation, and ease of use of non-cash payments, the need for credibility from the central bank as an effort to control monetary, it is necessary to improve facilities and infrastructure for non-cash transactions and Bank Indonesia must be able to apply technology and good legal facilities. With an increase in non-cash payments, Indonesia's GDP can

be boosted, and it can serve as a model for attempts to raise the value and volume of non-cash transactions in society to stimulate the economy in the future.

2. Future Researcher – this research is expected to be a reference for further researchers who can further develop the influence of each non-cash payment indicator on monetary policy and the welfare of the people in Indonesia.

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APPENDIX

Appendix 1

Unit Root Test

1.1. Unit Root Test at Level

Null Hypothesis: LNGDP has a unit root
Exogenous: Constant
Lag Length: 2 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.934227	0.3141
Test critical values:	1% level	-3.584743	
	5% level	-2.928142	
	10% level	-2.602225	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: LNCC has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.286480	0.1804
Test critical values:	1% level	-3.577723	
	5% level	-2.925169	
	10% level	-2.600658	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: LNDB has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.237328	0.0241
Test critical values:	1% level	-3.581152	
	5% level	-2.926622	
	10% level	-2.601424	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: LNEM has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		0.726325	0.9915
Test critical values:	1% level	-3.577723	
	5% level	-2.925169	
	10% level	-2.600658	

*MacKinnon (1996) one-sided p-values.

1.2. Unit Root Test at 1st Difference

Null Hypothesis: D(LNGDP) has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-11.86850	0.0000
Test critical values:	1% level	-3.584743	
	5% level	-2.928142	
	10% level	-2.602225	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(LNCC) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-6.705764	0.0000
Test critical values:	1% level	-3.581152	
	5% level	-2.926622	
	10% level	-2.601424	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(LNDB) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-8.125095	0.0000
Test critical values:	1% level	-3.581152	
	5% level	-2.926622	
	10% level	-2.601424	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(LNEM) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-5.889796	0.0000
Test critical values:	1% level	-3.581152	
	5% level	-2.926622	
	10% level	-2.601424	

*MacKinnon (1996) one-sided p-values.

Appendix 2

Optimum Lag Length Test

VAR Lag Order Selection Criteria
Endogenous variables: D(LNGDP) D(LNCC) D(LNDB) D(LNEM)
Exogenous variables: C
Date: 05/24/22 Time: 22:50
Sample: 2010Q1 2021Q4
Included observations: 41

Lag	LogL	LR	FPE	AIC	SC	HQ
0	228.2904	NA	2.08e-10	-10.94100	-10.77382	-10.88012
1	240.5983	21.61390	2.51e-10	-10.76089	-9.925005	-10.45651
2	279.9355	61.40435	8.22e-11	-11.89929	-10.39469	-11.35140
3	320.4255	55.30349	2.65e-11	-13.09393	-10.92062	-12.30253
4	350.3260	35.00537*	1.52e-11	-13.77200	-10.92998*	-12.73709
5	364.3983	13.72906	2.07e-11	-13.67796	-10.16723	-12.39955
6	394.6427	23.60544	1.48e-11*	-14.37282*	-10.19337	-12.85089*

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

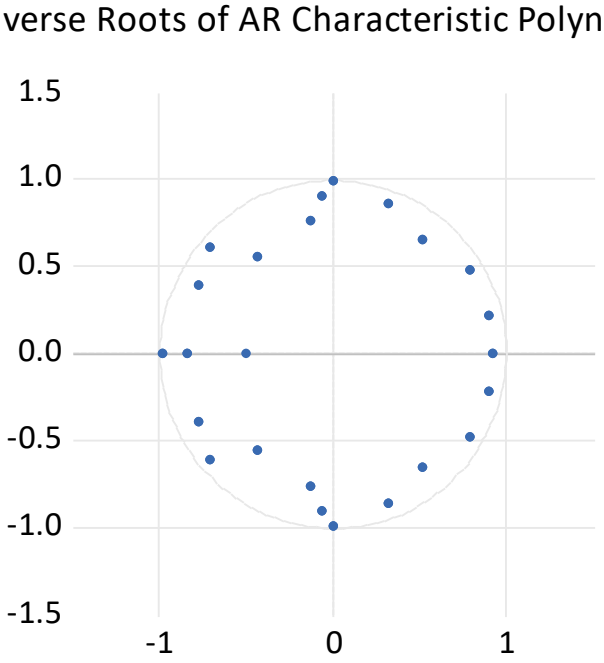
Appendix 3

VAR Stability Test

Roots of Characteristic Polynomial
Endogenous variables: D(LNGDP) D(LNCC) D(LNDB) D(LNEM)
Exogenous variables: C
Lag specification: 1 6
Date: 05/24/22 Time: 22:52

Root	Modulus
0.008518 - 0.987862i	0.987898
0.008518 + 0.987862i	0.987898
-0.981856	0.981856
-0.709876 + 0.615911i	0.939824
-0.709876 - 0.615911i	0.939824
0.793157 + 0.482777i	0.928532
0.793157 - 0.482777i	0.928532
0.898900 + 0.213629i	0.923937
0.898900 - 0.213629i	0.923937
0.922356	0.922356
0.319234 - 0.859157i	0.916549
0.319234 + 0.859157i	0.916549
-0.060196 + 0.905945i	0.907942
-0.060196 - 0.905945i	0.907942
-0.768123 - 0.396751i	0.864537
-0.768123 + 0.396751i	0.864537
0.525368 - 0.658243i	0.842197
0.525368 + 0.658243i	0.842197
-0.836059	0.836059
-0.123069 + 0.765200i	0.775034
-0.123069 - 0.765200i	0.775034
-0.430143 + 0.551637i	0.699519
-0.430143 - 0.551637i	0.699519
-0.499410	0.499410

No root lies outside the unit circle.
VAR satisfies the stability condition.



Appendix 4

Granger Causality Test

Pairwise Granger Causality Tests
Date: 05/24/22 Time: 22:55
Sample: 2010Q1 2021Q4
Lags: 6

Null Hypothesis:	Obs	F-Statistic	Prob.
LNDB does not Granger Cause LNCC	42	1.81176	0.1316
LNCC does not Granger Cause LNDB		1.71016	0.1542
LNEM does not Granger Cause LNCC	42	0.50684	0.7981
LNCC does not Granger Cause LNEM		0.20168	0.9735
LNGDP does not Granger Cause LNCC	42	1.32725	0.2769
LNCC does not Granger Cause LNGDP		1.90026	0.1147
LNEM does not Granger Cause LNDB	42	0.20400	0.9728
LNDB does not Granger Cause LNEM		0.51367	0.7930
LNGDP does not Granger Cause LNDB	42	3.69246	0.0076
LNDB does not Granger Cause LNGDP		3.45426	0.0107
LNGDP does not Granger Cause LNEM	42	0.40437	0.8700
LNEM does not Granger Cause LNGDP		0.57209	0.7492

Appendix 5

Co-Integration Test

Date: 05/24/22 Time: 22:52
Sample (adjusted): 2012Q1 2021Q4
Included observations: 40 after adjustments
Trend assumption: Linear deterministic trend
Series: D(LNGDP) D(LNCC) D(LNDB) D(LNEM)
Lags interval (in first differences): 1 to 6

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.566028	71.44474	47.85613	0.0001
At most 1 *	0.453542	38.05373	29.79707	0.0045
At most 2	0.238772	13.88185	15.49471	0.0862
At most 3	0.071537	2.968973	3.841465	0.0849

Trace test indicates 2 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.566028	33.39101	27.58434	0.0080
At most 1 *	0.453542	24.17188	21.13162	0.0181
At most 2	0.238772	10.91288	14.26460	0.1586
At most 3	0.071537	2.968973	3.841465	0.0849

Max-eigenvalue test indicates 2 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Appendix 6

VECM Test

Cointegrating Eq:	CointEq1
D(LNGDP(-1))	1.000000
D(LNCC(-1))	-1.598132 (0.42336) [-3.77488]
D(LNDB(-1))	1.759900 (0.58545) [3.00604]
D(LNEM(-1))	0.182227 (0.06493) [2.80638]
C	-0.077049

Error Correction:	D(LNGDP,2)	D(LNCC,2)	D(LNDB,2)	D(LNEM,2)
CointEq1	-0.023019	0.546230	0.186598	-3.385319
	(0.10603)	(0.69081)	(0.31714)	(1.48715)
	[-0.21709]	[0.79071]	[0.58837]	[-2.27638]
D(LNGDP(-1),2)	-2.702197	-8.613468	-3.925016	-14.36530
	(0.63797)	(4.15630)	(1.90812)	(8.94756)
	[-4.23564]	[-2.07239]	[-2.05701]	[-1.60550]
D(LNGDP(-2),2)	-4.159503	-16.12367	-7.833506	-30.35926
	(0.99701)	(6.49544)	(2.98200)	(13.9832)
	[-4.17197]	[-2.48231]	[-2.62693]	[-2.17112]
D(LNGDP(-3),2)	-4.082183	-15.55641	-7.360561	-32.29880
	(1.04443)	(6.80438)	(3.12383)	(14.6483)
	[-3.90852]	[-2.28624]	[-2.35626]	[-2.20496]
D(LNGDP(-4),2)	-3.231493	-16.33011	-7.482290	-30.67498
	(1.03313)	(6.73078)	(3.09004)	(14.4898)
	[-3.12786]	[-2.42618]	[-2.42142]	[-2.11700]
D(LNGDP(-5),2)	-1.092286	-5.727325	-2.624695	-11.85404
	(0.69195)	(4.50801)	(2.06959)	(9.70473)
	[-1.57856]	[-1.27048]	[-1.26822]	[-1.22147]
D(LNCC(-1),2)	0.204484	1.059797	0.740133	-1.375654
	(0.15083)	(0.98267)	(0.45113)	(2.11546)
	[1.35569]	[1.07849]	[1.64060]	[-0.65028]
D(LNCC(-2),2)	0.191427	0.897760	0.412425	-1.101154
	(0.14524)	(0.94626)	(0.43442)	(2.03708)
	[1.31796]	[0.94875]	[0.94937]	[-0.54056]
D(LNCC(-3),2)	0.218618	0.930491	0.451965	-0.674873
	(0.12595)	(0.82052)	(0.37669)	(1.76640)
	[1.73581]	[1.13402]	[1.19982]	[-0.38206]
D(LNCC(-4),2)	0.186355	1.262815	0.449912	1.977330
	(0.12037)	(0.78421)	(0.36002)	(1.68822)
	[1.54817]	[1.61030]	[1.24968]	[1.17125]
D(LNCC(-5),2)	0.097705	0.651526	0.167146	1.139290
	(0.09273)	(0.60416)	(0.27736)	(1.30061)
	[1.05360]	[1.07841]	[0.60263]	[0.87597]
D(LNDB(-1),2)	0.140945	-0.599079	-1.207123	4.358702
	(0.23387)	(1.52366)	(0.69950)	(3.28010)
	[0.60266]	[-0.39318]	[-1.72570]	[1.32883]
D(LNDB(-2),2)	0.645331	2.245407	0.507541	10.04135
	(0.27602)	(1.79822)	(0.82555)	(3.87117)
	[2.33802]	[1.24868]	[0.61479]	[2.59388]
D(LNDB(-3),2)	0.734385	2.806118	0.752154	11.81262
	(0.26588)	(1.73216)	(0.79522)	(3.72894)
	[2.76214]	[1.62001]	[0.94585]	[3.16782]
D(LNDB(-4),2)	0.611289	2.639307	0.907911	7.338830
	(0.24644)	(1.60552)	(0.73708)	(3.45633)
	[2.48050]	[1.64389]	[1.23177]	[2.12330]
D(LNDB(-5),2)	0.213091	0.998801	0.351122	2.226143
	(0.14974)	(0.97552)	(0.44785)	(2.10007)
	[1.42311]	[1.02386]	[0.78401]	[1.06003]
D(LNEM(-1),2)	0.038197	0.109196	0.069439	-0.043434
	(0.02123)	(0.13832)	(0.06350)	(0.29778)
	[1.79907]	[0.78943]	[1.09350]	[-0.14586]
D(LNEM(-2),2)	0.043146	0.103478	0.080026	-0.061390
	(0.02034)	(0.13248)	(0.06082)	(0.28520)
	[2.12174]	[0.78108]	[1.31576]	[-0.21525]
D(LNEM(-3),2)	0.075455	0.349537	0.176128	0.209240
	(0.02153)	(0.14029)	(0.06440)	(0.30201)
	[3.50411]	[2.49159]	[2.73473]	[0.69284]
D(LNEM(-4),2)	0.031387	0.120948	0.096637	-0.022069
	(0.01665)	(0.10847)	(0.04980)	(0.23351)
	[1.88522]	[1.11507]	[1.94064]	[-0.09451]
D(LNEM(-5),2)	0.029603	0.121804	0.098853	0.180199
	(0.01272)	(0.08285)	(0.03804)	(0.17837)
	[2.32775]	[1.47011]	[2.59882]	[1.01028]
C	-0.000558	-0.000916	-0.004448	0.003173
	(0.00208)	(0.01354)	(0.00622)	(0.02915)
	[-0.26841]	[-0.06765]	[-0.71553]	[0.10886]
R-squared	0.939843	0.830534	0.898137	0.779405
Adj. R-squared	0.873354	0.643229	0.785553	0.535589
Sum sq. resids	0.003269	0.138762	0.029246	0.643083
S.E. equation	0.013117	0.085459	0.039233	0.183974
F-statistic	14.13529	4.434138	7.977426	3.196697
Log likelihood	135.2770	58.43915	90.35795	27.00212
Akaike AIC	-5.525708	-1.777519	-3.334534	-0.244006
Schwarz SC	-4.606230	-0.858042	-2.415056	0.675472
Mean dependent	-0.000607	0.004238	-0.000506	-0.002628
S.D. dependent	0.036860	0.143075	0.084722	0.269964

Determinant resid covariance (dof adj.)	2.21E-12
Determinant resid covariance	1.02E-13
Log likelihood	380.5776
Akaike information criterion	-14.07695
Schwarz criterion	-10.23187
Number of coefficients	92

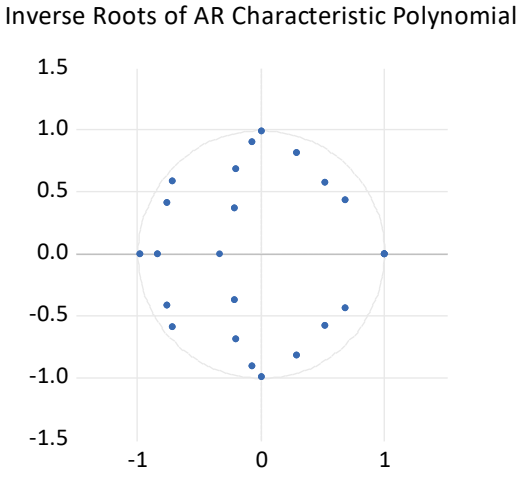
Appendix 7

VECM Stability Test

Roots of Characteristic Polynomial
Endogenous variables: D(LNGDP) D(LNCC)
D(LNDB) D(LNEM)
Exogenous variables:
Lag specification: 1 5
Date: 05/26/22 Time: 22:31

Root	Modulus
1.000000	1.000000
1.000000	1.000000
1.000000	1.000000
0.008181 + 0.988582i	0.988616
0.008181 - 0.988582i	0.988616
-0.981650	0.981650
-0.715223 + 0.593645i	0.929494
-0.715223 - 0.593645i	0.929494
-0.074533 - 0.910784i	0.913829
-0.074533 + 0.910784i	0.913829
0.292952 - 0.819359i	0.870155
0.292952 + 0.819359i	0.870155
-0.760642 - 0.417047i	0.867470
-0.760642 + 0.417047i	0.867470
-0.833148	0.833148
0.686185 - 0.434795i	0.812340
0.686185 + 0.434795i	0.812340
0.516663 - 0.582952i	0.778957
0.516663 + 0.582952i	0.778957
-0.201747 - 0.690815i	0.719671
-0.201747 + 0.690815i	0.719671
-0.217856 + 0.366258i	0.426153
-0.217856 - 0.366258i	0.426153
-0.330590	0.330590

VEC specification imposes 3 unit root(s).



Appendix 8

Classical Assumption Test

8.1. Autocorrelation Test

VEC Residual Serial Correlation LM Tests
Date: 05/27/22 Time: 00:11
Sample: 2010Q1 2021Q4
Included observations: 41

Null hypothesis: No serial correlation at lag h

Lag	LRE* stat	df	Prob.	Rao F-stat	df	Prob.
1	18.31841	16	0.3056	1.193865	(16, 37.3)	0.3169
2	19.01709	16	0.2678	1.249903	(16, 37.3)	0.2788
3	20.36157	16	0.2044	1.360257	(16, 37.3)	0.2145
4	17.75460	16	0.3385	1.149285	(16, 37.3)	0.3500
5	14.63932	16	0.5512	0.912931	(16, 37.3)	0.5618
6	8.642099	16	0.9274	0.502172	(16, 37.3)	0.9299
7	29.43937	16	0.0211	2.199800	(16, 37.3)	0.0238
8	11.44477	16	0.7812	0.687223	(16, 37.3)	0.7878

8.2. Normality Test

Component	Skewness	Chi-sq	df	Prob.*
1	-1.008270	6.946818	1	0.0084
2	-0.118582	0.096089	1	0.7566
3	-0.741308	3.755177	1	0.0526
4	-0.359428	0.882790	1	0.3474
Joint		11.68087	4	0.0199

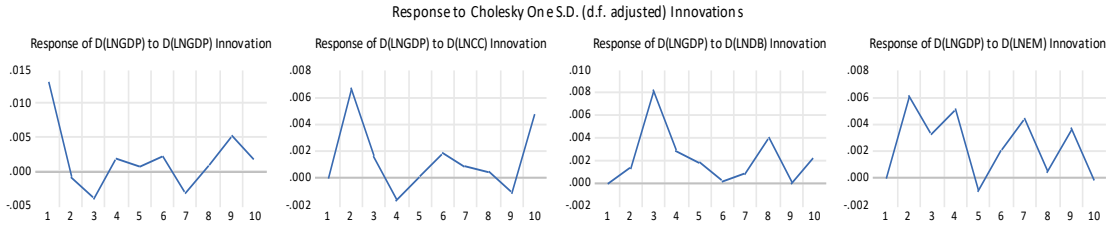
Component	Kurtosis	Chi-sq	df	Prob.
1	4.076194	1.978579	1	0.1595
2	3.095391	0.015545	1	0.9008
3	3.139958	0.033463	1	0.8549
4	2.658865	0.198804	1	0.6557
Joint		2.226392	4	0.6942

Component	Jarque-Bera	df	Prob.
1	8.925397	2	0.0115
2	0.111634	2	0.9457
3	3.788640	2	0.1504
4	1.081594	2	0.5823
Joint	13.90726	8	0.0842

*Approximate p-values do not account for coefficient estimation

Appendix 9

Impulse Response Function (IRF) Test



Appendix 10

Variance Decomposition (VD) Test

Variance Decomposition of D(LNGDP):

Period	S.E.	D(LNGDP)	D(LNCC)	D(LNDB)	D(LNEM)
1	0.013117	100.0000	0.000000	0.000000	0.000000
2	0.015978	67.71393	17.13443	0.644669	14.50698
3	0.018766	53.62738	13.17424	19.53890	13.65948
4	0.019792	49.05999	12.48464	19.61267	18.84270
5	0.019903	48.65413	12.35352	20.14916	18.84319
6	0.020219	48.22229	12.77769	19.53043	19.46960
7	0.020961	46.95741	12.05055	18.32938	22.66266
8	0.021356	45.42912	11.65457	21.04694	21.86936
9	0.022353	47.20615	10.88424	19.21451	22.69510
10	0.023033	44.95016	14.62615	19.04197	21.38172

Appendix 11

Raw Data

(In billion rupiah)

Year	GDP	Credit Card	ATM/Debit Card	E-Money
2010Q1	1642356.30	37311.59	455021.54	177.20
2010Q2	1709132.00	39565.60	479975.15	161.10
2010Q3	1775109.90	42009.44	518603.06	172.74
2010Q4	1737534.90	44321.86	548253.46	182.44
2011Q1	1748731.20	42944.63	563712.33	176.60
2011Q2	1816268.20	45066.16	589853.76	221.38
2011Q3	1881849.70	46825.04	648175.42	303.14
2011Q4	1840786.20	47766.51	675299.93	280.19
2012Q1	1855580.20	47410.86	696503.54	324.79
2012Q2	1929018.70	50238.96	744799.03	438.04
2012Q3	1993632.30	51719.28	804533.17	563.50
2012Q4	1948852.20	52471.63	819244.31	645.22
2013Q1	1958395.50	51436.68	866341.35	586.52
2013Q2	2036816.60	55230.77	934381.71	684.28
2013Q3	2103598.10	57084.76	982364.10	898.67
2013Q4	2057687.60	59617.38	1014283.28	737.96
2014Q1	2058584.90	56854.51	1020467.96	748.95
2014Q2	2137385.60	63646.10	1094870.22	833.89
2014Q3	2207343.60	65110.37	1150418.01	941.22
2014Q4	2161552.50	69446.48	1179317.24	795.49
2015Q1	2158040.00	66017.81	1141025.79	838.84
2015Q2	2238704.40	71145.33	1210020.05	1436.48
2015Q3	2312843.50	70548.39	1250118.15	1665.16

2015Q4	2272929.20	72832.40	1296630.45	1342.53
2016Q1	2264721.00	69857.18	1298657.71	1398.93
2016Q2	2355445.00	69841.62	1438396.02	1775.43
2016Q3	2429260.60	67702.41	1401456.00	1723.26
2016Q4	2385186.80	73619.32	1485402.92	2166.06
2017Q1	2378146.40	72011.99	1423064.09	2224.47
2017Q2	2473512.90	73733.53	1578619.78	2532.32
2017Q3	2552296.90	73965.82	1571917.38	2749.57
2017Q4	2508971.90	78049.88	1626836.39	4869.11
2018Q1	2498697.50	73372.66	1596591.88	10311.22
2018Q2	2603852.60	78113.47	1725258.70	10357.19
2018Q3	2684332.20	77292.35	1760596.76	10999.99
2018Q4	2638969.60	85515.58	1844820.17	15530.22
2019Q1	2625125.70	81929.51	1817918.50	20744.60
2019Q2	2735403.10	84145.72	1887950.96	35361.36
2019Q3	2818721.50	85776.06	1888459.92	39637.96
2019Q4	2769787.50	90831.54	1880494.45	49421.55
2020Q1	2703033.00	78618.92	1775275.75	46087.13
2020Q2	2589789.10	48153.15	1524425.89	47541.09
2020Q3	2720491.90	53834.40	1732852.90	51011.96
2020Q4	2709740.80	58297.14	1884320.70	60269.00
2021Q1	2684200.80	56852.48	1813116.66	61356.34
2021Q2	2772939.40	59546.96	1969575.13	70668.76
2021Q3	2815869.70	57292.26	1875685.02	77781.78
2021Q4	2845858.60	70824.29	2018807.96	95628.96