

The Dynamic Analysis of Economic Openness and Regional Economic Growth in Indonesia

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Received : August 31, 2026

Revised : September 14, 2026

Accepted : September 16, 2026

Online : October 07, 2026

Abstract

Economic openness has become a central component of regional development in Indonesia, yet its growth effects remain uneven across provinces because trade exposure, investment inflows, infrastructure, and absorptive capacity vary substantially. This study examines the dynamic relationships among trade openness, foreign direct investment (FDI), their interaction, and regional economic growth across 34 Indonesian provinces from 2015 to 2025. The empirical analysis employs a panel Vector Error Correction Model (VECM), complemented by Pairwise Granger Causality tests, Johansen cointegration tests, impulse response functions, and variance decomposition. The results identify bidirectional causality between trade openness and growth, supporting both the trade-led growth and growth-driven trade hypotheses. The results also find a significant two-way relationship between economic openness and growth, indicating that the joint effects of international market access and foreign capital are more informative than either channel in isolation. The Johansen test confirms one long-run cointegrating relationship, while the error-correction coefficient of -0.240885 indicates that approximately 24.09% of disequilibrium is corrected in each period, implying a gradual return to equilibrium over roughly two to three years. Variance decomposition further shows that FDI shocks become the dominant source of long-run growth fluctuations, accounting for 63.82% of the forecast error variance by the tenth period. These findings suggest that regional policy should prioritize the quality, stability, and domestic linkages of FDI, strengthen local absorptive capacity, and integrate trade and investment strategies to promote more resilient and inclusive regional growth.

Keywords: *Economic openness, Trade openness, Foreign direct investment, Regional economic growth, Panel VECM*

INTRODUCTION

Global economic openness is a major development strategy in developing countries (Gräbner et al., 2021). Raghutla (2020) links exports to broader market access, scale expansion, and participation in global value chains, though these gains vary with development conditions (Gries & Redlin, 2020). Imports provide capital goods, intermediate inputs, and productivity-enhancing technologies (Kong et al., 2021). Foreign investment supplies capital, managerial knowledge, and production networks that support industrial upgrading (Banday et al., 2021). These channels are especially relevant to Indonesia, where regional development is increasingly tied to international trade, special economic zones, downstream industrial policies, and FDI inflows (Fazaalloh, 2024).

Indonesia's integration into global markets through trade and capital flows has become a major determinant of its macroeconomic structure (Bank Indonesia, 2024). The national trade-to-GDP ratio reached 45.29% in 2023, indicating substantial exposure to international markets (BPS, 2024). FDI also continued to expand and shape capital formation, technology diffusion, and productivity across provinces (BKPM, 2024; Fazaalloh, 2024). However, transmission remains uneven because export structures, infrastructure, human capital, and industrial capacity differ sharply across regions. Wiguna and Panennungi (2019) document heterogeneous distributional

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effects within Indonesia, whereas cross-country research largely identifies average national relationships (Arribas et al., 2009; Feder, 1983). This contrast leaves unresolved how trade and FDI jointly affect provincial growth after accounting for post-pandemic shocks and dynamic adjustment.

Economic openness can promote growth while intensifying regional inequality because its distributional effects are heterogeneous (Marrero & Servén, 2022; Gunawan et al., 2021; Aginta et al., 2023). Existing Indonesian studies generally examine trade, FDI, or regional disparity separately and rely mainly on static or single-equation estimates; consequently, they do not identify bidirectional adjustment, the timing of shocks, or the joint TRADE×FDI mechanism within a single provincial system. This is the explicit research gap addressed here. The study aims to estimate short- and long-run relationships among trade openness, FDI, their interaction, and real GRDP growth across 34 provinces. Its novelty lies in combining panel VECM with Granger causality, Johansen cointegration, impulse responses, and variance decomposition while preserving trade-investment complementarity. Theoretically, it links capital accumulation and endogenous spillovers within a regional dynamic framework. Practically, it identifies adjustment speed and dominant shock channels to inform differentiated trade, investment, and absorptive-capacity policies.

LITERATURE REVIEW

The study is grounded in the Neoclassical Growth Model (Solow, 1956) and Endogenous Growth Theory (Lucas, 1988; Romer, 1990). In the Solow-Swan model, FDI accelerates physical capital accumulation and convergence to the steady state, though diminishing returns limit sustained growth. Endogenous theory complements this view by treating trade and FDI as channels for technology transfer, knowledge spillovers, learning-by-exporting, innovation, and productivity gains. Integrating the two perspectives allows the model to evaluate both capital deepening and dynamic productivity transmission across GRDP growth, trade, and FDI.

A substantial literature examines the openness-growth nexus. Feder (1983) and Arribas et al. (2009) provided early evidence linking exports and international integration to growth. More recent Asian studies show that trade can expand market access, enhance specialization, and generate dynamic feedback with growth (Raghutla, 2020; Alam & Sumon, 2020; Kong et al., 2021). However, their scope and methods differ. Cross-country studies typically estimate aggregate national relationships, whereas Indonesian research has focused on provincial FDI effects or the distributional consequences of trade (Fazaaloh, 2024; Wiguna & Panennungi, 2019). This difference in scale makes a dynamic provincial approach necessary.

These studies reveal two related limitations. First, aggregate models can obscure spatial heterogeneity: Indonesian provinces differ substantially in export exposure, industrial structure, and capacity to absorb foreign capital (Wiguna & Panennungi, 2019; Fazaaloh, 2024). Second, static or single-equation models do not fully address endogeneity and potential bidirectional causality among trade, FDI, and growth. Economic openness, therefore, should not be treated as linear or isolated. Evidence from BRICS and other Asian economies indicates that trade and foreign capital reinforce one another only when host-economy characteristics support spillovers and stability (Banday et al., 2021; Joo et al., 2022; Hossain et al., 2022).

To address the remaining methodological gap, this study applies a panel VECM to 34 provinces and includes TRADE×FDI. The framework treats the variables as endogenous, tests for bidirectional causality, and estimates short- and long-run adjustment rather than static average effects alone.

RESEARCH METHOD

This quantitative study examines dynamic relationships among trade openness, FDI, and regional growth using annual panel data for 34 Indonesian provinces from 2015 to 2025, compiled from official publications. Guided by Endogenous Growth Theory, the specification includes trade openness, FDI inflows, and their interaction to capture both direct channels and trade-investment complementarity:

$$\text{GROWTH}_{it} = \beta_0 + \beta_1 \text{TRADE}_{it} + \beta_2 \text{FDI}_{it} + \beta_3 (\text{TRADE} \times \text{FDI})_{it} + \varepsilon_{it}$$

GROWTH_{it} denotes real GRDP growth in province i and year t ; TRADE_{it} is the trade-openness ratio; FDI_{it} is foreign direct investment inflow; and $\text{TRADE} \times \text{FDI}$ tests whether trade exposure amplifies or weakens the growth effect of FDI. The interaction is therefore a complementarity term, not a direct measure of absorptive capacity.

To mitigate persistent endogeneity bias and assess the possibility of bidirectional causality among the macroeconomic variables, this study applies a panel-based Vector Error Correction Model (VECM). The VECM is appropriate because it decomposes shock transmission into short-run transitional adjustment dynamics and long-run structural equilibrium dynamics (Gujarati, 2012). The general form of the VECM is specified as follows:

$$\Delta Y_{it} = \alpha_i + \sum \Gamma_j \Delta Y_{it-j} + \Pi Y_{it-1} + \mu_{it}$$

In this formulation, Y_{it} is a vector of endogenous variables in the system. The Δ operator denotes first difference. Γ_j is the coefficient matrix governing short-run dynamics, and Π is the error-correction matrix, which captures the speed of adjustment to equilibrium following a shock.

The empirical sequence comprises panel unit-root tests, lag selection using information criteria, Johansen cointegration tests, and VECM estimation. Impulse response functions trace the time path of growth in response to shocks, while variance decomposition quantifies each innovation's contribution across forecast horizons (Wooldridge, 2016).

FINDINGS AND DISCUSSION

Pairwise Granger tests indicate bidirectional causality between TRADE and GROWTH . This supports trade-led growth through market expansion, specialization, capital inputs, competition, and knowledge diffusion, as well as growth-driven trade, since a larger productive capacity raises exports and demand for imported inputs. The finding aligns with Asian evidence (Alam & Sumon, 2020; Raghutla, 2020; Kong et al., 2021). However, gains are unlikely to be uniform: provinces with ports, industrial zones, skills, and supplier networks can absorb openness more effectively than less-connected regions (Wiguna & Panennungi, 2019).

Endogenous Growth Theory explains this feedback through learning-by-exporting and technology transfer. Openness raises productivity when production structures and institutions can absorb new knowledge; growth then expands firms' financing capacity and export competitiveness. The two mechanisms are therefore mutually reinforcing rather than competing, consistent with dynamic Asian evidence from Alam and Sumon (2020).

Table 1. Pairwise Granger Causality Tests

Null Hypothesis:	Obs.	F-Statistic	Prob.
TRADE does not Granger Cause GROWTH	306	22.6631	7.E-10
GROWTH does not Granger Cause TRADE		10.9078	3.E-05
FDI does not Granger Cause GROWTH	306	2.94120	0.0543
GROWTH does not Granger Cause FDI		2.23538	0.1087
TRADE*FDI does not Granger Cause GROWTH	306	22.8157	6.E-10
GROWTH does not Granger Cause TRADE*FDI		9.46371	0.0001

Source: Data processed by EViews, 2026

Beyond bilateral feedback, $\text{TRADE} \times \text{FDI}$ and GROWTH also show significant bidirectional causality. The interaction contains more predictive information than either channel alone: export-

oriented FDI can use trade access to build production bases, while growth creates markets and infrastructure that attract capital. Similar complementarity appears in BRICS, China, and crisis-affected Asian economies (Banday et al., 2021; Hao, 2023; Hossain et al., 2022). In endogenous-growth terms, trade and FDI jointly transmit technology, knowledge, and productivity, but only when financial development, human capital, and stability support spillovers (Joo et al., 2022).

FDI does not Granger-cause GROWTH at the 5% level ($p = 0.0543$), though the evidence is marginal at 10%. This does not conflict with its later dominance in variance decomposition: Granger tests whether lagged FDI improves conditional-mean forecasts, whereas decomposition attributes forecast-error variance to FDI shocks.

The policy implication of this pattern is that trade and growth should not be treated as a one-way relationship. Export strategies require adequate regional production capacity, while growth strategies depend on access to international markets. At the same time, FDI promotion should target investments linked to export activities, local suppliers, and domestic value creation, thereby preventing foreign-owned projects from operating as enclaves detached from regional economies.

Table 2. Johansen Cointegration Tests

Unrestricted Cointegration Rank Test (Trace)				
Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.158115	64.47554	47.85613	0.0007
At most 1	0.084213	23.51304	29.79707	0.2218
At most 2	0.008316	2.575923	15.49471	0.9828
At most 3	0.002470	0.588547	3.841466	0.4430

Trace test indicates 1 cointegrating equation at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

** MacKinnon-Haug-Michelis (1999) p-values

Source: Data processed by EViews, 2026

Transitioning from predictive causality to long-run equilibrium, Johansen's trace test rejects no cointegration ($64.47554 > 47.85613$; $p = 0.0007$) but does not reject at most one cointegrating equation ($23.51304 < 29.79707$). The system therefore has one cointegrating relation, indicating that GROWTH, TRADE, FDI, and TRADE×FDI share a stable long-run equilibrium.

The VECM adjustment coefficient is negative and significant (CointEq1 = -0.240885 ; $t = -2.88837$; Appendix), indicating that deviations from the long-run relationship lead to subsequent changes in GROWTH that restore equilibrium.

$$\Delta \text{GROWTH}(t) = -0.240885 \text{ECT}(t-1) + \text{short-run dynamics} + \varepsilon(t)$$

Approximately 24.09% of disequilibrium is corrected each year, implying a half-life of about 2.5 years. This moderate adjustment is economically plausible because trade and FDI affect growth only after capacity is built, technology is transferred, workers are trained, and supplier linkages are formed.

The first three own lags in the GROWTH equation are negative and significant, indicating mean reversion. TRADE's first lag is insignificant, whereas its second and third lags are marginally significant at 10%. This contrast with the Granger result suggests that trade matters jointly across lags rather than through a single short-run coefficient. FDI has stronger short-run effects: its second lag is positive (7.579680 ; $t = 3.13421$), while its third lag is negative (-5.215921 ; $t = -2.42124$). The sign reversal may capture an investment cycle in which construction, input demand, and employment initially raise growth before import dependence, profit repatriation, or crowding-out effects emerge. Provincial FDI effects are likewise heterogeneous by sector and regional

characteristics (Fazaaloh, 2024).

The lagged $\text{TRADE} \times \text{FDI}$ interaction terms in the GROWTH equation are not individually significant at the 5% level, but this does not imply that complementarity is irrelevant. Because the panel estimates represent an average dynamic relationship, the result should not be interpreted as uniform across provinces. Resource-based provinces may attract large FDI inflows yet generate weak local spillovers when projects remain import-intensive or enclave-like, whereas manufacturing and port-connected provinces can convert FDI into supplier linkages and exports more quickly. Provinces with weaker human capital, logistics, finance, and governance are likely to experience slower transmission (Fazaaloh, 2024; Gunawan et al., 2021; Aginta et al., 2023). The practical implication is a place-based policy mix: supplier and technology-transfer requirements in resource regions, skills and cluster support in industrializing regions, and basic connectivity plus institutional strengthening in lagging regions. Heterogeneity should therefore be treated as a conditioning mechanism rather than as a contradiction of the pooled result.

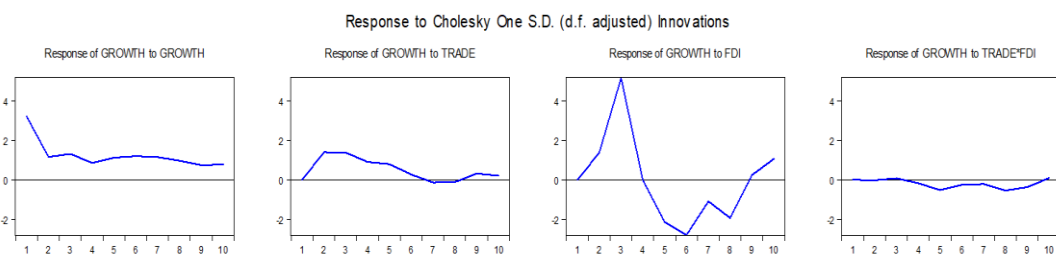


Figure 1. Impulse Response Function of Growth

Source: Data processed by EViews, 2026

With the error-correction mechanism in place, variance decomposition identifies the sources of changes in each variable's forecast error variance across several horizons (Table 3). In the first period, 100% of the variation in GROWTH is attributable to its own shock. In the second period, GROWTH's internal contribution declines to 75.19%, while TRADE and FDI explain 12.72% and 12.08%, respectively. The largest change occurs in the third period, when FDI's contribution rises to 62.34% and GROWTH's own shock falls to 29.20%.

By period ten, FDI shocks account for 63.82% of GROWTH's forecast-error variance, followed by own shocks (27.44%), TRADE (7.59%), and $\text{TRADE} \times \text{FDI}$ (1.15%). Medium- to long-run growth uncertainty is therefore driven primarily by FDI innovations rather than by direct trade shocks.

The dominance of FDI can be explained by capital accumulation, technology transfer, managerial knowledge, and production networks, which affect growth more persistently than short-term trade fluctuations (Fazaaloh, 2024; Asongu et al., 2020). Cross-country evidence places the Indonesian result in perspective. Studies of Asian and BRICS economies likewise find that trade and FDI can reinforce growth when host conditions support spillovers (Alam & Sumon, 2020; Banday et al., 2021; Hossain et al., 2022; Joo et al., 2022), and China's ARDL evidence identifies a comparable feedback mechanism (Hao, 2023). Indonesia is distinctive because the dominant FDI shock occurs within a provincial system marked by large differences in infrastructure and production structures. Thus, the international comparison supports a conditional, regionally mediated openness-growth mechanism rather than an automatic effect of foreign capital.

Table 3. Variance Decomposition of Growth

Variance Decomposition of GROWTH:					
Period	S.E.	GROWTH	TRADE	FDI	TRADE*FDI

1	3.183987	100.0000	0.000000	0.000000	0.000000
2	3.908111	75.19485	12.72309	12.07783	0.004238
3	6.726268	29.19784	8.444139	62.34362	0.014407
4	6.843487	29.77309	9.925926	60.22660	0.074388
5	7.317419	28.37013	9.867148	61.19471	0.568012
6	7.927556	26.45477	8.526436	64.43283	0.585968
7	8.087658	27.43474	8.220583	63.71476	0.629919
8	8.388145	26.82271	7.660500	64.51899	0.997807
9	8.437938	27.27078	7.718575	63.84103	1.169621
10	8.541650	27.43870	7.589631	63.81941	1.152262

Source: Data processed by EViews, 2026

The growth equation does not fully capture the transmission mechanism. The variance decomposition of TRADE also shows a strong role for FDI. By the tenth period, variation in TRADE is explained by FDI shocks (56.00%), TRADE's own shocks (32.64%), GROWTH shocks (7.49%), and TRADE×FDI shocks (3.87%). This result indicates that foreign investment inflows can alter the structure of trade through imports of machinery and intermediate inputs, expanded production capacity for exports, and the integration of domestic firms into global value chains.

FDI remains highly persistent: by period ten, its own shocks explain 84.56% of its variance, while TRADE accounts for 12.20%. The D(FDI) equation's low R-squared (8.56%) suggests that global interest rates, country risk, multinational strategies, commodity prices, and investment policy lie largely outside the system. Cross-country evidence similarly shows that the benefits of financial openness depend on development and institutional quality ([Gregori & Giansoldati, 2023](#)). Productive FDI promotion should therefore be paired with regulatory stability and macroprudential safeguards.

For TRADE×FDI, the period-ten variance is driven mainly by FDI (46.42%) and TRADE (39.79%), with smaller shares from GROWTH (11.45%) and its own shock (2.35%). This is expected for a constructed interaction: its dynamics are transmitted primarily through the constituent variables.

CONCLUSIONS

The findings reveal a gradual, interdependent openness-growth process. Trade and growth reinforce each other, while FDI becomes the dominant medium- to long-run shock. The result bridges the Solow-Swan emphasis on capital accumulation with endogenous-growth mechanisms: sustainable gains arise when foreign capital transfers technology, develops skills, supports innovation, and links with local firms. FDI dominance therefore justifies prioritizing the quality, stability, and domestic embeddedness of investment rather than volume alone.

Three policy implications follow. First, incentives should prioritize FDI that raises domestic value added, trains workers, transfers technology, conducts research and development, and links with local suppliers. Second, place-based policy should strengthen absorptive capacity according to regional needs: vocational skills and industrial infrastructure ([Santoso, 2021](#)), finance and governance ([Solihin et al., 2021](#)), and fiscal arrangements that do not deepen inequality ([Siburian, 2020](#)). Because structural transformation varies across regions ([Andriansyah et al., 2023](#)), uniform incentives are unlikely to yield uniform spillovers. Third, export and FDI portfolios should be diversified toward downstream manufacturing and modern services with strong local linkages to support inclusive growth ([Purwanti, 2024](#)). The study contributes evidence on feedback, long-run equilibrium, adjustment speed, and FDI-led shock transmission, shifting analysis from whether openness matters to how, when, and under what regional conditions it matters.

LIMITATIONS & FURTHER RESEARCH

This study has several limitations. The panel VECM estimates common dynamic parameters across 34 provinces, so the results reflect average adjustment and do not directly estimate province-specific coefficients or spatial spillovers. The 2015-2025 annual sample offers a limited time dimension and includes the exceptional COVID-19 shock, which may affect parameter stability despite the model's dynamic structure. $\text{TRADE} \times \text{FDI}$ is a parsimonious interaction term rather than a direct measure of absorptive capacity, and omitted factors such as human capital, infrastructure quality, institutions, sectoral composition, and domestic investment may influence the estimated transmission. Finally, Granger causality indicates predictive precedence, not structural causality. These limitations should guide interpretation of the findings and the design of subsequent research.

These limitations define the next agenda: use district-level data, estimate spatial spillovers and heterogeneous provincial coefficients, and incorporate direct measures of human capital, infrastructure, digitalization, governance, sectoral structure, and ease of doing business. Spatial panel or panel-VAR extensions could then distinguish within-region effects from spillovers across neighboring provinces and test whether results remain stable across pre-pandemic, pandemic, and recovery periods.

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APPENDIX

Vector Error Correction Estimates

Cointegrating Eq:	CointEq1			
GROWTH(-1)	1.000000			
TRADE(-1)	0.049700 (0.22437) [0.22151]			
FDI(-1)	-0.090209 (1.07074) [-0.08425]			
TRADE(-1)*FDI(-1)	0.005033 (0.02656) [0.18951]			
C	-7.505641			
Error Correction:	D(GROWTH)	D(TRADE)	D(FDI)	D(TRADE*FDI)
CointEq1	-0.240885 (0.08340) [-2.88837]	0.260707 (0.07707) [3.38265]	-0.000281 (0.00994) [-0.02825]	3.685119 (0.91175) [4.04180]
D(GROWTH(-1))	-0.484510 (0.08950) [-5.41345]	-0.295586 (0.08271) [-3.57368]	-0.001434 (0.01066) [-0.13447]	-3.802400 (0.97847) [-3.88605]
D(GROWTH(-2))	-0.296102 (0.08755) [-3.38212]	-0.203930 (0.08091) [-2.52052]	-0.010845 (0.01043) [-1.03968]	-3.183464 (0.95713) [-3.32603]
D(GROWTH(-3))	-0.161607 (0.07141) [-2.26323]	0.108051 (0.06599) [1.63741]	0.001623 (0.00851) [0.19082]	0.740000 (0.78064) [0.94794]
D(TRADE(-1))	0.460253 (0.36824) [1.24987]	1.252393 (0.34031) [3.68018]	0.021629 (0.04387) [0.49298]	15.23548 (4.02580) [3.78446]
D(TRADE(-2))	-0.571153 (0.29825)	-1.569158 (0.27563)	-0.022782 (0.03554)	-11.53461 (3.26062)

	[-1.91501]	[-5.69308]	[-0.64112]	[-3.53755]
D(TRADE(-3))	0.724624 (0.39563) [1.83159]	2.691157 (0.36561) [7.36064]	0.004935 (0.04714) [0.10470]	27.76561 (4.32518) [6.41953]
D(FDI(-1))	3.690354 (2.17136) [1.69956]	11.68746 (2.00664) [5.82438]	-0.013639 (0.25871) [-0.05272]	116.2577 (23.7384) [4.89745]
D(FDI(-2))	7.579680 (2.41837) [3.13421]	-0.237540 (2.23492) [-0.10629]	0.103557 (0.28814) [0.35940]	15.00090 (26.4389) [0.56738]
D(FDI(-3))	-5.215921 (2.15423) [-2.42124]	-19.74042 (1.99082) [-9.91572]	-0.599115 (0.25667) [-2.33421]	-203.9625 (23.5512) [-8.66038]
D(TRADE(-1)*FDI(-1))	-0.001855 (0.03445) [-0.05386]	-0.069142 (0.03183) [-2.17189]	-0.000557 (0.00410) [-0.13571]	-0.900310 (0.37660) [-2.39061]
D(TRADE(-2)*FDI(-2))	0.041068 (0.03078) [1.33437]	0.091644 (0.02844) [3.22208]	0.002556 (0.00367) [0.69715]	0.551219 (0.33647) [1.63823]
D(TRADE(-3)*FDI(-3))	-0.053529 (0.03603) [-1.48586]	-0.217192 (0.03329) [-6.52375]	-1.54E-06 (0.00429) [-0.00036]	-2.241376 (0.39385) [-5.69098]
C	-1.011317 (0.39841) [-2.53842]	1.282461 (0.36818) [3.48321]	0.119892 (0.04747) [2.52574]	18.08881 (4.35557) [4.15303]
R-squared	0.567538	0.779759	0.085600	0.705069
Adj. R-squared	0.542440	0.766977	0.032532	0.687952
Sum sq. resids	2270.861	1939.410	32.23642	271413.6
S.E. equation	3.183987	2.942461	0.379358	34.80902
F-statistic	22.61267	61.00508	1.613019	41.19221
Log likelihood	-606.1290	-587.3537	-99.80569	-1175.364
Akaike AIC	5.211168	5.053392	0.956350	9.994652
Schwarz SC	5.415419	5.257644	1.160602	10.19890
Mean dependent	0.046176	0.469286	0.105744	9.860950
S.D. dependent	4.707033	6.095526	0.385683	62.31335
Determinant resid covariance (dof adj.)		831.8776		
Determinant resid covariance		652.7452		
Log likelihood		-2122.091		
Akaike information criterion		18.33690		
Schwarz criterion		19.21226		
Number of coefficients		60		

Source: Data processed by EViews, 2026