

THE IMPACT OF EXPORTS, IMPORTS, REAL INTEREST RATES (RIR), AND INFLATION IN INDONESIA FROM 1991 TO 2024 USING THE VECM MODEL

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ABSTRACT

This study uses the Vector Error Correction Model (VECM) technique to determine the effects of imports, exports, real interest rates, and inflation in Indonesia from 1991 to 2024. The World Bank provided the annual data, which was empirically analyzed using a number of econometric stages. According to the stationarity test, all variables are not stationary at the level level but become stationary following the first differentiation. The VAR model was declared stable with an optimum lag of 2. The Johansen cointegration test proves the existence of a long-term relationship between variables. VECM estimates reveal that Exports and Imports are significant factors that affect Inflation in the short term, while Real Interest Rates act as an important adjustment mechanism that guides variables towards long-term equilibrium. The Granger Causality Test found that there is a two-way relationship that affects each other between Inflation and Imports.

Keywords: Inflation, Exports, Imports, Real Interest Rates and Vector Error Correction Model (VECM).

ABSTRAK

Tujuan penelitian ini adalah untuk mengidentifikasi dampak Ekspor, Impor, Suku Bunga Riil, dan Inflasi di Indonesia selama periode 1991–2024 dengan menggunakan pendekatan Vector Error Correction Model (VECM). Data yang digunakan merupakan data tahunan yang bersumber dari World Bank, dianalisis secara empiris melalui beberapa tahapan ekonometrika. Uji stasioneritas mengindikasikan bahwa semua variabel bersifat tidak stasioner pada tingkat level, namun menjadi stasioner setelah dilakukan diferensiasi pertama. Model VAR dinyatakan stabil dengan lag optimum 2. Uji kointegrasi Johansen membuktikan adanya hubungan jangka panjang antarvariabel. Estimasi VECM mengungkapkan bahwa Ekspor dan Impor adalah faktor signifikan yang memengaruhi Inflasi dalam jangka pendek, sedangkan Suku Bunga Riil berperan sebagai mekanisme penyesuaian penting yang memandu variabel menuju keseimbangan jangka panjang. Uji Kausalitas Granger menemukan adanya hubungan dua arah yang saling memengaruhi antara Inflasi dan Impor.

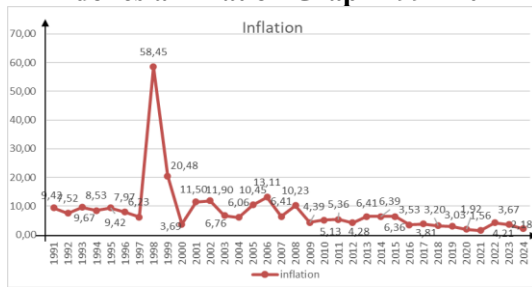
Kata kunci: Inflasi, Ekspor, Impor, Suku Bunga Riil dan Vector Error Correction Model (VECM).

1. Introduction

The economic structure of developing countries, which tends to be agrarian-based, places the stability of economic activity in a position that is highly vulnerable to shocks. In this context, Indonesia is a relevant example because it often experiences uncertainty in maintaining the stability of economic activity. When economic conditions become unstable, the impact spreads to fundamental macroeconomic problems, namely stagnant economic growth, increased unemployment, and high inflation rates (Khoirudin & Ardini, 2023)

Inflation is defined as a sustained and pervasive escalation in the prices of goods and services. High inflation can reduce people's ability to purchase goods and services and disrupt economic growth. Therefore, it is important to maintain macroeconomic stability, which ultimately contributes to improving people's welfare (Aditya et al., 2024)

Figure 1
Indonesia Inflation Graph 1991-2024



Data source: World Bank, Indonesia

Based on Figure 1, Indonesia's inflation rate from 1991 to 2024 fluctuated quite sharply. Inflation peaked in 1998, reaching 58.45%, reflecting the profound impact of the Asian monetary crisis. The crisis caused a significant depreciation of the rupiah against the US dollar by more than 500%. As a result, the prices of imported goods rose dramatically because Indonesia was heavily dependent on raw materials and capital goods from abroad.

In addition to crisis factors, export and import activities play an important role in inflation dynamics. The weakening of the rupiah exchange rate causes an increase in the price of imported goods, thereby triggering inflation through the mechanism of imported inflation. Conversely, an increase in export performance can strengthen foreign exchange reserves and exchange rate stability, which has the potential to reduce external inflationary pressures. Thus, the balance between exports and imports is an important instrument in maintaining domestic price stability. The export structure, which is dominated by raw commodities, also makes the Indonesian economy vulnerable to global price fluctuations, which have a direct impact on domestic inflation.

On the other hand, interest rates serve as the main tool of monetary policy in controlling inflation. In response to escalating inflation, Bank Indonesia elevates interest rates, thereby constraining aggregate demand and mitigating inflationary pressures. Conversely, during periods of subdued inflation, interest rates are lowered to encourage investment and consumption. Research (Anjelisni et al., 2025) demonstrates that key macroeconomic indicators such as money supply, benchmark interest rates, exchange rates, exports, and

imports exhibit a significant long-term association with inflation rates in Indonesia. Using the Vector Error Correction Model (VECM) approach, it was found that exports and exchange rates have a positive effect on inflation, while interest rates and imports have a negative effect. These findings emphasize the important role of monetary policy and foreign trade in maintaining price stability and supporting sustainable economic growth.

Meanwhile, according to (Hanitha et al., 2024), fluctuations in macroeconomic variables such as inflation, exchange rates, exports, and imports are closely related in determining national economic stability. Changes in inflation rates can affect the competitiveness of export products, while exchange rate movements and import activities also play a role in maintaining the balance of trade. Thus, an analysis of the dynamic relationship between these variables is necessary to understand the transmission mechanism of economic policy and its impact on the overall economic stability of Indonesia.

The research question in this study focuses on the dynamics of macroeconomic variables that affect inflation in Indonesia. This study examines the development of exports, imports, real interest rates (RIR), and inflation during the period 1991–2024. In addition, this study formulates the problem of whether these variables are stationary or require a differentiation process to meet the requirements of time series analysis. The next problem formulation relates to the extent to which the VAR model used is stable so that it can be used as the basis for VECM analysis. This study also questions the most appropriate optimum lag to describe the dynamic relationship between variables, whether there is a long-term relationship (cointegration) between exports, imports, inflation, and RIR, and how the short-term and long-term relationships are generated through VECM estimation. The final problem formulation highlights the direction of causality, the response pattern (Impulse Response in Variable Variance Decomposition) in influencing inflation in Indonesia.

2. Literature Review and Hypothesis Development

When prices for goods and services in the economy often rise steadily, this is known as inflation. According to (Mankiw, 2016) inflation is a macroeconomic phenomenon that occurs when the general price level rises continuously as a result of the money supply growing faster than real output growth. Meanwhile, (Mishkin, 2016) emphasizes in his research that inflation is also influenced by economic actors' expectations of future prices. There are three main criteria that characterize inflation, namely price increases, general coverage, and continuity over a certain period, so that inflation can be interpreted as an event that generally represents an increase in price levels and occurs continuously (Nairizi, 2023). Several previous studies have shown mixed results. (Anjelisni et al., 2025) found that exports have a positive effect on inflation, while imports have a negative effect. (Khoirudin & Ardini, 2023) argued that Bank Indonesia's interest rates, exports, and imports do not contribute significantly to changes in inflation.

Exports are goods and services produced domestically but sold to consumers abroad, making them one of the main channels for integrating the domestic economy with the global economy (Krugman et al., 2018). According to (Reza Noer Irvansyah, 2024), because of international trade, exports are crucial to Indonesia's economy, the country can earn foreign exchange and expand the market for domestic products. According to (Ginting, 2017), exports are one of the main factors driving a country's economic growth. Indonesia's export performance can be improved through administrative reforms, strengthening research and product development, improving infrastructure, maintaining exchange rate stability, expanding non-traditional markets, and improving the structure of export commodities.

Imports are international trade activities involving purchasing or importing products and services to satisfy domestic need, both for consumption and production activities. (Paul & William, 2010) explain that in an open economy, imports are part of a country's economic activities because through imports, countries obtain goods that they are

unable to produce themselves or that would be more expensive to produce domestically. (Mashita, 2023) states that imports are activities of bringing goods or services from abroad into a country's customs territory as a form of international trade transactions. In line with this, (Kartikasari & Khoirudin, 2022), add that imports are not only intended to meet domestic demand, but can also be a means of establishing good relations between countries and encouraging technology transfer from more advanced countries to countries that do not yet have adequate technological capabilities.

Has been modified to account for inflation is known as the real interest rate so that it reflects the real return received by investors or the real cost paid by borrowers. According to (Fisher, 1930) in his theory The Theory of Interest, the difference between the expected inflation rate and the nominal interest rate of inflation is known as the real interest rate, where changes in inflation will be offset by changes in the nominal interest rate so that the real interest rate remains stable in the long term. (Musliha, 2023) explains that interest rates play a major role in monetary policy in controlling inflation through their influence on public consumption and investment, while (Yulianti et al., 2025) found that interest rate fluctuations can affect real economic activities such as exports, because an increase in interest rates increases production costs and reduces product competitiveness.

Research Hypothesis

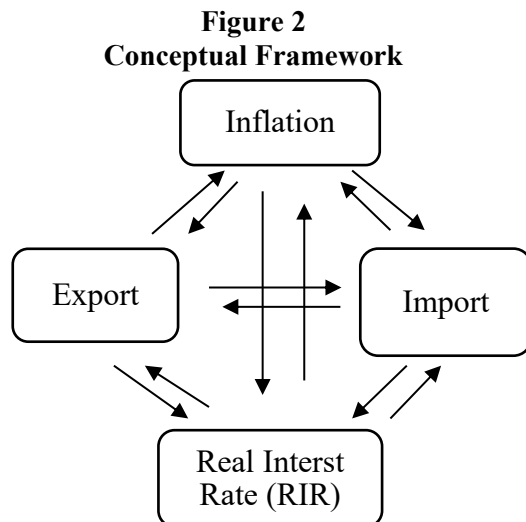
Based on previous theoretical studies and empirical findings, it is suspected that there is a long-term relationship and causality between the variables of inflation, exports, imports, and real interest rates (RIR). To prove this assumption, this study establishes the following hypothesis:

- H₁: In Indonesia, there is a long-term correlation between inflation, real interest rates (RIR), imports, and exports from 1991 - 2024.
- H₂: Between 1991 - 2024, Indonesian exports and inflation were causally related.
- H₃: Inflation and imports in Indonesia from 1991 - 2024 are causally related.

- H₄: There is a causal association between inflation and real interest rates (RIR) in Indonesia during the period 1991–2024.
- H₅: Exports and imports in Indonesia from 1991 - 2024 are causally related.
- H₆: Exports and real interest rates (RIR) in Indonesia are causally related between 1991 - 2024.
- H₇: Imports and real interest rates (RIR) in Indonesia from 1991 to 2024 are causally related.

3. Conceptual Framework

To illustrate the relation between the variables studied in this study, the following framework shows the direction of the relationship between inflation, exports, imports, real interest rates (RIR), and inflation:



4. Research Methodology

The research methodology covers the time frame, location, data collection techniques, sampling techniques, operational definitions of variables, and data analysis techniques. Sub-sections may be numbered hierarchically if necessary. This research was conducted in 2025 with a focus on Indonesia's economic conditions, so all analyses used Indonesian macroeconomic data. Time series from 1991 to 2024 served as secondary data. The World Bank's official World Development Indicators (WDI) data was downloaded in order to conduct documentation studies and data collection techniques.

The variables used include inflation, consumer prices (annual %) as an indicator of inflation, exports of goods and services (% of

GDP) as an export variable, imports of goods and services (% of GDP) as an import variable, and real interest rate (RIR) as an indicator of real interest rates. All data were used in their entirety without sampling techniques because this study utilized full time series data (census approach).

This study applies the Vector Error Correction Model (VECM) method introduced by Engle and Granger. This method is used to adjust the imbalance between short-term and long-term relationships. VECM is an extension of Vector Autoregressive (VAR) designed to analyze integrated non-stationary data. If there is cointegration between variables, the model used is called restricted VAR or VECM. Before conducting an analysis with VECM, there are several assumptions that must be met, namely that all research variables must be stationary at the same level of integration (Putri et al., 2023). The stages in VECM/VAR analysis are:

1. Stationarity test
2. VAR stability test
3. Determination of optimum lag
4. Cointegration Test
5. Estimation of the Vector Error Correction Model (VECM)
6. Granger Causality Test
7. Impulse Response Function (IRF)
8. Variance Decomposition (VD)

There are several conditions that must be met when analyzing using the VECM method, namely that one of the variables must be stationary at the first difference and there must be cointegration between the research variables. When both conditions are met, analysis using the VECM method can proceed.

$$\begin{aligned}
 \Delta Y_t &= \mu_1 + \sum_{i=1}^n \beta_i \Delta Inflation_{t-i} \\
 &+ \sum_{i=1}^n \beta_i \Delta Export_{t-i} \\
 &+ \sum_{i=1}^n \beta_i \Delta Import_{t-i} + \sum_{i=1}^n \beta_i \Delta RIR_{t-i} \\
 &+ \theta_1 ECT_{t-1} + \varepsilon_1
 \end{aligned}$$

5. Results and Discussion

1. Stationarity Test

Table 1. Stationarity Test Results Inflation

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-12.75450	0.0000
Test critical values:		
1% level	-3.711457	
5% level	-2.981038	
10% level	-2.629906	

Source: Data processed using Eviews 12, 2025

The partial stationarity test results presented in Table 1 indicate that the Augmented Dickey-Fuller (ADF) p-value is 0.0000, which falls below the 0.05 significance threshold. Consequently, the inflation variable can be deemed stationary at the first difference level.

Table 2. Results of the Exsprot Stationarity Test

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-8.571433	0.0000
Test critical values:		
1% level	-3.653730	
5% level	-2.957110	
10% level	-2.617434	

Source: Data processed using Eviews 12, 2025

The partial stationarity test results presented in Table 2 show that the Augmented Dickey-Fuller (ADF) test p-value is 0.0000, which is below the significance threshold of 0.05. As a result, the Export variable achieves stationarity at the first difference level.

Table 3. Import Stationarity Test Results

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-3.346031	0.0225
Test critical values:		
1% level	-3.699871	
5% level	-2.976263	
10% level	-2.627420	

Source: Data processed using Eviews 12, 2025

The partial stationarity test results presented in Table 3, show that the Augmented Dickey-Fuller (ADF) p-value is 0.0225, which is below the significance threshold of 0.05. As a result, the import variable can be considered stationary at the first difference level.

Table 4. Results of the RIR Stationarity Test

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-10.48152	0.0000
Test critical values:		
1% level	-3.653730	
5% level	-2.957110	
10% level	-2.617434	

Source: Data processed using Eviews 12, 2025

The partial stationarity test results presented in Table 4, show that the Augmented Dickey-Fuller (ADF) p-value is 0.0000, which is below the significance threshold of 0.05. As a result the Real Interest Rate (RIR) variable can be considered stationary at the first difference level.

2. VAR Stability Test

Table 6. Stability Test Results

Root	Modulus
-0.304929 - 0.870778i	0.922625
-0.304929 + 0.870778i	0.922625
-0.747498 - 0.513890i	0.907103
-0.747498 + 0.513890i	0.907103
0.551067 - 0.706119i	0.895700
0.551067 + 0.706119i	0.895700
0.380058 + 0.805398i	0.890567
0.380058 - 0.805398i	0.890567
-0.843219 - 0.258513i	0.881957
-0.843219 + 0.258513i	0.881957
0.768501 - 0.393981i	0.863605
0.768501 + 0.393981i	0.863605
-0.471182 - 0.722394i	0.862477
-0.471182 + 0.722394i	0.862477
-0.017681 + 0.848075i	0.848260
-0.017681 - 0.848075i	0.848260
0.079785 - 0.818774i	0.822652
0.079785 + 0.818774i	0.822652
0.652278	0.652278
-0.620947	0.620947

Source: Data processed using Eviews 12, 2025

Model stability can be seen through the modulus value in the AR root table in Table 6. If all AR root values are less than 1, the model is considered stable. Based on the above output, no modulus value exceeds 1, so the model remains stable up to the 4th lag.

3. Optimum Lag Test

Table 7. Optimum Lag Test Results Test

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-318.1113	NA	115446.7	23.00795	23.19827	23.06613
1	-290.6000	45.19719	51518.01	22.18571	23.13729	22.47662
2	-260.9568	40.23003*	21039.97*	21.21120	22.92403*	21.73483
3	-247.7203	14.18196	31725.86	21.40859	23.88269	22.16495
4	-224.0420	18.60442	29335.61	20.86014	24.09549	21.84922
5	-193.2990	15.37149	27978.78	19.80707*	23.80368	21.02887*

Source: Data processed using Eviews 12, 2025

Based on Table 7, the results of the optimum lag test as seen from the central sign (*) show that Lag 2 meets the LR, FPE, and SC criteria. Therefore, the optimum lag to be used is Lag 2.

4. Cointegration Test

Table 7. Cointegration Results

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.734485	85.79462	47.85613	0.0000
At most 1 *	0.552473	46.01215	29.79707	0.0003
At most 2 *	0.407300	21.89162	15.49471	0.0047
At most 3 *	0.186699	6.199621	3.841465	0.0128

Source: Data processed using Eviews 12, 2025

Based on the cointegration test results, the selected lag is 2. This indicates that all trace statistic values are greater than the critical value at a significance level of 5 percent. The trace statistic value indicates the existence of 4 cointegration ranks at $\alpha = 0.05$, marked with an asterisk (*).

5. Estimasi Vector Error Correcti Model (VECM)

Table 9. VECM Test Results Long Term

Variabel	CointEq1	t-statistic	t-table
D(INFLATION(-1))	1.000.000		
D(EXPORT(-1))	-0.190185	-0.67939	
D(IMPORT(-1))	-0.76222	-180.921	204.227
D(RIR(-1))	-0.12266	-0.60931	
C	0.086887		

Source: Data processed using Eviews 12, 2025

$$ECT_{t-1} = -0,190185EXPORT_{t-1} - 0,762220IMPORT_{t-1} + 0,122660RIR_{t-1} + \varepsilon_t$$

The results of the Long-Term VECM estimation show that:

1. The Export variable has a t-statistic value of -0.67939, which is greater than the t-table (-2.04227), so it has no effect on the first lag (1) at a significance level of 5%. The coefficient of -0.19019 indicates that a 1% increase in exports in the previous year will reduce inflation by 19.02% in the current year.
2. The Import variable has a t-statistic value of -0.80921, which is greater than the t-table (-2.04227), so it has no effect on the first lag (1) at the 5% level. The coefficient of -0.76222 indicates that a 1% increase in imports in the previous year can reduce inflation by 76.22% in the current year.
3. The Real Interest Rate (RIR) variable has a t-statistic of -0.60931, which is greater than the t-table (-2.04227), so it has no effect on the first lag (1) at the 5% level. The coefficient of -0.12266 indicates that a 1% increase in RIR in the previous year will reduce inflation by 12.27% in the current year.

Table 10. Results of Short-Term VECM Test for Inflation Variables

Error Correlation:	Coefficient	Std. Error	t-Statistic	t-table	Description
CointEq1	-4863930	0.8183	-594397		Influent
D(INFLATION(-1))	-1753590	0.47275	370936		Influent
D(INFLATION(-2))	1159828	0.38741	299379		Influent
D(EXPORT(-1))	3196489	140130	228109		Influent
D(EXPORT(-2))	2617519	117881	222047	2.04227	Influent
D(IMPORT(-1))	-3846794	126223	-304762		Influent
D(IMPORT(-2))	-3122669	104321	-299334		Influent
D(RIR(-1))	0.040218	0.48723	0.08254		No Effect
D(RIR(-2))	0.393136	0.37248	105545		No Effect
C	0.219761	184791	0.11892		No Effect

Source: Data processed using Eviews 12, 2025

The short-term estimation results derived from the VECM for the Economic Growth (PE) variable can be seen in the following VECM model:

$$\begin{aligned} \Delta INFLATION_{1-t} &= -4.863930ECT_{t-1} \\ &- 1.753590\Delta INFLATION_{t-1} \\ &+ 1.159828\Delta INFLATION_{t-2} \\ &+ 3.196489\Delta EXPORT_{t-1} \\ &+ 2.617519\Delta EXPORT_{t-2} \\ &- 3.846794\Delta IMPORT_{t-1} \\ &- 3.122669\Delta IMPORT_{t-2} \\ &+ 0.040218\Delta RIR_{t-1} + 0.393136\Delta RIR_{t-2} \\ &+ 0.219761 + \varepsilon_t \end{aligned}$$

In the short run, the Inflation variable has a positive Impact on the Inflation variable itself at lag 1 with a coefficient value of (-1.753590) and at lag 2 with a coefficient value of (1.159828), the Export variable has a positive Impact on lags 1 and 2, with coefficient values of (3.196489) and (2.617519) the Import variable has a negative effect on the Inflation variable at lag 1 with a coefficient value of (-3.846794) and lag 2 with a coefficient value of (-3.122669), and the RIR variable has no effect on the Inflation variable at lag 1 with a coefficient value of (0.040218) or lag 2 with a coefficient value of (0.393136).

Table 11. Results of Short-Term VECM Test for Export Variables

Error Correlation:	Coefficient	Std. Error	t-Statistic	t-label	Description
CointEq1	-1.966226	0.41412	-4.74797		Influential
D(INFLATION(-1))	0.740407	0.23925	3.09476		Influential
D(INFLATION(-2))	0.684700	0.19606	3.49231		Influential
D(EXPORT(-1))	1.197386	0.70916	1.68845		No Effect
D(EXPORT(-2))	1.308498	0.59657	2.19337	2.04227	Influential
D(IMPORT(-1))	-1.923445	0.63878	-3.01111		Influential
D(IMPORT(-2))	-1.881228	0.52794	-3.56333		Influential
D(RIR(-1))	-0.069463	0.24658	-0.28171		No Effect
D(RIR(-2))	0.158337	0.18850	0.83997		No Effect
C	0.199843	0.93518	0.21369		No Effect

Source: Data processed using Eviews 12, 2025

The short-term estimation results derived from the Export variable can be seen in the following VECM model:

$$\begin{aligned} \Delta EXPORT_{1-t} &= -1.966226ECT_{t-1} \\ &+ 0.740407\Delta INFLATION_{t-1} \\ &+ 0.684700\Delta INFLATION_{t-2} \\ &+ 1.197386\Delta EXPORT_{t-1} \\ &+ 1.308498\Delta EXPORT_{t-2} \\ &- 1.923445\Delta IMPORT_{t-1} \\ &- 1.881228\Delta IMPORT_{t-2} \\ &- 0.069463\Delta RIR_{t-1} + 0.158337\Delta RIR_{t-2} \\ &+ 0.199843 + \varepsilon_t \end{aligned}$$

In the short run, the export variable does not influence its own value at lag 1, however, at lag 2 it shows a positive impact, reflected by a coefficient of 1.308498. The inflation variable contributes positively to export performance at both lag 1 and lag 2, with coefficient values of 0.740407 and 0.684700, respectively. Meanwhile, the import variable exerts a negative influence on exports in the short term, as indicated by coefficients of -1.923445 at lag 1 and -1.881228 at lag 2. Furthermore, the real

interest rate (RIR) variable does not display any significant effect on exports at lag 1 (-0.069463) or lag 2 (0.158337).

Table 12. Results of Short-Term VECM Test for Import Variable

Error Correlation:	Coefficient	Std. Error	t-Statistic	t-label	Description
CointEq1	-1.455.365	0.28132	-517.328		Influential
D(INFLATION(-1))	0.494437	0.16253	304.219		Influential
D(INFLATION(-2))	0.440401	0.13319	330.659		Influential
D(EXPORT(-1))	1.507.951	0.48175	313.012		Influential
D(EXPORT(-2))	1.195.775	0.40527	295.059	2.04227	Influential
D(IMPORT(-1))	-2.034.819	0.43394	-468.913		Influential
D(IMPORT(-2))	-1.776.695	0.35864	-495.391		Influential
D(RIR(-1))	0.038304	0.16751	0.22867		No Effect
D(RIR(-2))	0.066539	0.12806	0.51961		No Effect
C	0.070628	0.6353	0.11117		No Effect

Source: Data processed using Eviews 12, 2025

The short-term estimation results derived from the Import variable can be seen in the following VECM model:

$$\begin{aligned} \Delta IMPORT_{1-t} &= -1.455.365ECT_{t-1} \\ &+ 0.494437\Delta INFLATION_{t-1} \\ &+ 0.440401\Delta INFLATION_{t-2} \\ &+ 1.507951\Delta EXPORT_{t-1} \\ &+ 1.195775\Delta EXPORT_{t-2} \\ &- 2.034819\Delta IMPORT_{t-1} \\ &- 1.776695\Delta IMPORT_{t-2} \\ &+ 0.038304\Delta RIR_{t-1} + 0.066539\Delta RIR_{t-2} \\ &+ 0.070628 + \varepsilon_t \end{aligned}$$

With a coefficient value of (-2.034819) at lag 1 and (-1.776695) at lag 2, the import variable has a short-term negative impact on the import variable itself. With a coefficient value of 0.494437 at lag 1 and 0.44041 at lag 2, the inflation variable positively affects import. The RIR variable has no effect on imports at lag 1 with a coefficient value of 0.038304 or at lag 2 with a coefficient value of 0.066539, whereas the Export variable has a positive effect on imports at lag 1 with a coefficient value of 1.507951 and at lag 2 with a coefficient value of 1.195775.

Table 13. Results of Short-Term VECM Test for Real Interest Rate (RIR)

Variable					
Error Correlation:	Coefficient	Std. Error	t-Statistic	t-tabel	Description
CointEq1	3.200752	0.56301	5.68507		Influential
D(INFLATION(-1,2	1.174202	0.32526	-3.61001		Influential
D(INFLATION(-2,2	-1.112095	0.26655	-4.17219		Influential
D(EXPORT(-1,2	-2.722197	0.96413	-2.82347		Influential
D(EXPORT(-2,2	-1.930749	0.81106	-2.38054	2.04227	Influential
D(IMPORT(-1,2	3.314943	0.86845	3.81709		Influential
D(IMPORT(-2,2	2.593381	0.71775	3.61319		Influential
D(RIR(-1,2	-0.447798	0.33523	-1.33580		No Effect
D(RIR(-2,2	-0.409415	0.25628	-1.59755		No Effect
C	-0.107878	1.27142	-0.08485		No Effect

Source: Data processed using Eviews 12, 2025

The short-term estimation results derived from the Real Interest Rate (RIR) variable can be seen in the following VECM model:

$$\begin{aligned} \Delta RIR_{1-t} &= 3.200752ECT_{t-1} - 1.174202\Delta INFLATION_{t-1} \\ &- 1.112095 \Delta INFLATION_{t-2} \\ &- 2.722197\Delta EXPORT_{t-1} \\ &- 1.930749\Delta EXPORT_{t-2} \\ &+ 3.314943\Delta IMPORT_{t-1} \\ &+ 2.593381\Delta IMPORT_{t-2} \\ &- 0.447798\Delta RIR_{t-1} - 0.409415 \Delta RIR_{t-2} \\ &- 0.107878 + \varepsilon_t \end{aligned}$$

In the short term, the Real Interest Rate (RIR) variable does not affect the Real Interest Rate (RIR) variable itself at lag 1 with a coefficient value of (-0.447798) and lag 2 with a coefficient value of (-0.409415). the Inflation variable has a negative effect on the Real Interest Rate (RIR) at lag 1 with a coefficient value of (-1.174202) and at lag 2 with a coefficient value of (-1.112095) The Real Interest Rate (RIR) is affected negatively by the Export variable at lags 1 and 2, with coefficient values of (-2.722197) and (-1.930749), respectively, and positively by the Import variable at lags 1 and 2, with coefficient values of (3.314943) and (2.593381).

6. Granger Causality Test

Table 14. Granger Causality Test Results

Null Hypothesis:	Obs	F-Statistic	Prob.
EXPORT does not Granger Cause INFLATION	32	1.69250	0.2030
INFLATION does not Granger Cause EXPORT		2.54141	0.0974
IMPORT does not Granger Cause INFLATION	32	3.70341	0.0379
INFLATION does not Granger Cause IMPORT		4.35255	0.0230
RIR does not Granger Cause INFLATION	32	0.87009	0.4303
INFLATION does not Granger Cause RIR		1.75179	0.1926
IMPORT does not Granger Cause EXPORT	32	0.20848	0.8131
EXPORT does not Granger Cause IMPORT		0.40584	0.6704
RIR does not Granger Cause EXPORT	32	1.02323	0.3730
EXPORT does not Granger Cause RIR		0.09726	0.9076
RIR does not Granger Cause IMPORT	32	1.58693	0.2230
IMPORT does not Granger Cause RIR		0.17196	0.8429

Source: Data processed using Eviews 12, 2025

Based on the results of the Granger causality test, it is known that::

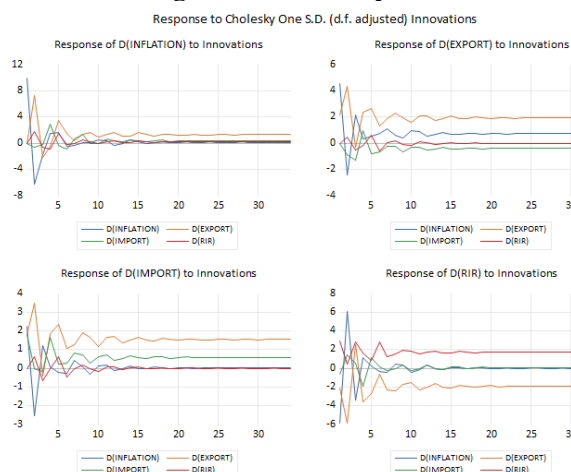
1. In the relationship between Inflation and Export, the Prob value (0.2030) > α (0.05) means that Inflation does not have a significant effect on Export. The Prob value (0.0974) > α (0.05) means that Exports do not significantly affect Inflation. This indicates that there is no reciprocal (two-way) causal relationship between exports and inflation.
2. In the relationship between Inflation and Imports, the Prob value (0.0379) < α (0.05) indicates that inflation has a significant influence on imports. Meanwhile, the Prob value (0.0230) < α (0.05) indicates that imports also have a significant influence on inflation. Thus, the two variables influence each other in a two-way causal relationship.
3. The Prob value (0.4303) > α (0.05) in the relationship between inflation and real interest rates indicates that real interest rates are not significantly affected by inflation. The Real Interest Rate has not had any effect on inflation, as indicated by the Prob value (0.1926) > α (0.05). This indicates that the real interest rate and inflation do not have a reciprocal (two-way) causal relationship.
4. The Prob value (0.8131) > α (0.05) in the correlation between imports and exports indicates that imports aren't significantly affected by exports. Imports do not significantly affect exports, as indicated by the Prob value (0.6704) > α (0.05). This indicates that exports and imports

do not have a two-way causal relationship.

5. The probability value ($0.3720 > \alpha$ (0.05)) indicates that exports have not had any effect on real interest rates. The probability value ($0.9076 > \alpha$ (0.05)) indicates that exports are not significantly affected by real interest rates. This indicates that the real interest rate and exports do not have a two-way causal relationship.
6. The Prob value ($0.2230 > \alpha$ (0.05)) in the correlation between import and real interest rate indicates that import has no discernible impact on real interest rate. Real interest rates do not significantly affect imports, as indicated by the Prob value ($0.8429 > \alpha$ (0.05)). This indicates that the real interest rate and import have no reciprocal (two-way) causal link.

7. Impulse Response Function (IRF)

Test Figure 3. IRF Graph



Source: Data processed using Eviews 12, 2025

Based on the Impulse Response Function (IRF) estimates in the figure above, we can see the dynamics of the response between variables to shocks occurring in the economic system. This examination focuses particularly on the interrelationships among the variables of inflation, exports, imports, and real interest rates (RIR). The analysis elucidates the mechanisms through which each variable responds to abrupt perturbations in the others, encompassing both short-term dynamics and long-term equilibria.

In the graph showing the response of D(INFLATION) to innovations, it can be seen

that the inflation variable responds quite fluctuatively in the early period (periods 1–16) due to shocks from the inflation variable itself and from other variables. The sharp ups and downs at the beginning of the period reflect a rapid adjustment process in the short term. However, after entering periods 17 to 34, the inflation response began to stabilize and move in the same direction, indicating that the impact of shocks on inflation is temporary and will subside in the long term. Thus, the economic system tends to return to equilibrium after the initial adjustment period.

Meanwhile, in the graph of the response of D(EXPORT) to innovations, the response of the Export variable shows a fluctuating pattern until the 24th period, mainly due to shocks from inflation, imports, and real interest rates. This indicates that Export performance is quite sensitive to macroeconomic changes in the short term. After the 25th period, the movement of exports began to decline and stabilize, which means that the influence of shocks from other variables began to decrease. In other words, in the long term, exports tend to return to their equilibrium level despite previously experiencing dynamic adjustments.

Furthermore, the graph showing the response of D(IMPORT) to innovations indicates that the import variable also experienced a fairly volatile response until the 19th period, mainly due to the influence of inflation and exports. Shocks to these two variables caused a rapid response in imports at the beginning of the period, indicating that import activity was significantly influenced by changes in prices and foreign trade. However, after the 20th to 34th periods, the response pattern of imports became more stable, indicating that the impact of shocks from other variables was short-term and would disappear over time.

In the last graph, namely the response of D(RIR) to innovations, it can be seen that the real interest rate (RIR) variable shows a strong fluctuating response until the 27th period, particularly to shocks from inflation and exports. These fluctuations illustrate the instability of real interest rates in adjusting to changes in prices and trade activity. However, from the 28th to the 34th period, the response of RIR appears to be increasingly stable and flat, which means that in the long term, the

impact of shocks from other macroeconomic variables on real interest rates is relatively small and the system tends to reach equilibrium..

Overall, the IRF results show that all variables in the model (inflation, exports, imports, and real interest rates) experienced a significant but temporary response to various economic shocks. The fluctuating response at the beginning of the period indicates a strong short-term adjustment, while the stability at the end of the period shows that the economic system tends to converge towards long-term equilibrium. These findings reinforce the view that macroeconomic shocks tend to have a temporary impact, while long-term stability is maintained.

8. Variance Decomposition (VD) Test

Table 15. Results of the VD Test for Inflation in Indonesia

Variance Decomposition of D(INFLATION):					
Period	S.E.	D(INFLAT...	D(EXPORT)	D(IMPORT)	D(RIR)
1	9.959096	100.0000	0.000000	0.000000	0.000000
2	13.92751	71.09794	26.92203	0.214849	1.765182
3	14.20317	69.74329	28.14415	0.227360	1.885195
4	14.60444	67.10198	26.72134	0.472424	2.104256
5	15.19053	63.21991	29.96438	3.795263	3.020448
6	15.30285	62.38453	30.50683	4.116163	2.992476
7	15.32471	62.23925	30.49903	4.276028	2.985686
8	15.45396	61.21057	30.83371	4.933394	3.022324
9	15.55086	60.45089	31.65298	4.872208	3.023923
10	15.58523	60.29482	31.84230	4.850955	3.011930
11	15.66503	59.74256	32.27850	4.960339	3.018605
12	15.76526	59.01591	32.98944	4.954096	3.040551
13	15.80236	58.73921	33.27293	4.960358	3.027508
14	15.85825	58.42855	33.53296	5.023074	3.015420
15	15.94621	57.80595	34.14575	5.019293	3.029008
16	16.00669	57.37162	34.60405	5.002379	3.021950
17	16.05242	57.05450	34.88680	5.047205	3.011496
18	16.11946	56.60612	35.29415	5.088563	3.011164
19	16.18579	56.14942	35.76141	5.080092	3.009080
20	16.23824	55.79435	36.11702	5.087819	3.000813
21	16.29687	55.40613	36.47683	5.120513	2.996535
22	16.36021	54.98462	36.88689	5.133779	2.994719
23	16.41629	54.61701	37.25363	5.140792	2.988564
24	16.47270	54.25677	37.60074	5.159429	2.983058
25	16.53363	53.86656	37.97839	5.174667	2.980387
26	16.59150	53.49736	38.34235	5.184316	2.975972
27	16.64707	53.15034	38.67921	5.199860	2.970593
28	16.70541	52.79037	39.02709	5.215683	2.966856
29	16.76371	52.43151	39.37929	5.226037	2.963167
30	16.81973	52.09069	39.71250	5.238328	2.958485
31	16.87635	51.75101	40.04114	5.253498	2.954346
32	16.93376	51.40913	40.37433	5.265820	2.950716
33	16.99002	51.07723	40.69922	5.276975	2.946584
34	17.04592	50.75137	41.01614	5.290012	2.942480

Source: Data processed using Eviews 12, 2025

Table 15 shows that in the first period, the inflation variable contributed 100% to inflation itself, without any influence from other variables such as exports, imports, and real interest rates. Among the external variables, exports had the greatest contribution to inflation compared to imports and real interest rates. From the second period to the 34th period, the contribution of the Export variable increased significantly, reaching 41.01% in the 34th period.

Meanwhile, the contribution of the import variable was 5.29% and the real interest rate was 2.94% to inflation in Indonesia.

Table 16. VD Export Test Results in Indonesia

Variance Decomposition of D(EXPORT):					
Period	S.E.	D(INFLAT...	D(EXPORT)	D(IMPORT)	D(RIR)
1	5.040052	81.96827	18.03173	0.000000	0.000000
2	7.174819	51.98730	46.04151	1.487593	0.483597
3	7.631444	54.21958	40.82741	4.076545	0.876461
4	8.046017	48.96219	45.19639	5.007714	0.833703
5	8.556525	43.68231	49.69329	5.316314	1.308085
6	8.737874	42.68481	49.93608	5.667045	1.712066
7	9.006827	41.60673	51.37299	5.400982	1.619302
8	9.317465	39.32493	54.01619	5.115627	1.543255
9	9.545912	37.63823	55.57725	5.306959	1.477563
10	9.730306	37.13879	56.21259	5.201951	1.446667
11	9.999863	35.99018	57.63319	4.999655	1.376972
12	10.24971	34.55050	59.10133	5.036562	1.311609
13	10.42982	33.79819	59.90292	5.019831	1.279052
14	10.63954	33.10425	60.77680	4.889797	1.229149
15	10.86986	32.14072	61.84607	4.834506	1.178705
16	11.06570	31.39929	62.62175	4.839147	1.139812
17	11.25591	30.82226	63.30321	4.771782	1.102748
18	11.46081	30.13670	64.09478	4.704688	1.063835
19	11.65403	29.50106	64.78367	4.686008	1.029259
20	11.83704	29.00065	65.35046	4.650026	0.998867
21	12.02666	28.48416	65.94933	4.598868	0.967638
22	12.21321	27.95577	66.53576	4.570088	0.938380
23	12.39013	27.50671	67.03665	4.544181	0.912466
24	12.56787	27.09045	67.51607	4.506421	0.887066
25	12.74640	26.66320	67.99782	4.476522	0.862455
26	12.91881	26.26839	68.43725	4.454443	0.839919
27	13.08833	25.91029	68.84450	4.426595	0.818615
28	13.25827	25.55715	69.24579	4.399178	0.797881
29	13.42531	25.21766	69.62594	4.378054	0.778347
30	13.58902	24.90463	69.97901	4.356376	0.759982
31	13.75187	24.60379	70.32067	4.333288	0.742255
32	13.91309	24.31134	70.65001	4.313338	0.725312
33	14.07160	24.03632	70.95955	4.294850	0.709286
34	14.22860	23.77501	71.25550	4.275584	0.693906

Source: Data processed using Eviews 12, 2025

The Export variable's Variance Decomposition (VD) test results are shown in Table 16. During the first time, the Export variable was influenced by Inflation by 81.97 percent and by Export itself by 18.03 percent, with no contribution from the Import and Real Interest Rate variables. In the 34th period, the influence of Export on itself increased significantly to 71.25 percent, while the influence of Inflation decreased to 23.77 percent, Import to 4.27 percent, and Real Interest Rate to 0.69 percent. This means that the Export variable is most influenced by the Export variable itself, while the influence of Inflation, Imports, and Real Interest Rates is relatively small.

Table 17. Results of VD Import Tests in Indonesia

Variance Decomposition of D(IMPORT):					
Period	S.E.	D(INFLAT...	D(EXPORT)	D(IMPORT)	D(RIR)
1	3.423849	44.10564	27.92668	27.96768	0.000000
2	5.538763	37.47348	50.54563	10.68711	1.293786
3	5.725981	39.56125	47.82024	10.08698	2.531529
4	6.237045	33.36096	49.08193	15.42098	2.136128
5	6.696142	29.03964	54.77051	13.49899	2.690865
6	6.804097	28.25979	55.40291	13.24949	3.087811
7	6.980660	27.18245	55.96608	13.91780	2.933668
8	7.278520	25.01432	58.39826	13.81104	2.776382
9	7.472947	23.90159	60.22042	13.24375	2.634236
10	7.595922	23.16520	60.71738	13.53015	2.587274
11	7.811466	21.96104	61.88101	13.69601	2.461941
12	8.014647	20.88600	63.44707	13.32085	2.346075
13	8.148622	20.20524	64.22189	13.29125	2.281624
14	8.313950	19.43402	64.92686	13.44715	2.191969
15	8.499328	18.59574	65.99332	13.30749	2.103453
16	8.646800	17.96854	66.80010	13.19805	2.033306
17	8.792338	17.38557	67.39611	13.25128	1.967038
18	8.956936	16.75379	68.12839	13.22036	1.897458
19	9.107745	16.20424	68.82914	13.13143	1.835186
20	9.246820	15.72172	69.37077	13.12672	1.780794
21	9.395256	15.23125	69.91974	13.12372	1.725297
22	9.542104	14.76606	70.49309	13.06794	1.672913
23	9.678725	14.35229	70.98153	13.04011	1.626074
24	9.816688	13.95315	71.42931	13.03683	1.580709
25	9.956463	13.56446	71.89183	13.00684	1.536870
26	10.09039	13.20687	72.32090	12.97588	1.496348
27	10.22195	12.86981	72.70726	12.96486	1.458081
28	10.35470	12.54247	73.08871	12.94779	1.421036
29	10.48481	12.23330	73.45785	12.92283	1.386027
30	10.61187	11.94248	73.79716	12.90732	1.353037
31	10.73876	11.66243	74.12201	12.89426	1.321292
32	10.86450	11.39432	74.43909	12.87565	1.290935
33	10.98775	11.14042	74.73773	12.85970	1.262149
34	11.10992	10.89719	75.02066	12.84759	1.234567

Source: Data processed using Eviews 12, 2025

Table 17 presents the outcomes of the Variance Decomposition (VD) test for the Import variable. In the first period, Imports were influenced by Inflation by 44.10 percent, Exports by 27.93 percent, and by themselves by 27.97 percent, without any contribution from Real Interest Rates. In the 34th period, the contribution of Exports increased to 75.02 percent, while the influence of Inflation decreased to 10.89 percent, Imports themselves to 12.85 percent, and Real Interest Rates to 1.23 percent. Thus, it can be concluded that imports are most influenced by the export variable, while the influence of inflation, imports themselves, and real interest rates is relatively small.

Table 18. Results of the Real Interest Rate (RIR) VD Test in Indonesia

Variance Decomposition of D(RIR):					
Period	S.E.	D(INFLAT...	D(EXPORT)	D(IMPORT)	D(RIR)
1	6.852130	71.74537	9.460683	0.811715	17.98223
2	10.97895	58.28443	32.38384	2.148886	7.182850
3	12.09920	55.71738	30.96665	1.950201	11.36577
4	12.92464	49.66389	35.02814	3.828007	11.47996
5	13.27685	47.10286	37.21717	4.403357	11.27661
6	13.58926	45.02322	35.75817	4.218198	15.00041
7	13.84452	43.47807	37.10778	4.095400	15.31874
8	14.14222	41.75118	38.46394	3.925145	15.85974
9	14.38032	40.44846	38.55502	3.873293	17.12323
10	14.58583	39.40652	38.55399	3.784155	18.25533
11	14.84659	38.04112	39.64059	3.652763	18.66552
12	15.09195	36.85964	40.19641	3.578546	19.36540
13	15.29084	35.90713	40.24511	3.486095	20.36166
14	15.50806	34.91741	40.75597	3.394106	20.93251
15	15.73822	33.90687	41.34236	3.305661	21.44512
16	15.94329	33.04095	41.56126	3.227618	22.17017
17	16.14511	32.22185	41.86742	3.148024	22.76270
18	16.35737	31.39157	42.31923	3.067685	23.22151
19	16.56019	30.62833	42.60125	2.997769	23.77265
20	16.75552	29.91905	42.84185	2.928598	24.31051
21	16.95564	29.21699	43.18329	2.860197	24.73953
22	17.15325	28.54855	43.47387	2.797136	25.18044
23	17.34360	27.92535	43.69323	2.737057	25.64437
24	17.53430	27.32136	43.95252	2.678180	26.04794
25	17.72528	26.73591	44.21752	2.622172	26.42440
26	17.91154	26.18288	44.43190	2.569267	26.81595
27	18.09549	25.65325	44.64473	2.517816	27.18421
28	18.27950	25.13940	44.87090	2.468209	27.52149
29	18.46104	24.64747	45.07346	2.421116	27.85795
30	18.63989	24.17676	45.26143	2.375647	28.18616
31	18.81789	23.72155	45.45515	2.331612	28.49169
32	18.99440	23.28276	45.63991	2.289435	28.78790
33	19.16863	22.86146	45.81036	2.248851	29.07933
34	19.34149	22.45464	45.97963	2.209533	29.35619

Source: Data processed using Eviews 12, 2025

The results of the Variance Decomposition (VD) test for the Real Interest Rate variable are shown in Table 18. In the first period, the RIR variable was influenced by Inflation by 71.75 percent, Exports by 9.46 percent, Imports by 0.81 percent, and by itself by 17.98 percent. In the 34th period, the contribution of Inflation decreased to 22.45 percent, Exports increased to 45.97 percent, Imports were 2.20 percent, and RIR increased to 29.36 percent. Thus, the Real Interest Rate (RIR) variable is most influenced by the Export and Inflation variables, while the influence of Imports is relatively small.

6. Conclusion

Based on the results of a Vector Error Correction Model (VECM) analysis applied to Indonesia's annual data for the period 1991 to 2024, the following conclusions emerge:

1. The stationarity test results show that all variables of exports, imports, real interest rates (RIR), and inflation are non-stationary at the level, but become stationary after first differentiation. This indicates the existence of long-term trends in these variables.

2. The VAR model stability test shows that the model used is stable and meets the requirements for further analysis using the VECM method.
3. The determination of the optimum lag shows that the dynamic relationship between variables is best explained at lag 2, which illustrates that changes in exports, imports, and real interest rates take about two years to have a full impact on inflation.
4. Johansen's cointegration test results demonstrate that the variables of exports, imports, real interest rates, and inflation have a long-term relationship. This demonstrates that all variables tend to gravitate toward the same long-term economic equilibrium despite short-term fluctuations.
5. The VECM estimation shows that in the short term, Inflation is significantly impacted by changes in imports and exports, while Real Interest Rates act as a mechanism for adjustment towards long-term equilibrium.
6. The Granger causality test found a positive two-way causal relationship between Inflation and Imports. This is evidenced by the probability value of Inflation on Imports of 0.0379, which is smaller than α (0.05), and the probability value of Imports on Inflation of 0.0230, which is smaller than α (0.05).
7. Analysis of the Impulse Response Function (IRF) reveals that all variables in the Export, Import, Real Interest Rate, and Inflation models show a fluctuating response pattern in the early period and tend to stabilize in the subsequent period. This illustrates that the impact of shocks between variables is temporary and will subside in the long term..
8. According to the Variance Decomposition (VD) analysis, variations in exports contribute to the largest long-term volatility in inflation, while the contributions of Imports and Real Interest Rates are relatively smaller.

7. Suggestion and Recommendation

To make the analysis more thorough, additional macroeconomic factors like exchange rates, the money supply, or fiscal policy should be included in future studies. Furthermore, more

detailed results can be obtained by applying various econometric techniques and using higher frequency data. Even when variables have different levels of integration, the Autoregressive Distributed Lag (ARDL) approach can be used to examine both short-term and long-term correlations between them. Through theoretical constraints, the structural impact of policies can be determined using Structural Vector Autoregression (SVAR). In the meantime, potential non-linear correlations and asymmetric effects on inflation can be captured using the Nonlinear ARDL (NARDL) or Threshold VAR technique. The findings of this study can be taken into account by decision-makers when creating monetary and trade policies to preserve sustainable

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