How Domestic and Foreign Assets Interact Through Granger Causality and Dynamic Models

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Abstract. This study investigates the long-term interactions between foreign assets (ALN) and domestic assets (ADN) within the Indonesian economy from January 2013 to November 2020. Utilizing the Vector Error Correction Model (VECM), the research reveals a significant cointegration relationship, indicating that ALN and ADN influence each other over the long term. The findings underscore the importance of considering these interactions in the formulation of economic policies. The model's residuals exhibit some deviations from normal distribution, yet it remains effective in capturing the primary dynamics between these variables. The practical implications of this study suggest that policymakers need to account for the interplay between foreign and domestic assets to enhance national economic and financial stability.

Keywords: Foreign assets, Domestic assets, VECM, Cointegration, Indonesian economy, Economic policy, Financial stability

1 Introduction

The complexity of interactions between numerous economic and financial elements, as well as economic growth, is reflected in the interconnections between inflation, foreign assets, and domestic assets. Consequently, additional research and analysis are required to acquire a thorough comprehension of this matter. Investment and economic growth are intricately linked by these three variables. Investment in infrastructure, technology, and other sectors is typically necessary for economic growth and sustainable development. Nevertheless, inflation may result from accelerated growth in the absence of increased productivity. Inflationary conditions are also referred to as issues that result from reliance on specific sectors.

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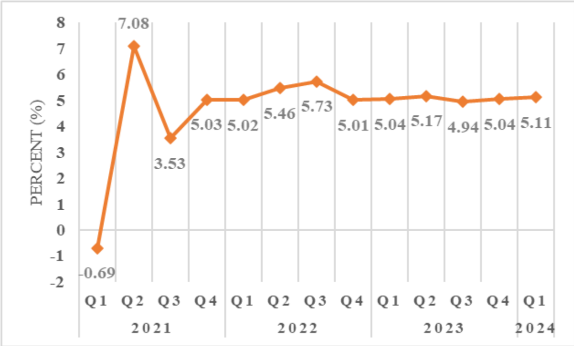


Fig 1. Indonesian economic growth

Despite the global economic downturn and the declining prices of major export commodities, Indonesia's economy has maintained a growth rate of over 5 percent for seven consecutive quarters. This economic resilience in Indonesia is a result of the increased mobility and purchasing power of the population during the month of Ramadan, as well as numerous national holidays, including Idul Fitri, Easter, Idul Adha, Waisak, and long school holiday.

External factors, such as swings in global commodity prices, currency exchange rates, and geopolitical instability, can also impact a country's inflation rate [6]. Relying heavily on specific imports or exports might increase the economy's susceptibility to price and exchange rate swings, resulting in oscillations in inflation rates. As a country becomes more receptive to the global economy, the impact of the global economy on its home economy increases. Global economic policy adjustments can impact the valuation of foreign assets and exert an influence on domestic inflation.

Inflation is frequently linked to a disparity between the overall supply and demand in the economy. Insufficient expansion in the supply of goods and services can lead to inflationary pressures, even in the presence of rapid economic growth [9]. Hence, the inflation of a nation is likewise influenced by worldwide uncertainty. Uncertainty in global politics or economics can impact the actions of governments and the decisions of investors. This, in turn, has an effect on both local and international assets, as well as inflation rates. The correlation between local and foreign assets is significantly influenced by the global economic conditions. Domestic assets encompass the aggregate worth of wealth possessed by individuals, firms, and domestic governments, whereas overseas assets denote the value of wealth owned by individuals, companies, and foreign governments. Inflation is the phenomenon of a widespread and continuous rise in the prices of goods and services.

It is essential to comprehend the influence of domestic assets on the economy. Ultimately, these assets have the capacity to increase inflation rates, drive up aggregate demand, and improve the purchasing power of individuals. Conversely, inflation may be influenced by substantial foreign assets through mechanisms associated with international trade and the transmission of monetary policy. Capital flows to and from other countries may be affected by monetary policy changes, such as adjustments to interest rates or currency interventions. These flows can affect a country's transaction deficit and have implications for the development of foreign assets [1]. It is imperative to comprehend the influence of inflation on capital outflows and domestic investments. The real value of domestic investments can be substantially diminished during periods of high inflation. Conversely, when inflation is low, capital tends to exit the country in pursuit of higher profit margins in other regions [8]. Furthermore, inflation is an essential factor in the acceleration of economic expansion. Vibrant economic growth can be fostered when inflation is effectively managed. Nevertheless, if not effectively managed, it can result in economic instability and have a detrimental effect on the public [2].

An in-depth comprehension of the interplay among these three concepts will offer policy makers valuable insights into effectively managing domestic and foreign assets, as well as maintaining stable and sustainable economic growth while keeping inflation in check. This research will greatly enhance our comprehension of the intricate elements that influence a country's economic and financial conditions.

2 Literature Review

2.1 Inflation Theory

The subsequent stage is to conduct a literature review of inflation theory after formulating the research problem of the dynamic model between inflation, domestic assets, and foreign assets. [12]. The domestic and international economies are currently experiencing substantial transformations. Additionally, a literature review can facilitate the identification of methodologies that have been implemented. In previous research, it established a robust foundation for the development of dynamic models in this study.

Considering multiple perspectives is crucial when conducting a literature review. Regarding inflation theory, it encompasses various aspects such as monetary theory [11], the theory of reserves, classical theory, and Keynesian theory. In addition, taking into account previous relevant research on this topic can offer a thorough grasp of the dynamics of relationships. When making decisions, it's important to take into account various factors such as inflation, domestic assets, and foreign assets.

Examining the macroeconomic effects on inflation in Indonesia before and after the implementation of the Inflation Targeting Framework during the period 2002:1. Once the library study on inflation theory is complete, the next logical step is to delve into the correlation between inflation and domestic assets and understand how the theory explains it. The theory of inflation offers a thorough understanding. When considering the factors that impact the inflation rate, it is important to take into account certain aspects related to domestic assets. Based on economic theory, inflation has the potential to impact the value of domestic assets. This occurs when there is an increase in the money supply, leading to a rise in asset prices. Furthermore, the reserve theory also suggests that inflation can occur unintentionally. Domestic economic activity has a substantial influence on the value of domestic assets. However, the Keynesian theory highlights the significance of domestic asset demand when it comes to addressing inflation. When examining the connection between inflation and domestic assets, it becomes crucial to take into account the monetary policy put in place by the central bank. This can have an impact on the value of assets within the country. Interest rate policy and market liquidity play crucial roles in shaping this connection. Now, let's address the research questions that have been posed. Acquired a deep understanding of inflation theory and its correlation with domestic assets. Studying inflation will offer a solid foundation for examining the ever-changing connection between inflation, domestic assets, and foreign assets.

2.2 Relationship between Inflation and Foreign Assets

Empirical research enables the comprehension of the short- and long-term impacts of inflation on domestic and foreign assets. Additionally, the dynamic relationship between inflation, domestic assets, and foreign assets can be influenced by the identification of specific factors. It is worthwhile to analyse historical data in order to determine the extent to which these variables interact over time and whether there are any dynamics that alter their relationships [8].

Furthermore, this empirical analysis offers a framework for evaluating the influence of fiscal and monetary policy on the correlation between inflation and foreign assets. It is imperative to comprehend the broader implications for the economy in the context of inflation dynamics by examining the impact of policy interventions on capital flows and investment decisions [4]

Additionally, this empirical analysis offers a framework for evaluating the influence of fiscal and monetary policies on the correlation between inflation and foreign assets. In this context, it is crucial to comprehend the influence of policy intervention on investment decision-making and capital flow in order to comprehend the broader implications for the economy. [5]

2.3 Relationship between Inflation and Domestic Assets

Having a deep understanding of the theoretical framework and the dynamic interaction between inflation, domestic, and foreign assets is crucial for conducting a thorough analysis of the subject matter. However, delving into empirical data is equally crucial to offer practical insight and validation to the research questions formulated. Examining empirical data entails analysing historical trends and patterns of inflation rates, domestic and foreign assets. The process will include gathering a range of economic indicators, including consumer price indices, money supply figures, interest rates, exchange rate movements, and capital flows. When it comes to inflation, the price of goods and services tends to increase, which can have an impact on domestic assets like stocks, bonds, and property.

3 Research Method

3.1 Data Types and Sources

The data used in this study comes from monthly time series data covering the period from 2010 to 2022, obtained from the annual report of Bank Indonesia (BI). The data includes information on inflation, as well as foreign and domestic assets. With this long-time span, the study is expected to provide in-depth insights into the interactions between the three variables.

3.2 Research Steps

3.2.1 Data Stationarity Test

Typically, economic data in the form of a time series does not exhibit stationarity at the network level. On the other hand, when dealing with data at a network level, it is important to consider whether the data is integrated from a zero or I(0) series. Similarly, if the data is at the first differentiation level, it is integrated out of a series one or I(1). In this study, the data from the Augmented Dickey Fuller (ADF) will be utilised to test the unit's root. When the critical test value is greater than the statistical test value of ADF, H0 is rejected and Ha is accepted. On the other hand, this happens when the value of the Critical Test is less than the ADF statistic test value. The hypothesis utilised for the sitting test is:

H0 : $\rho = 1$, there is a root unit or non-stable data, while

Ha : $\rho < 1$, no root units or stationary data.

Table 1. Test nonstationary data ALN and ADN

Dickey-Fuller Unit Root Tests					
Variable	**Type**	**Rho**	**P-value**	**Tau**	**P-value**
ALN	Zero Mean	0.5122	0.8068	1.95	0.9874
	Single Mean	-1.0424	0.8800	-0.71	0.8378
	Trend	-14.1827	0.1908	-2.60	0.2795
ADN	Zero Mean	0.8981	0.8921	5.00	0.9999
	Single Mean	-1.1718	0.8675	-0.63	0.8589
	Trend	0.4970	0.9977	0.06	0.9965

In order to fulfill the stationary assumption, the differencing process with d=1 (first differencing, d=1) is carried out [10] [3]. The results of differencing data are presented in Table 2 below:

Table 2. Nonstationary test of ALN and ADN data after the first differencing (d=1)

Dickey-Fuller Unit Root Tests					
Variable	**Type**	**Rho**	**Pr < Rho**	**Tau**	**Pr < Tau**
ALN	Zero Mean	-96.20	<.0001	-6.68	<.0001
	Single Mean	-113.57	0.0001	-7.15	<.0001
	Trend	-113.64	0.0001	-7.09	<.0001
ADN	Zero Mean	-86.30	<.0001	-5.63	<.0001
	Single Mean	-169.35	0.0001	-7.41	<.0001
	Trend	-180.34	0.0001	-7.65	<.0001

Test using the Augmented Dicky Fuller test (ADF) test with the null hypothesis that the data is nonstationary. The test results with the ADF test are presented in Table 2. Showing that the null hypothesis is rejected, with the tau test = -7.15 with p-value <0.0001 for ALN data, t test = -7.41 with p-value <0.0001 for ADN Fund data. So the data is stationary after the first differencing (d = 1).

3.2.2 Autocorrelation Test, Cross Correlation and Cointegration Test

Understanding the cross correlation and auto-correlation is essential when it comes to modelling multivariate time series [14]. If this is accurate, the modelling will require multi-variant time series. After conducting autocorrelation testing, the co-integration test is employed to determine if nonstationary data sets with order 1, referred to as I(1) in Johansen terms, are integrated with order 1. Alternatively, if differentiation is performed once (d=1), nonstationary data becomes stationary and is symbolised as I(0). If co-integration is absent, the models that will be utilised are the Vector Autoregressive (VAR), Vector Moving Average (VMA), or Vector Autoregressively Moving Vector Averages (VARMA) models. If co-integration is present, the vector Error Correction (VECM) model is employed.

Table 3. White noise examination with Box-Pierce test for ALN data, AND data.

Data	To lag	Chi-Square	DF	p-value	Autocorrelation					
ALN	6	447.36	6	<.0001	0.964	0.923	0.880	0.841	0.793	0.751
	12	684.74	12	<.0001	0.703	0.658	0.615	0.577	0.548	0.521
	18	807.85	18	<.0001	0.492	0.460	0.427	0.398	0.378	0.360
ADN	6	424.38	6	<.0001	0.945	0.885	0.848	0.811	0.781	0.750
	12	700.12	12	<.0001	0.722	0.693	0.662	0.639	0.612	0.584
	18	859.23	18	<.0001	0.554	0.521	0.489	0.462	0.432	0.401

Table 3 provides an analysis of whether there is autocorrelation in the Foreign Assets (ALN) data, Foreign Assets (AND) data. The Box-Pierce Test [14] to test whether there is autocorrelation in the data with the null hypothesis that the error is white noise. This test is distributed Chi-Square with degrees of freedom K (K indicates lag). Test up to lag 6 for ALN data, ADN data the null hypothesis is rejected, where the chi-square test = 447.36 with p-value <0.0001 for ALN data, chi-square test = 424.38 with p-value <0.0001 for ADN data (Table 3). So a model with autocorrelation is needed in the analysis of ALN and ADN (CR) data (SAS / ETS 13.2, 2014, p.193).

It has been shown in advance that the data is non-stationary and after the first differencing the data becomes stationary, according to Johansen this is called integrated with order 1, I(1), for ALN and ADN data. Therefore, the cointegration of the data will be checked at the optimum lag of the VAR(p) model. To check the optimum lag, Akaike's Information Criterion corrected (AICC) will be used [13] [14]. From the results of the AICC analysis, the optimum lag for the VAR(p) model is for p=4 (Table 4).

Table 4. Minimum Information Criterion Based on AICC

Lag	AR0	AR1	AR2	AR3	AR4	AR5
IACc	17.2893	17.0534	17.0727	16.9285	16.8701	16.9375

The method that will be used for the cointegration test is the Johansen test at the optimum lag of the VAR(p) model. If the value of the trace statistic is greater than the critical value, then we conclude that there are at least two cointegrations between the variables. With the hypothesis Ho: Rank = r (no cointegration) with the alternative Ha: Rank > r (There is cointegration). The results of the cointegration test for the Ho: Rank = 1 test are rejected with a p-value <0.0001. So the cointegration is order 2 (Table 5). Because the multivariate time series data: ALN data and AND data have a cointegration relationship with order 2, the VAR(p) model is modified into a VECM(p) model with p = 4 and cointegration with order r = 2 [14]

Table 5. Cointegration rank test using Trace statistics

Ho: Rank=r	Ha: Rank > r	Eigen Value	Trace	p-value
0	0	0.2669	40.2669	<0.0001
1	1	0.1280	12.3285	0.0002

Based on the analysis above, the model that will be used is VECM(4) with cointegration rank r=2. The next step is to estimate the parameters of the VECM(4) model. The results are as follows:

From the parameter estimation results, we get the estimated model for VECM(4) as follows:

$$\Delta X_t = \Pi X_{t-1} + \Gamma_1 \Delta X_{t-1} + \Gamma_2 \Delta X_{t-2} + \Gamma_3 \Delta X_{t-3} + \varepsilon_t \quad (1)$$

$$\Delta\begin{bmatrix} ALN_t \\ ADN_t \end{bmatrix} = \begin{bmatrix} -0.9682 & 0.2435 \\ 1.6098 & -0.8771 \end{bmatrix}\begin{pmatrix} ALN_{t-1} \\ ADN_{t-1} \end{pmatrix} + \begin{bmatrix} -0.1529 & -0.3521 \\ -1.4061 & -0.7730 \end{bmatrix}\Delta\begin{pmatrix} ALN_{t-1} \\ ADN_{t-1} \end{pmatrix}$$

$$+\begin{bmatrix} -0.1526 & -0.2364 \\ -1.1357 & -0.4348 \end{bmatrix}\Delta\begin{pmatrix} ALN_{t-2} \\ ADN_{t-2} \end{pmatrix} + \begin{bmatrix} -0.2186 & -0.0966 \\ 0.1427 & -0.0289 \end{bmatrix}\Delta\begin{pmatrix} ALN_{t-3} \\ ADN_{t-3} \end{pmatrix} + \begin{pmatrix} \varepsilon_{t1} \\ \varepsilon_{t2} \end{pmatrix}$$

With Covariance the innovation is

$$Var\begin{pmatrix} \varepsilon_{t1} \\ \varepsilon_{t2} \end{pmatrix} = \begin{bmatrix} 1131.4516 & -314.0177 \\ -314.0177 & 12777.3482 \end{bmatrix}$$

Table 6. Long run parameter beta estimate (β) if rank=2

Variable	1	2
ALN	0.0510	0.0428
ADN	-0.0165	0.0381

Table 7. Adjustment Coefficient Alpha Estimates When RANK=2

Variable	1	2
ALN	-17.6966	-5.9415
ADN	38.1792	-33.6707

Table 8. Parameter Alpha * Beta' Estimates (Π)

Variable	ALN	ADN

ALN	-0.9682	0.2435
ADN	1.6098	-0.8771

To check whether the model is suitable for use in further analysis, we need to check the residual white noise of the univariate model equation as presented in Table 10. Table 10, the univariate model test for ALN and ADN all p-value <0.0001 indicating that the univariate model is very significant with its R-square of 0.6582 and 0.7777 for each univariate model with dependent variables ALN and ADN.

Table 11 shows the normality test and ARCH effect, the test uses the JB normality test. For ALN data, the null hypothesis, Ho, is not rejected with a p-value of 0.2354 which means that the residuals are normally distributed, and ALN does not have an ARCH effect. From Figure 4, the Q-Q plot for ALN data appears to form a straight line, this means that the residual distribution is normal. The error prediction plot also shows a normal distribution. While for ADN data, the effect normality test shows that the null hypothesis is rejected with a p-value <0.0001. This means that the residual distribution for ADN is not normally distributed and the ARCH effect test shows that the null hypothesis is not rejected, which means that the residual does not have an ARCH effect. Figure 2, Q-Q plot for ADN data shows a straight line and this shows that although the null hypothesis is rejected, the deviation from the normal distribution is not far.

Table 9. Estimation and testing of VECM(4) model parameters with cointegration rank r=2.

Model Parameter Estimates						
Equation	**Parameter**	**Estimate**	**Standard Error**	**t Value**	**Pr > |t|**	**Variable**
D_ALN	AR1_1_1	-0.96819	0.20285			ALN(t-1)
	AR1_1_2	0.24345	0.09389			ADN(t-1)
	AR2_1_1	-0.15292	0.17529	-0.87	0.3856	D_ALN(t-1)
	AR2_1_2	-0.35211	0.09717	-3.62	0.0005	D_ADN(t-1)
	AR3_1_1	-0.15265	0.14464	-1.06	0.2944	D_ALN(t-2)
	AR3_1_2	-0.23641	0.08636	-2.74	0.0076	D_ADN(t-2)
	AR4_1_1	-0.21860	0.10203	-2.14	0.0351	D_ALN(t-3)
	AR4_1_2	-0.09658	0.05519	-1.75	0.0838	D_ADN(t-3)
D_ADN	AR1_2_1	1.60979	0.68167			ALN(t-1)
	AR1_2_2	-0.87712	0.31551			ADN(t-1)
	AR2_2_1	-1.40612	0.58906	-2.39	0.0193	D_ALN(t-1)
	AR2_2_2	-0.77303	0.32654	-2.37	0.0203	D_ADN(t-1)
	AR3_2_1	-1.13575	0.48605	-2.34	0.0219	D_ALN(t-2)
	AR3_2_2	-0.43487	0.29020	-1.50	0.1378	D_ADN(t-2)
	AR4_2_1	0.14274	0.34287	0.42	0.6783	D_ALN(t-3)

Model Parameter Estimates						
Equation	**Parameter**	**Estimate**	**Standard Error**	**t Value**	**Pr > |t|**	**Variable**
	AR4_2_2	-0.02889	0.18545	-0.16	0.8766	D_ADN(t-3)

Model (2) can be written as a univariate model as follows:

$$\Delta ALN_t = -0.9682 ALN_{t-1} + 0.2435 ADN_{t-1} - 0.1529 \Delta ALN_{t-1} - 0.3521 \Delta ADN_{t-1} - 0.6571 \Delta ALN_{t-2} - 0.2364 \Delta ADN_{t-2} - 0.2186\, \Delta ALN_{t-3} - 0.0966 \Delta ADN_{t-3} + \varepsilon_{t1} \quad (3)$$

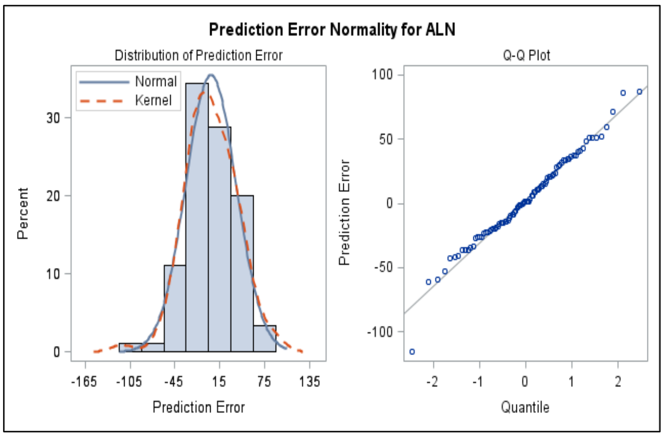
$$\Delta ADN_t = 1.6098 ALN_{t-1} - 0.8771 ADN_{t-1} - 1.4061 \Delta ALN_{t-1} - 0.7730 \Delta ADN_{t-1} - 1.1357 \Delta ALN_{t-2} - 0.4348 \Delta ADN_{t-2} + 0.1427 \Delta ALN_{t-3} - 0.0289 \Delta ADN_{t-3} + \varepsilon_{t2} \quad (4)$$

Table 10. Univariate Model ANOVA Diagnostics

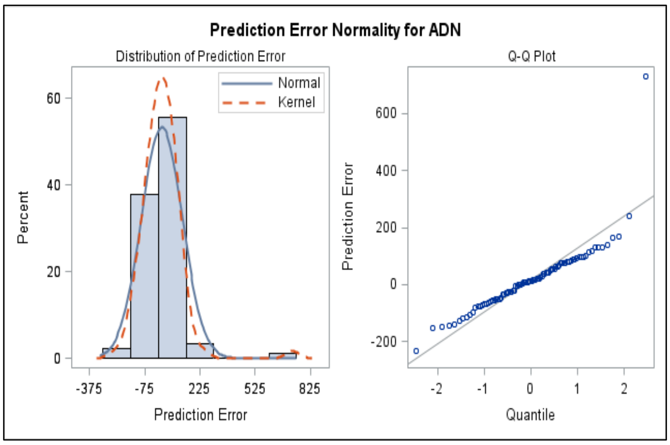
Univariate Model ANOVA Diagnostics				
Variable	**R-Square**	**Standard Deviation**	**F Value**	**Pr > F**
ALN	0.6285	33.63706	19.82	<.0001
ADN	0.7777	113.03693	40.99	<.0001

Table 11. Univariate Model White Noise Diagnostics

Univariate Model White Noise Diagnostics					
Variable	Durbin Watson	Normality		ARCH	
		Chi-Square	P-value	F Value	P-value
ALN	2.03412	2.89	0.2354	0.53	0.4674
ADN	1.96974	1248.00	<.0001	0.58	0.4494



(a)



(b)

Fig 2. Normality error prediction for (a) ALN, (b) ADN data

Table 12. Roots of AR Characteristic Polynomial

Index	Real	Imaginary	Modulus	Radian	Degree
1	0.91734	0.00000	0.9173	0.0000	0.0000
2	0.24993	0.00000	0.2499	0.0000	0.0000
3	0.17474	0.67943	0.7015	1.3191	75.5765
4	0.17474	-0.67943	0.7015	-1.3191	-75.5765
5	-0.31931	0.33284	0.4612	2.3354	133.8114
6	-0.31931	-0.33284	0.4612	-2.3354	-133.8114
7	-0.82470	0.39653	0.9151	2.6934	154.3210
8	-0.82470	-0.39653	0.9151	-2.6934	-154.3210

Table 12 shows that the AR characteristic polynomial with modulus is smaller than 1, this indicates that the VECM(4) model with cointegration rank r=2 is a stable model [14]. Based on the study above, the VECM(4) model with cointegration rank r=2 for modeling ALN and ADN data is a good model and can be used for further analysis.

3.2.3 Granger-Causality Test

Table 13. Granger-Causality Wald Test

Test	Group-Variabel	Null Hypothesis	DF	Chi-Square	p-value	Granger Causality
1	Group1 Variable: ALN Group2 Variable: ADN	ALN is influenced by itself, and not by ADN.	4	20.78	0.0003	Significant

Test	Group-Variabel	Null Hypothesis	DF	Chi-Square	p-value	Granger Causality
2	Group1 Variable: ADN Group2 Variable: ALN	ADN is influenced by itself, and not by ALN.	4	18.19	0.0011	Significant

Granger analysis is used to determine whether there is a reciprocal causal relationship between variables. The Granger Causality analysis method is widely used for the analysis of causal relationships between variables, especially in the field of economics [7] [13] [14].

The Granger causality test is based on a linear model and uses the Wald test, which uses the Chi-Square test. Where the null hypothesis is that the Granger causality test is group 1 is influenced by itself and not by the variables in group 2 (SAS / ETS 13.2, 2014). Table 13 shows that ALN as Group 1 and ADN as Group 2 (Test 1), the Chi-Square test result is 20.78 with a p-value = 0.0003, we conclude that Ho is rejected. So, ALN is not only influenced by past information from itself, but also by past and present information from ADN. Table 13 shows that ADN as Group 1 and ALN as Group 2 (Test 2), the Chi-Square test result is 18.19 with a p-value = 0.0011, we conclude that Ho is rejected. So, DNA is not only influenced by past information from itself, but also by past and present information from the ALN.

3.2.4 Impulse Response Function

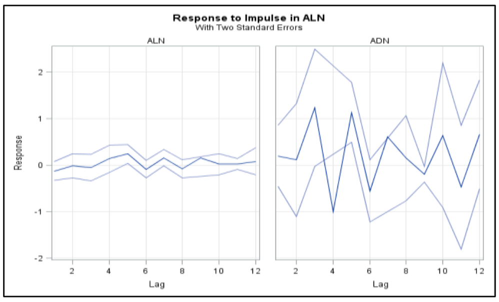


Fig 3. Impulse Response Function for shock on ALN variable

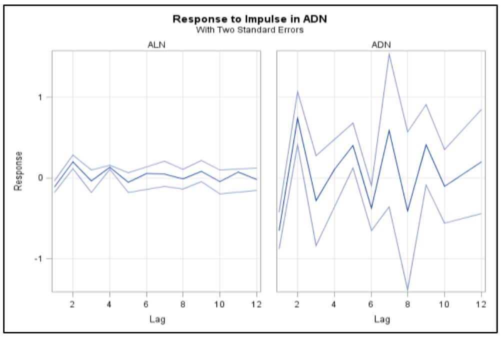


Fig 4. Impulse Response Function for shock on ADN variable

Figure 5 is an IRF graph if there is a shock of one standard deviation in Foreign Assets (ALN) and its effect on ALN itself and on ADN. A shock of one standard deviation in ALN causes ALN itself to fluctuate for approximately 12 months and is unstable as shown by a wide confidence interval in the first 12 months after the shock. In the first month the ALN response was negative by -0.1211, in the second month the ALN response was negative by -0.0072, in the third month the ALN response was negative by -0.0538, in the fourth month the ALN response was positive by 0.1400, and in the fifth month the ALN response was positive by 0.2441, in the sixth month the ALN response was negative by -0.0823, in the seventh month the ALN response was positive by 0.1614, in the eighth month the ALN response was negative by -0.0721, and in the ninth month the ALN response was positive by 0.1548, in the tenth month the ALN response was positive by 0.0236, in the eleventh month the ALN response was positive by 0.0255, in the twelfth month the ALN response was positive by 0.0838.

A one standard deviation shock to ALN causes ADN itself to fluctuate for approximately 12 months and is unstable as indicated by wide confidence intervals in the first 12 months after the shock. In the first month the ADN response was negative by 0.2036, in the second month the ADN response was negative by 0.1133, in the third month the ADN response was negative by 1.2395, in the fourth month the ADN response was positive by -0.9954, and in the fifth month the ADN response was positive by 1.1402, in the sixth month the ADN response was negative by -0.5516, in the seventh month the ADN response was positive by 0.6118, in the eighth month the ADN response was negative by 0.1525, and in the ninth month the ADN response was positive by -0.1945, in the tenth month the ADN response was positive by 0.6406, in the eleventh month the ADN response was positive by -0.4712, in the twelfth month the ADN response was positive by 0.6682.

Figure 6 is an IRF graph if there is a shock of one standard deviation in Domestic Assets (ADN) and its effect on ALN and on AND itself. A shock of one standard deviation in ADN causes ALN itself to fluctuate for approximately 4 months and is unstable as shown by a wide confidence interval in the first 4 months after the shock. And after the fourth month the effect weakens towards equilibrium. In the first month the ALN response is negative by -0.1087, in the second month the ALN response is positive by 0.1995, in the third month the ALN response is negative by -0.0398, in the fourth month the ALN response is positive by 0.1339, and after the fourth month the effect weakens.

A one standard deviation shock to ADN causes ADN itself to fluctuate for approximately 12 months and is unstable as indicated by wide confidence intervals in the first 12 months after the shock. In the first month the ADN response was negative by -0.6501, in the second month the ADN response was positive by 0.7387, in the third month the ADN response was negative by -0.2829, in the fourth month the ADN response was positive by 0.1056, and in the fifth month the ADN response was positive by 0.4039, in the sixth month the ADN response was negative by -0.3752, in the seventh month the ADN response was positive by 0.5876, in the eighth month the ADN response was positive by 0.4089, and in the ninth month the ADN response was positive by 0.4111, in the tenth month the ADN response was negative by -0.1068, in the eleventh month the ADN response was positive by 0.0477, in the twelfth month the ADN response was positive by 0.2008.

4 Discussion

In the analysis of the interaction between foreign assets (ALN) and domestic assets (ADN) using the VECM model, it was found that the initial data of ALN and ADN were non-stationary, which was confirmed through the Augmented Dickey-Fuller (ADF) test. This means that the two data series have inconsistent trends and fluctuations throughout the observation period. After the first differencing (d=1), the data became stationary, indicating that the differencing process was effective in overcoming the problem of non-stationarity. The rapid decline in the Autocorrelation Function (ACF) after differencing strengthens this conclusion, so that the analysis can be continued with a more stable model.

The results of the cointegration analysis using the Johansen test indicate that there are two cointegration relationships between ALN and ADN. In other words, although each variable is not stationary, there is a linear combination of the two that is stationary. This indicates a long-term relationship between foreign assets and domestic assets. The VECM model with rank cointegration $r = 2$ is used to estimate the parameters of this interaction, with the results showing that changes in ALN and ADN affect each other in the long run. These parameter estimates provide important insights into the dynamics of the interaction between the two variables.

Furthermore, the residual test of the model shows that the residual of ALN is normally distributed and has no ARCH effect, while the residual of ADN shows deviation from the normal distribution but has no significant ARCH effect. This indicates that the model used is quite good at capturing the dynamics of the interaction between ALN and ADN even though there are some abnormalities in the residual of ADN. Overall, the VECM model provides a deeper understanding of the long-run relationship between foreign and domestic assets, which can be the basis for better economic policies.

5 Conclusion

From the analysis that has been done, it can be seen that the data of foreign assets (ALN) and domestic assets (ADN) show non-stationarity during the period from January 2013 to November 2020. After the first differencing, the data becomes stationary, allowing us to proceed with further analysis using the Vector Error Correction Model (VECM). This model finds cointegration with order 2, which indicates a long-term relationship between ALN and ADN.

In addition, the results of the diagnostic test on the VECM model indicate that the residuals of the model are not normally distributed and there is an ARCH effect on the ADN data. Nevertheless, the model remains significant with a fairly high R-square for both variables, namely ALN and ADN. This indicates that the VECM model is able to capture the main dynamics in the relationship between foreign assets and domestic assets. The practical implication of these results is that policy makers should consider the interaction between ALN and ADN in formulating policies aimed at managing national economic and financial stability.

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