

THE ANALYSIS OF THE IMPACT OF DIGITALIZATION ON INTERNATIONAL TRADE IN ENHANCING ECONOMIC GROWTH IN INDONESIA

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Abstract

This study examines the impact of digitalization on international trade and its role in boosting Indonesia's economic growth using the Vector Autoregression (VAR) model. The variables analyzed are exports, imports, exchange rates, internet penetration (as a digitalization indicator), and GDP (as an economic growth indicator), with annual data from 2007–2024 sourced from the World Bank. Stationarity tests show all variables become stationary at first or second differences, while the Johansen cointegration test confirms four long-term relationships among them. The impulse response function (IRF) indicates GDP reacts variably to shocks in internet penetration, exchange rates, exports, and imports. Variance decomposition (FEVD) reveals that in the short term, variables are largely influenced by themselves, but in the medium and long term, internet penetration increasingly contributes to trade variables and GDP. These results highlight digitalization's substantial role in enhancing trade performance and economic growth, emphasizing the need to strengthen digital infrastructure and integrate IT into the national trade system for inclusive, sustainable development.

Keywords: Digitalization, International Trade, Economic Growth, Internet Penetration, VAR

INTRODUCTION

In the era of globalization and the Fourth Industrial Revolution (Industry 4.0), digitalization has become a transformative force that is reshaping nearly every aspect of life, including the economic sector. Advances in information and communication technology (ICT) have not only changed the way people interact but have also fundamentally transformed how countries conduct international trade. Digitalization creates opportunities for efficiency, expands market access, and reduces transaction costs in export and import activities. As a developing country with vast digital economic potential, Indonesia holds a strategic role in leveraging digitalization to strengthen its position in global trade. The Indonesian government has also promoted digital transformation through various policies, such as the Making Indonesia 4.0 roadmap and the

acceleration of the national digital economic transformation.

At present, we are witnessing a decline in trade globalization due to political and economic shifts around the world. Global trade continues to evolve, driven by technological advances and changing political dynamics, ranging from periods of trade stability to the fluctuations experienced during the world wars. As an ever-evolving phenomenon, global trade continues to spur economic growth and cultural interaction worldwide. A complex and interconnected set of factors influences global trade. Countries engage in international trade due to the need for goods and services that cannot be efficiently produced domestically, while trade to exploit comparative advantages is driven by differences in natural resources between countries. In addition, globalization and a country's economic and political policies shape the global trade landscape (Asrini et al., 2025). For centuries, world economic growth has been driven by international trade. Trade has connected people across the globe from the age of sailing ships to the digital era. However, with the advent of digital technology and the rise of e-commerce, international trade has undergone major transformations. Digitalization and e-commerce have dramatically reshaped global trade, opening new opportunities while also presenting unprecedented challenges (Pratama & Nugroho, 2019).



Figure 1. Indonesia's GDP Data from 2004 to 2024

Source: <https://data.worldbank.org/indicator/NY.GDP.MKTP.KD.ZG?year=1984>

The graph illustrates the development of Indonesia's Gross Domestic Product (GDP) from 2004 to 2024. Overall, Indonesia's GDP showed a fairly stable and upward trend from 2004 until around 2019. There were some minor slowdowns during this period, but on the whole, Indonesia's economic growth remained above the zero line, indicating positive growth. A sharp decline is evident in 2020, reflecting the significant impact of the COVID-19 pandemic on the national economy. In that year, Indonesia's GDP contracted deeply, even falling into negative territory. Following this drastic drop, a significant recovery is visible in 2021, where GDP surged back above zero and re-entered positive growth territory. However, after this recovery, the growth rate appeared to level off, although it remained on a positive trend. This indicates that Indonesia's economy resumed growth, but at a slower pace compared to the pre-pandemic

period. Overall, this graph demonstrates Indonesia's economic resilience in facing the crisis, while also highlighting the ongoing challenges in maintaining stable and sustainable growth in the post-pandemic era.

Digital economic growth has become one of the main drivers of overall economic growth in recent years. With a large population and an increasing number of people gaining internet access, Indonesia has great potential to become one of the leading digital economic powers in Southeast Asia. This is supported by advancements in digital technology, growing internet users, and continuously rising investments in the technology industry (Purba et al., 2025). The evolving digital era brings changes, especially in international trade aspects such as exports and imports, facing significant challenges while leveraging globalization opportunities that enable exports, access to wider markets, advanced technologies, and attracting foreign direct investment. Countries that are unprepared to compete in the global market may struggle to reduce poverty and create more jobs. However, globalization also causes many problems. Developing countries often find it difficult to compete with developed countries that have more advanced capital and technology as the global economy rapidly grows. Moreover, they become more vulnerable to global economic fluctuations and protectionist policies from major countries due to their reliance on global markets. Crises such as the COVID-19 pandemic have shown that dependence on globalization can make populations more susceptible to external disruptions. Over the past decades, businesses have been transformed by globalization, which has integrated national economies into an interdependent global economic system. Globalization has opened numerous opportunities for easier technology transfer, faster economic growth, and broader market access (Ningrum & Sakuntala, 2025)

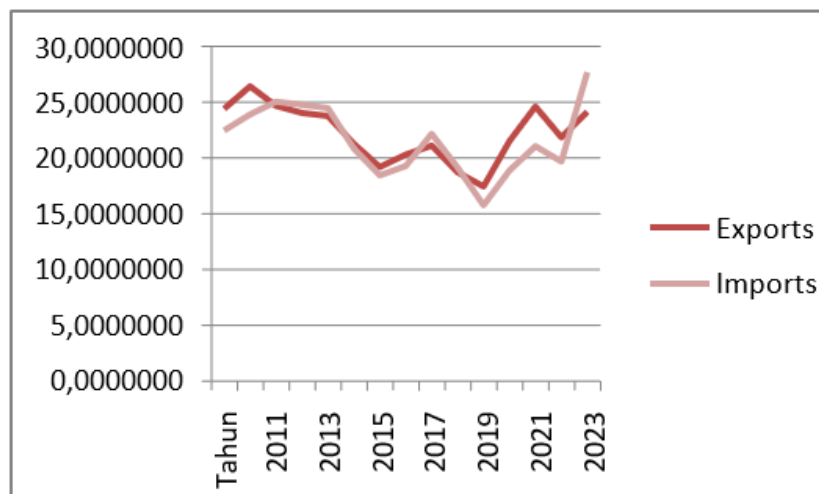


Figure 2. Export and Import Data for the Year 2010-2024

Source: <https://data.worldbank.org/indicator/NE.EXP.GNFS.ZS>

The graph illustrates the development of Indonesia's exports and imports from 2010 to 2023. Overall, both exports and imports fluctuated from year to year. At the beginning of the period, export values were slightly higher than imports. However, both tended to decline until

around 2016. After that, there were alternating increases and decreases. In 2023, exports experienced a significant surge compared to the previous year, with values once again exceeding imports. This indicates a recovery or improvement in Indonesia's international trade performance during that year.

Exports and imports are two factors that can influence the movement of a country's domestic currency exchange rate. Increasing exports indicate an inflow of foreign currency into a country, both through goods and services transactions, which raises the amount of foreign currency in the country and, in turn, leads to the appreciation of the domestic currency (Dewi, 2020). Internet business is now more widely used for business strategies such as marketing, sales, and customer service rather than merely for electronic information exchange. Internet marketing overcomes many barriers, national borders, and unclear regulations. Compared to conventional marketing, internet marketing requires less effort since goods are distributed through sea ports, containers, distributors, guarantor agencies, importers, and banking institutions. Direct marketing via the internet allows customers to communicate directly with sellers, even if those sellers are abroad (Yuliana, 2000). Internet penetration in Indonesia and ASEAN partner countries significantly impacts the increase in Indonesia's export volume. The growing internet access enables business actors in Indonesia, including MSMEs (Micro, Small, and Medium Enterprises), to more easily showcase their products online, access international trade platforms, and communicate directly with overseas buyers. Furthermore, the internet reduces information barriers, lowers market search costs, and speeds up cross-border transaction processes. This study also shows that ASEAN countries with high internet penetration rates are more open to digital trade with Indonesia, making the internet an essential tool in forming regional export networks. Internet penetration drives a country's international trade, which subsequently boosts economic growth (Aryani et al., 2020).

The implementation of technology also plays a crucial role in improving the efficiency and costs of exports and imports. The relationship between exports, imports, and GDP is important for economic growth. Exports contribute to foreign exchange earnings that support import activities, thereby driving overall economic progress. In the long term, exports and exchange rates have a significant impact on economic growth, while the effect of imports tends to be smaller. Export and import activities play a vital role in maintaining economic stability and promoting national growth. Export policies not only carry risks in terms of foreign exchange earnings but also influence domestic economic growth and market balance. Exports contribute to economic advancement by opening new market access for local producers. Increased demand for Indonesian export products in international markets encourages local producers to boost production capacity, create jobs, and develop the economic system (Falah & Syafri, 2023).

LITERATURE REVIEW

Economic Growth

An increase in output per capita over a longer period is referred to as economic growth in brief. Economic growth is a process, not just a single snapshot. Viewing the economy as something that develops or changes over time is part of dynamic economics. According to Simon Kuznets, economic growth is defined as a long-term increase in a country's ability to provide a greater variety of economic goods to its population. This ability improves alongside technological advances, as well as necessary changes in organization and philosophy. Technological progress is considered the most important component in the economic growth process (Nabila et al., 2022). The expenditure approach is used to calculate Gross Domestic Product (GDP), which includes exports and imports. Therefore, mathematically, it is possible for these exports and imports to affect GDP values. Exports can increase GDP, while imports can reduce it. GDP can then be compared to determine how high or low a country's economic growth is. Conversely, the exchange rate of the rupiah against global currencies influences exports and imports. Logically, a country may be encouraged to export more when its currency exchange rate is low, and vice versa. This is because income in domestic currency increases as a result of a low exchange rate, while the opposite mechanism applies to imports (Julianti & Wahyuni, 2024).

Digitalization

Digitalization is the shift in how work is conducted involving the use of information technology to enhance the effectiveness and efficiency of various sectors such as e-learning, business, banking, and government, all of which have adopted it. The main goal of this process is to increase productivity and work efficiency as well as the use of databases to manage documents, replacing paper-based systems. All transaction evidence that previously existed in document form is now easier, more flexible, and accessible at any time because of this. Since administration and marketing no longer require significant costs, product prices tend to be lower. As customers tend to shift to digital transactions, which offer convenience, efficiency, speed, and affordability in the digital era, advances in digital technology have played a role in improving integration, efficiency, and accelerating trade processes at both international and domestic levels. As a result, traditional businesses face the risk of losses. However, it is important not to forget that the opportunities offered also carry security risks (Carolin et al., 2024). Digitalization is the transformation of business activities and operational models into digital formats. It makes many aspects of human life more efficient, connected, and automated. It enables faster data access, increased efficiency, and enhanced creativity. Digitalization has become a key driver of Indonesia's economic development in the modern era, as information and communication technology plays a vital role in changing the way we work, learn, communicate, and interact with our environment. Business and industrial processes in Indonesia have undergone significant changes in terms of innovation, interaction with global markets, and production processes due to advances in information and communication technology. Digitalization helps Indonesian economic actors, both large companies and small and medium enterprises, open new opportunities to improve efficiency, market access, and competitiveness (Gultom et al., 2024).

Export

One of the main sources of foreign exchange for a country is exports. An open economy allows for increased production, driving economic growth that spreads across many countries. This is similarly explained by the Heckscher-Ohlin theory, which states that products made by intensively utilizing abundant and cheap production factors will be exported. Exports have a significant impact on a country's economic growth. This activity increases national income and accelerates economic progress and development (Ikaningtyas et al., 2023). Because exports are directly related to foreign currency flows, exports can strengthen a country's exchange rate due to increased demand for the exporter's currency. Previous studies have shown that international trade can improve economic efficiency and welfare through specialization and comparative advantage. Therefore, international trade is essential for maintaining economic stability and currency exchange rates (BR Silitonga et al., 2019). Exports can directly increase national income, but the opposite is not always true. National income can rise without leading to increased exports because income growth may result from higher household consumption, corporate investment, government spending, or a shift from imported goods consumption to domestically produced goods. Among the factors driving exports, the exchange rate plays an important role in determining the competitiveness of export products. An increase in the domestic exchange rate can raise the price of exported goods for foreign buyers, potentially reducing export volumes. Conversely, a depreciation of the currency can strengthen a product's position in the global market (Carolyn et al., 2024). Exports can increase government budgets through revenue and foreign currency that can be used to improve infrastructure and create an attractive investment climate. This is a crucial part of economic growth. Exports also play an important role in developing the domestic goods market. This role aims to increase competition, which encourages countries to boost production and adopt new technologies in the production process (Nasution & Yusuf, 2018).

Import

Imports involve purchasing goods from abroad and bringing them into the domestic market, typically subject to import duties. High tariffs can limit the entry of certain foreign goods while encouraging local production, which in turn can create more jobs. Import activities play a crucial role in international trade (Kumaat, 2021) and influence foreign currency demand, as payments to exporting countries require foreign currency, such as the US dollar. Higher import volumes can increase this demand. According to prior research, shifts in the trade balance and exchange rates affect currency values: a trade surplus strengthens the local currency, whereas a deficit can lead to depreciation (Fatmawati & Sugiharti, 2021).

Exchange Rate

The exchange rate refers to the amount of domestic currency—here, the rupiah—needed to obtain one unit of foreign currency. It is a key factor in an open economy, influencing prices, interest rates, the balance of payments, and current account transactions. Mundell's theory suggests a negative relationship between exchange rates and economic growth: a higher exchange rate reduces

net exports, which lowers production and GDP (Nurani & Sasana, 2022). Exchange rates affect consumption by enabling cross-country price comparisons and are shaped by supply and demand in the foreign exchange market. Their stability is critical, as fluctuations can harm both the economy and capital markets. Bank Indonesia's research highlights that macroeconomic factors such as interest rate differentials, trade policies, productivity, and net foreign assets significantly impact the rupiah's movement (Kinski et al., 2023). In Indonesia, exchange rates have shown ongoing fluctuations, with rises and falls influencing overall economic performance (Rangkuty et al., 2023).

Internet Penetration

Rising internet access has fueled growth in international e-commerce, supported by improved logistics and global digital payment systems (Naomi et al., 2024). The internet has become a necessity, influencing communication, entertainment, work, and commerce. The number of internet users has consistently increased, especially during the COVID-19 pandemic, which accelerated online activities such as remote work, education, and digital entrepreneurship (Putra, 2018). This growth significantly impacts economic activities, particularly trade. Businesses are increasingly adopting internet-based technologies—including IoT, artificial intelligence, and blockchain—to boost efficiency, productivity, and competitiveness. These advancements also enable closer connections with partners and customers through digital platforms (Ivana Nabila Putri et al., 2024).

Hypotheses

H1: Exports, imports, exchange rate, GDP, and internet penetration have a significant effect on digitalization.

H2: Exports, imports, exchange rate, GDP, and internet penetration have a significant effect on economic growth.

METODELOGI PENELITIAN

The Vector Autoregression (VAR) model (Caraiani et al., 2023) is an econometric method used to examine reciprocal relationships among multiple time series variables. This study applies the VAR model to analyze the interactions between exports, imports, exchange rate, internet penetration, and GDP in Indonesia over the 2007–2024 period. In this framework, each variable is assumed to be influenced both by its own past values and by the past values of other variables in the system (Rusiadi et al., 2024). All variables use secondary data obtained from the World Bank via Data Indonesia (<https://data.worldbank.org/>). The VAR model enables an in-depth understanding of the dynamic interdependencies among variables over time. It is widely applied in economics—particularly in macroeconomics, finance, and policy analysis—for purposes such as forecasting, assessing the effects of policy shocks, tracing the transmission of impacts among economic variables, and testing causal relationships. Thus, the VAR model serves as a robust analytical tool for understanding and predicting economic behavior in complex and evolving contexts.

The conceptual framework for the VAR model in this study is presented as follows:

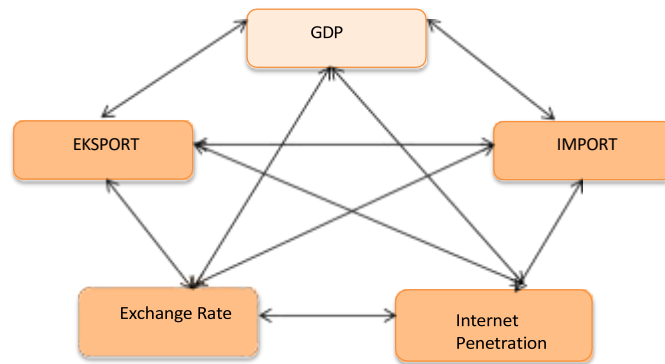


Figure 3. VAR Conceptual FrameworkSource: Author Analysis, 2025

Model Analisis VAR

$$\begin{aligned}
 EKS_t &= \beta_{10}EKS_{t-p} + \beta_{11}IMP_{t-p} + \beta_{12}NIT_{t-p} + \beta_{13}PDB_{t-p} + \beta_{14}PI_{t-p} + e_{t1} \\
 IMP_t &= \beta_{10}EKS_{t-p} + \beta_{11}IMP_{t-p} + \beta_{12}NIT_{t-p} + \beta_{13}PDB_{t-p} + \beta_{14}PI_{t-p} + e_{t1} \\
 NIT_t &= \beta_{10}EKS_{t-p} + \beta_{11}IMP_{t-p} + \beta_{12}NIT_{t-p} + \beta_{13}PDB_{t-p} + \beta_{14}PI_{t-p} + e_{t1} \\
 PDB_t &= \beta_{10}EKS_{t-p} + \beta_{11}IMP_{t-p} + \beta_{12}NIT_{t-p} + \beta_{13}PDB_{t-p} + \beta_{14}PI_{t-p} + e_{t1} \\
 PI_t &= \beta_{10}EKS_{t-p} + \beta_{11}IMP_{t-p} + \beta_{12}NIT_{t-p} + \beta_{13}PDB_{t-p} + \beta_{14}PI_{t-p} + e_{t1}
 \end{aligned}$$

Where :

EKS = Eksport (Million) IMP = Import (Million)
 NIK = Exchange Rate (Million)
 GDP = Economic Growth (Percent)
 PI = Internet Penetration (Percent)
 et = Random Shocks (*random disturbance*) p = Lag length

RESULTS AND DISCUSSION

The impact of digitalizational trade in enhancing economic growth is analyzed based on the following data:

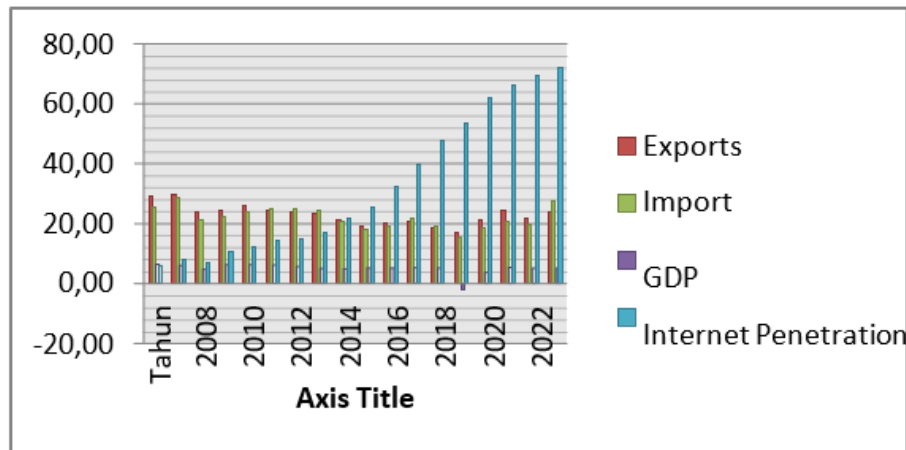


Figure 5. The impact of digitalization on international trade in enhancing economic growth

Source: World Bank Data, processed by the author (2025)

Unit Root Test

ResultsBelow is Table 2, which shows the unit root test using the augmented Dickey-Fuller (ADF):

Table 2. Unit Root Test Results

Variable	<i>Augmented Dickey Fuller</i>	
	<i>t-statistic</i>	Stasioneritas
a	0.0000	2 nd
Import	0.0034	2 nd
Exchange Rate	0.0020	2 nd
PDB	0.0336	1 st
Internet Penetration	0.0001	2 nd

Source: Data analysis, eviews 10

Note: ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

Table 2 presents the results of the stationarity test, indicating that the Augmented Dickey-Fuller (ADF) values for the variables achieve stationarity at different levels. Specifically, Exports, Imports, Exchange Rate, and Internet Penetration are stationary at the second-difference level, while GDP is stationary at the first-difference level. All variables have probability values of 0.00, which are less than 0.05, confirming their stationarity. Given these results, the analysis proceeds with the Johansen cointegration test, as detailed below.

Table 3. Johansen Test Results

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.958163	132.8840	69.81889	0.0000
At most 1 *	0.919612	82.10026	47.85613	0.0000
At most 2 *	0.802397	41.76604	29.79707	0.0013
At most 3 *	0.620260	15.82214	15.49471	0.0446
At most 4	0.020405	0.329851	3.841466	0.5657

Source: Data analysis, Eviews 10

The Johansen cointegration test shows the pattern of relationships among variables. Table 3 above indicates that there are four cointegrated equations at a 5% significance level. This proves the existence of a long-term relationship among the variables. To analyze the results of the VAR test, the next step is to analyze the stability test results of the lag structure as follows:

Table 4. Results of Lag 1 and Lag 2 Test

Vector Autoregression Estimates LAG 1	
Akaike information criterion	50.58701
Schwarz criterion	52.05738
Number of coefficients	30
Vector Autoregression Estimates LAG 2	
Akaike information criterion	46.22470
Schwarz criterion	48.88048
Number of coefficients	55

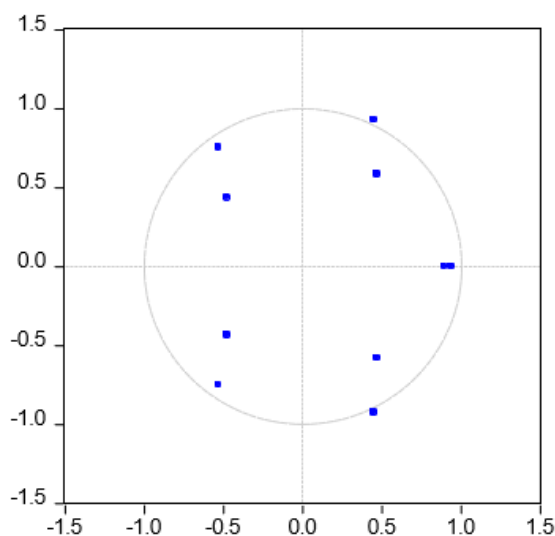
Source: Data analysis, Eviews 10

The selection of the optimal lag length is based on the Schwarz Criterion (SC) and the Akaike Information Criterion (AIC), with preference given to the lag that produces the lowest values for both criteria. As shown in Table 2, the AIC value at lag 2 (48.88048) is lower than that at lag 1 (52.05738), indicating that lag 2 is the most suitable. Therefore, the subsequent analysis is carried out using lag 2. The next section presents the results of the lag structure stability test, as detailed in the following table and figure.

Table 5. Structural Lag Stability Test

Root	Modulus
$0.447957 - 0.927165i$	1.029709
$0.447957 + 0.927165i$	1.029709
0.937375	0.937375
$-0.529325 - 0.750738i$	0.918582
$-0.529325 + 0.750738i$	0.918582
0.892262	0.892262
$0.469679 - 0.582775i$	0.748481
$0.469679 + 0.582775i$	0.748481
$-0.477625 - 0.434784i$	0.645881
$-0.477625 + 0.434784i$	0.645881

Source: Data analysis, Eviews 10

Inverse Roots of AR Characteristic Polynomial**Figure 6. Inverse Roots of the AR Characteristic Polynomial Graph**

As shown in Table 5 and Figure 6, all root modulus values are less than 1, and the graphical representation confirms that all roots lie within the unit circle. This indicates that, based on the characteristic polynomial and its inverse roots, the VAR model is stable. With the lag stability test satisfied, the analysis can proceed to the VAR estimation stage as follows:

Table 6. VAR Estimation Test Results

Variable	Biggest Contribution	
	Biggest I	Biggest II
Eksport	Eksport	Import
Import	Eksport	Import
Exchange Rate	Exchange Rate	GDP
GDP	GDP	Eksport
Internet Penetration	Exchange Rate	GDP

Source: Data Analysis, Eviews 10

Exports contribute most significantly to their own variation but are also notably influenced by imports. Conversely, imports are primarily affected by exports, indicating a strong bidirectional relationship within international trade. The exchange rate exerts the greatest influence on its own movements, followed by the impact of GDP. For GDP, the largest contributions come from itself and exports, underscoring the critical role of the foreign trade sector in driving economic growth. Internet penetration is more strongly influenced by the exchange rate and GDP, suggesting that digitalization development depends on macroeconomic stability and the population's purchasing power. The Impulse Response Function (IRF) is used to measure how each variable responds to changes in other variables over different time horizons. A summary of these effects across various periods is presented in the following table:

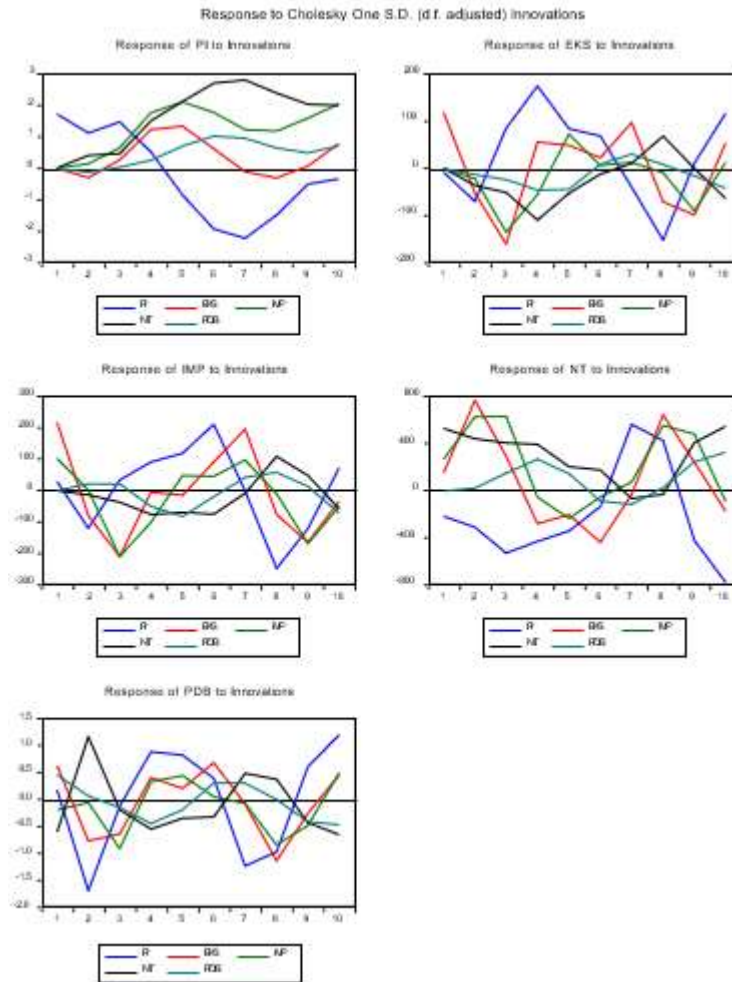


Figure 7. Summary Graph of IRF (Impulse Response Function) Test Results

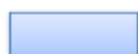

Source: Data Analysis, Eviews 10

The figure presents the Impulse Response Function (IRF) results from the VAR model, showing how each variable responds to shocks from other variables over a given period. It can be seen that each variable reacts differently to shocks from others. For instance, in the *response of GDP to innovations* graph, GDP exhibits relatively fluctuating responses to shocks from Internet Penetration (PI), Exchange Rate (NT), Exports (EK), and Imports (IMP), with directions varying from positive to negative depending on the time period. This indicates that economic growth does not move in a strictly linear fashion in response to shocks from digitalization and trade but is influenced by the dynamics among variables. Meanwhile, in the *response of NT to innovations* graph, the exchange rate (NT) tends to show a relatively strong reaction to shocks from GDP and PI, suggesting that macroeconomic factors and digitalization contribute to exchange rate fluctuations. The other graphs also depict the complex interdependencies among variables, with some responses being temporary and others persisting in the medium term.

Table 7. Interaction of Digitalization with International Trade in Enhancing Economic Growth

Variable	Interaction of Digitalization with International Trade in Enhancing Economic Growth					Period
	PI	EKS	IMP	NT	PDB	
Internet Penetration	100.00%	-	-	-	-	Short Term
	27.68%	12.77%	30.51%	26.89%	2.13%	Medium Term
	21.60%	5.38%	25.33%	43.34%	4.33%	Long Term
Eksport	0.45%	99.54%	-	-	-	Short Term
	33.03%	32.23%	18.66%	12.92%	3.13%	Medium Term
	38.35%	31.38%	15.21%	11.81%	3.22%	Long term
Import	1.25%	80.60%	18.13%	-	-	Short Term
	16.88%	43.15%	29.80%	5.63%	4.51%	Medium Term
	32.12%	34.81%	21.58%	7.33%	4.14%	Long Term
Exchange Rate	10.81%	5.90%	17.30%	65.96%	-	Short Term
	20.84%	24.14%	27.01%	24.48%	3.40%	Medium Term
	29.97%	22.93%	22.30%	20.18%	4.57%	Long Term
GDP	3.50%	38.06%	3.22%	34.90%	20.30%	Short Term
	45.15%	15.92%	12.11%	23.60%	4.87%	Medium Term
	46.63%	18.56%	12.43%	17.05%	5.30%	Long Term

Source: Processed data by the author, 2025

 : Biggest 1
 : Biggest 2

The variance decomposition results reveal that, in the short term, internet penetration is entirely influenced by its own variation, indicating that digitalization remains independent from direct influences of international trade or other macroeconomic variables. In the medium and long term, however, the exchange rate and imports begin to make significant contributions, reflecting a growing interconnection between digitalization and external factors. Exports are dominated by their own contributions across all periods, yet the influence of internet penetration steadily increases in the medium and long term, suggesting that digitalization enhances exports by expanding access to information and global markets. Imports are strongly driven by exports in the short term, underscoring a structural link in trade, but the role of internet penetration also grows over time, facilitating the acceleration and efficiency of goods and services imports. The exchange rate is largely self-determined in the short term, though the contributions of exports, imports, and internet penetration rise in the medium and long term. This indicates that exchange rate stability is shaped not only by monetary mechanisms but also by trade flows and digital connectivity. Economic growth (GDP) is significantly influenced by internet penetration throughout the observation period, with its impact intensifying from short to long term. Exports and the exchange rate also emerge as key contributors to GDP. Overall, these findings underscore that, in the long run, digitalization plays a pivotal role in supporting international trade and,

indirectly, in driving sustainable national economic growth.

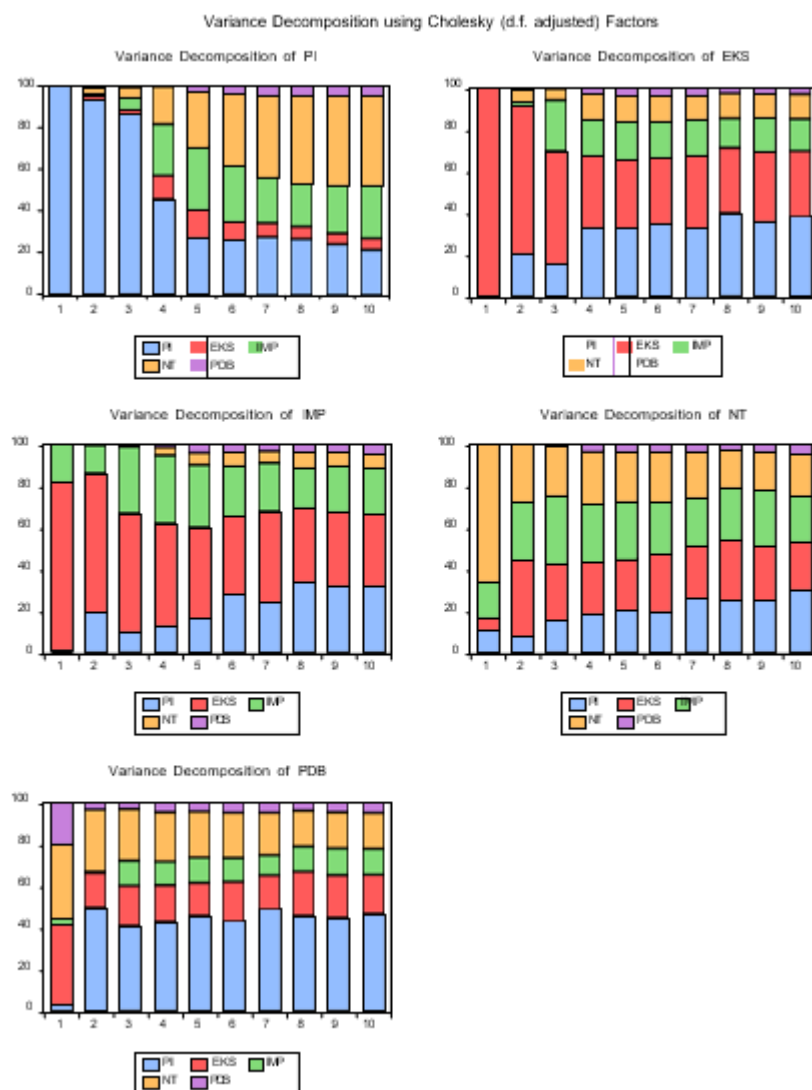


Figure 8. Summary Graph of FEVD (Forecast Error Variance Decomposition) Results

Source: Data Analysis, Eviews 10

The FEVD (Forecast Error Variance Decomposition) results from the VAR model illustrate the relative contribution of each variable to others across multiple future periods. In the short term, most variables are almost entirely explained by their own variation, as shown by the uniform color in the first bar of each chart. Over time, however, the proportion of contributions from other variables increases, reflecting stronger dynamic interactions.

For Internet Penetration (PI), the initial contribution is nearly 100% from itself, but in subsequent periods it becomes increasingly influenced by the exchange rate (NT), imports (IMP), and GDP, suggesting that long-term digitalization depends more on trade and macroeconomic

conditions. For Exports (EKS), the influence of internet penetration and the exchange rate grows over time, underscoring the role of digitalization in market expansion and the sensitivity of exports to macroeconomic stability. Imports (IMP) are consistently shaped by exports, internet penetration, and GDP, reflecting Indonesia's reliance on export-driven trade and the growing impact of digital access. The Exchange Rate (NT) is increasingly affected by internet penetration, exports, and GDP in later periods, showing its sensitivity to both digital and trade developments. GDP is progressively influenced by internet penetration, exports, and the exchange rate, with internet penetration's share rising notably in the long term—reinforcing the role of digitalization in promoting trade and growth.

The VAR analysis began with a stationarity check using the Augmented Dickey-Fuller (ADF) test, confirming that all variables became stationary after differencing ($p < 0.05$). The optimal lag length, determined using the AIC and SC criteria, was found to be lag 2. Johansen's cointegration test indicated a long-term relationship among variables at the 5% significance level, and the model passed stability testing as all root modulus values were below one.

Indonesia's digital economy is growing rapidly, driven by rising internet penetration, the adoption of digital devices, and innovations across sectors. In 2022, its value reached IDR 714.4 trillion (up 27.6% year-on-year), with a government target of IDR 1,700 trillion by 2025. Policies supporting this growth include infrastructure expansion, digital payment systems, regulatory reforms, and workforce digital skills development.

Exports remain a key driver of economic growth, providing foreign exchange and enabling production expansion. Removing trade barriers and improving credit access for exporters can enhance growth further. Digital technologies—such as AI, blockchain, and cloud computing—enable faster, more secure international transactions and boost competitiveness for businesses of all sizes.

Exchange rate stability is critical for macroeconomic health, as depreciation against major currencies like the US dollar can dampen investor confidence and economic performance. Digitalization also influences exchange rate dynamics through trade integration and investment flows.

Greater internet use is linked to GDP growth by enabling higher productivity, market access, and knowledge economy transitions. ICT adoption strengthens the long-term growth process by fostering innovation and global economic integration.

Impulse Response Function (IRF) analysis shows how shocks to exports, imports, exchange rate, internet penetration, and GDP produce short-, medium-, and long-term effects, capturing the dynamic interactions between them. FEVD results confirm that digitalization's contribution to international trade and economic growth strengthens over time, highlighting its strategic importance for Indonesia's sustainable economic development.

CONCLUSION

The findings of this study demonstrate that digitalization, as measured by internet penetration, significantly influences international trade dynamics and economic growth in Indonesia. VAR model results reveal strong reciprocal relationships among exports, imports, exchange rate, GDP, and internet penetration in both the short and long term. The Johansen cointegration test confirms a long-term equilibrium relationship among these variables. Impulse Response Function (IRF) analysis shows that GDP reacts variably to shocks from digitalization and trade, indicating that Indonesia's economic growth is sensitive to changes in both global trade and digital infrastructure. Forecast Error Variance Decomposition (FEVD) results reveal that, while variables are initially influenced primarily by their own past values, the contribution of internet penetration to exports, imports, exchange rate, and GDP grows over time. In the long term, digitalization exerts a particularly strong impact on economic growth. Overall, digitalization plays a crucial role in enhancing international trade efficiency and fostering national economic growth. These findings underscore the importance of accelerating digital infrastructure development, improving technological literacy, and integrating digital systems into national trade mechanisms to support inclusive and sustainable economic development.

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