Journal of Management and Social Sciences
Volume 5, Nomor 3, Agustus 2026
e-ISSN :2963-5497 dan p-ISSN :2963-5047; Hal. 331-343
DOI: https://doi.org/10.55606/jimas.v5i3.2859
Tersedia: https://journal-stiayappimakassar.ac.id/index.php/Jimas

Macroeconomic Determinants of Energy Subsidy Allocation in ASEAN-5 Countries: An ARDL Panel Approach

Nadia Intan Lestari[1*], Kenedi[2], Pramudi Harsono[3]
[1-3]Program Studi Ekonomi, Universitas Bina Bangsa, Indonesia

**Penulis Korespondensi: ndiaa.0220@yahoo.com*

Abstract. A solid fiscal framework is essential for stabilizing the economies of developing countries, particularly in facing macroeconomic shocks and global uncertainties. This study analyzes fiscal resilience vulnerabilities in the ASEAN-5 countries, namely Indonesia, Malaysia, the Philippines, Thailand, and Vietnam, during the period 2010–2025. The research focuses on the ratio of energy subsidies to GDP as a key fiscal instrument that functions as a shock absorber during periods of economic disruption. Employing a quantitative approach, this study applies the Autoregressive Distributed Lag (ARDL) model estimated through the Pooled Mean Group (PMG) estimator to examine the dynamic relationships among macroeconomic variables. The analysis utilizes official secondary data obtained from international institutions, including the International Monetary Fund (IMF) and the World Bank. The findings confirm the existence of long-term cointegration among the examined variables. The Error Correction Term (ECT) value of -0.4303 indicates that fiscal adjustment occurs at a rate of approximately 43.03% annually, requiring around 2.3 years for fiscal normalization following economic shocks. The results reveal that global oil prices have a positive and significant influence on energy subsidies in both the short and long term. Exchange rate depreciation does not significantly affect short-term subsidy fluctuations but creates significant negative pressure on long-term fiscal equilibrium. Meanwhile, domestic inflation does not show a significant effect on subsidy allocations. These findings highlight the importance of fiscal discipline, subsidy rationalization, and institutional coordination between fiscal and monetary authorities to strengthen fiscal resilience and maintain macroeconomic stability in ASEAN-5 economies.

Keywords: ASEAN-5; energy subsidies; exchange rates; global oil prices; panel ARDL.

1. INTRODUCTION

Over the past decade, developing countries within ASEAN have encountered constant obstacles in managing state budgets. During the transition to industrialization, the energy sector has served as a central component of national development rather than merely supplementing the market. Affordable energy prices and reliable supply are closely associated with economic growth, which in turn affects social stability and financial security for communities.

In response to volatility in global commodity markets, governments in the region have historically implemented a range of protective measures, including explicit fossil fuel subsidy interventions. These policies seek to safeguard the purchasing power of vulnerable and lower-middle-income communities against international price fluctuations. Although effective in dampening social unrest and preventing panic, this policy unintentionally creates dual vulnerabilities that damage the country's fiscal space, as the burden of continuing these artificially low energy prices is tied to the cycle of international crises.

Naskah Masuk: 17 Mei 2026; Revisi: 19 Juni 2026; Diterima: 20 Juli 2026; Tersedia: 28 Juli 2026

The IMF data show that the fossil fuel subsidy-to-GDP ratios in ASEAN-5—Indonesia, Malaysia, the Philippines, Thailand, and Vietnam—are highly volatile, driven mainly by global shocks such as the 2022 supply chain crisis triggered through geopolitical disputes. For instance, Malaysia's ratio spiked to 4.85%, reflecting government efforts to cover price losses, with Indonesia and Thailand at 3.75% and 2.65%, respectively. Earlier in the decade, these ratios were more stable, as shown in Figure 1.

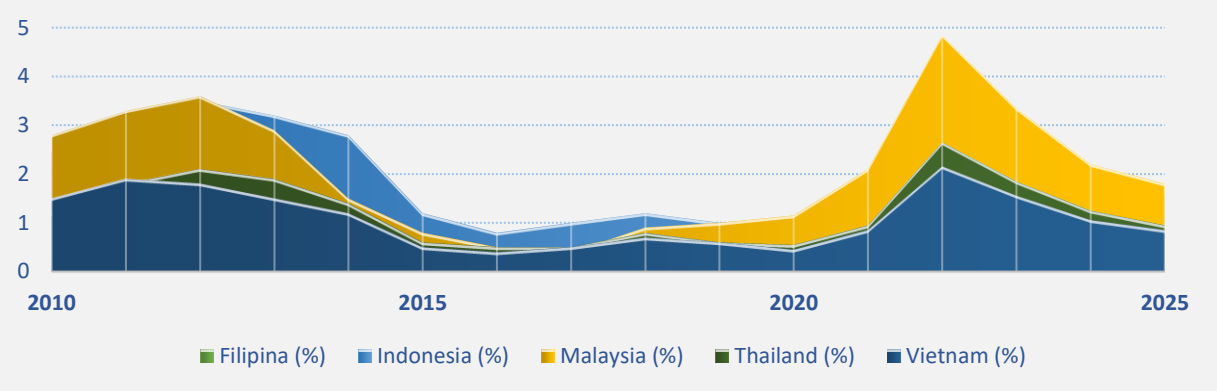

Figure 1. Graph of the Energy Subsidy Ratio to GDP in ASEAN-5 Countries (Period 2010–2025).

Source: Processed from International Monetary Fund Data, 2026.

The phenomenon of external shocks plunges policymakers into a complex dilemma: protecting social order and preventing runaway inflation versus the financial risks of continuous subsidy budget expansion, which threaten fiscal solidity and worsen long-term debt ratios.

Most conventional economic studies tend to focus too heavily on ex-post impact assessments of external shocks on macroeconomic indicators. Usually, research only analyzes the impact of oil price shocks on GDP or the influence of exchange rates on inflation. It is very rare to find studies that reverse this logic by examining the 'fiscal defense' instrument—energy subsidy ratios—as the main variable. Understanding the dynamic response of budget expansion to pressures from oil prices, exchange rates, and inflation is key to future economic robustness.

Furthermore, relying on conventional static regression approaches to analyze this issue is an analytical mistake. Fiscal intervention policies do not produce immediate results. When government authorities implement budgetary easing or tightening to address external shocks, a time lag inevitably occurs between the onset of a crisis and the actual execution of fiscal measures. Employing static regression to analyze such time-dependent dynamics often leads towards biased and possibly misleading conclusions. Due to these methodological-related

challenges, this study intends to empirically demonstrate the presence of structural cointegration and to assess the impact of various macroeconomic determinants on energy subsidy allocation in ASEAN-5, applying advanced dynamic econometric techniques, specifically the Panel Autoregressive Distributed Lag (ARDL) model.

2. THEORETICAL STUDY

Subsidies are government financial interventions designed to decrease production costs or retail prices for consumers. In developing countries, Todaro and Smith (2020) note that governments employ fuel subsidies as countercyclical steps to reduce market panic during macroeconomic shocks. However, extensive and sustained subsidy allocations may result in resource assignment inefficiencies. In this context, subsidies are analyzed as a dependent variable (Y), representing the government's function as a shock absorber.

Global oil prices are determined by the exchange rate of international crude oil and influence the global cost structure. Since ASEAN-5 countries primarily act as price takers, fluctuations caused as a result arising from geopolitical risks constitute uncontrollable exogenous variables. Such price increases compel governments to expand fiscal deficits to bridge the gap between retail prices and actual costs (Eleyan et al., 2022). Consequently, the initial hypothesis asserts a significant positive relationship between oil prices and the proportion of energy subsidies.

The exchange rate transmits international price signals to the domestic economy through the Exchange Rate Pass-Through (ERPT) mechanism. Depreciation of the local currency relative to the US dollar raises the real cost of imports. From a political-economic standpoint, sustained currency depreciation diminishes the government’s foreign-exchange reserves designated for servicing foreign debt. To avoid default, the government often has to rationalize social spending, including energy subsidies (Bloom, 2021). Consequently, currency depreciation is believed to exert a negative long-term impact on energy subsidies.

The inflation rate quantifies the percentage depreciation of domestic purchasing power. While higher inflation usually necessitates increased subsidies as a social safety net, the modern monetary architecture in ASEAN-5, exemplified by the Inflation Targeting Framework, aims to contain inflation through central bank interest-rate instruments rather than directly impacting fiscal policy (Han et al., 2020). This multidimensional interaction is analyzed using a dynamic econometric model to evaluate the extent to which these determinants influence the state budget balance.

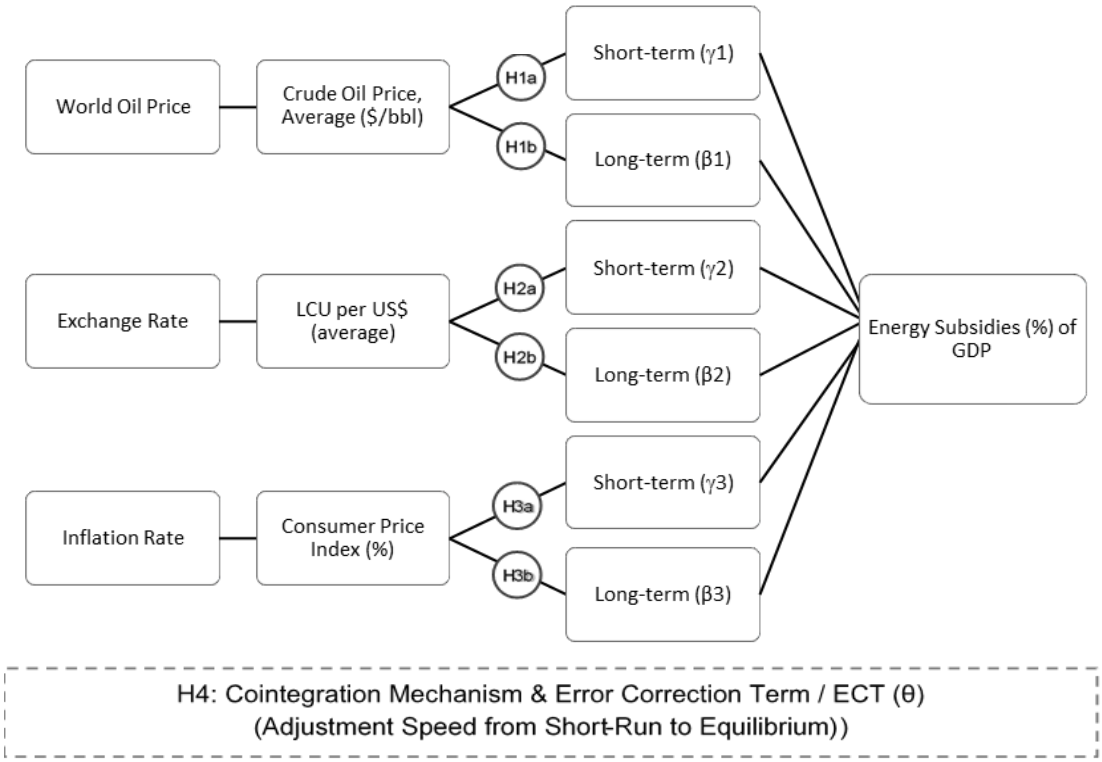

Figure 2. Research Framework.

This research framework functions as a conceptual model which integrates macroeconomic theory based on empirical data to explain the interactions among exogenous variables and their effects on the fiscal posture of ASEAN-5. Consistent with the Panel Autoregressive Distributed Lag (ARDL) methodology, the framework distinguishes between short-run dynamics as well as long-run equilibrium in the transmission of shocks, and measures the speed of adjustment mechanisms toward equilibrium using the Error Correction Term (ECT). Structurally, (1) global oil prices act as the main external shock triggering the expansion of energy subsidy allocations; (2) the exchange rate (depreciation of the local currency) in the long term constrains fiscal space due to the depletion of foreign exchange liquidity for external debt, which in turn forces governments to cut subsidies; and (3) the inflation rate triggers high living cost expectations, which are highly dependent on the effectiveness of fiscal and monetary policy coordination in each country.

3. RESEARCH METHODOLOGY

This study uses an explanatory quantitative design with balanced panel data from 2010 to 2025, spanning 16 years and multiple economic cycles. The target population comprises all ASEAN member countries, but, using strict purposive sampling, five countries were selected:

Indonesia, Malaysia, Thailand, the Philippines, and Vietnam, based on their track records in energy subsidy policies and comprehensive, transparent macroeconomic data.

To maintain the independence and credibility of the data, all variable series are downloaded directly from the official publication repositories of the highest global financial authorities. The main dependent variable, the ratio of Energy Subsidy to GDP (Energy Subsidy/ES), is derived from the International Monetary Fund (IMF) database. The independent variable series, including Global Oil Prices (Ln_COP), is sourced from The Pink Sheet, a leading commodity publication owned by the World Bank. The Official Exchange Rate (Ln_ER) and the Inflation Indicator (INF) are also obtained from the World Bank data servers. As an initial step to reduce potential heteroskedasticity bias and normalize overly volatile data variance, the raw values of oil prices and foreign exchange rates are transformed into logarithms (Ln) before running the regression algorithm.

Construction of the ARDL Panel Model and PMG Approach

The computational center for econometric modeling is built using the Panel Autoregressive Distributed Lag (Panel ARDL) specification and is carefully estimated using the Pooled Mean Group (PMG) approach within the EViews 13.1 analytics platform. However, before the software is allowed to draw any causal lines, the entire data set must be proven to be pure through a series of very strict mathematical prerequisite tests.

The first checking step entails conducting panel unit root tests to assess the stationarity of each variable. This test relies on the reliability of two complementary methods, namely Levin, Lin & Chu (LLC) and ADF-Fisher Chi-square. The fundamental objective of this stage is to provide an absolute guarantee that none of the variables in the panel are integrated of order two (I(2). If an I(2) variable enters the system, the entire conceptual basis of the ARDL assumption will collapse, and the estimation results will become completely invalid. The standard mathematical formulation guiding this stationarity test is written as:

$$\Delta U_{it} = \rho_i U_{i,t-1} + \sum_{j=1}^{p_i} \theta_{it} \Delta\, U_{i,t-j} + z'_{it} + e_{it}$$

The second checking step shows the potential for cross-sectional dependence within economic blocks such as ASEAN, where a crisis in one country can spread widely. The Breusch-Pagan LM and Pesaran CD tests are used to measure the strength of this effect, with the probability formulation of the Breusch-Pagan LM explained via equations.

$$LM = T \sum_{i=1}^{N-1} \sum_{j=it}^{N} \hat{\rho}_{ij}^2$$

The third step in checking is to run the Kao Residual Cointegration Test. This diagnostic test aims to determine whether an invisible, long-term structural equilibrium anchor continuously holds the variables in place and pulls them back so they do not deviate too far from their main trajectory over time.

After successfully breaking through this required barrier, the PMG estimation method is implemented. The decision to choose PMG over other methods, such as MG or DFE, is not coincidental. PMG has developed a mathematical architecture that accommodates extreme heterogeneity in how countries respond to shocks while retaining the assumption of the coefficient homogeneity once long-term equilibrium is reached. This model reflects the ASEAN-5 economy: although Indonesia's bureaucracy and Thailand's parliament may respond differently to oil price spikes, the economic law of import oil subsidies, given a depreciating currency, will force their fiscal limits toward structural contraction in the future.

The mathematical mechanism of Error Correction, which elegantly captures the dynamics of adjustment correction from shock conditions back toward equilibrium, is described as:

$$\hat{e}_{it} = \rho \hat{e}_{i,t-1} + \sum_{j=1}^{P} v_j \Delta \hat{e}_{i,t-j} + v_{it}$$

The culmination of this methodological design is captured in a large equation, the Panel Cointegration Error Correction Model (PCEM), specifically formulated for this research.

$$\Delta ES_{it} = \theta_i ES_{i,t-1} + \beta_{1i} COP_{i,t} + \beta_{2i} ER_{i,t} + \beta_{3i} INF_{i,t} + \sum_{j=1}^{p-1} \gamma_{ij} \Delta ES_{i,t-j} +$$

$$\sum_{j=0}^{q-1} \delta_{1ij} \Delta COP_{i,t-j} + \sum_{j=0}^{q-1} \delta_{2ij} \Delta ER_{i,t-j} + \sum_{j=0}^{q-1} \delta_{3ij} \Delta INF_{i,t-j} + \mu_i + e_{it}$$

From the elaborate mathematical notation, the coefficient appears as the main protagonist. It is a numerical representation of the Error Correction Term (ECT), a magical value that both dictates and measures how agile the national bureaucratic institution is at repairing damage and moving out of short-term panic dynamics toward long-term equilibrium.

4. RESULTS AND DISCUSSION

Results of the Econometric Assumption Test

The long series of executing statistical prerequisite tests ultimately yielded results that very convincingly confirmed the feasibility, flexibility, and absolute suitability of using dynamic modeling for this historical data structure.

When we dissect the results of the Unit Root Test for the Panel, the data landscape shows a mixture of stationarity levels—an environment where the econometrics ARDL actually shows its sharp edge. Specifically, the variables Energy Subsidy Ratio (ES), World Oil Price (Ln_COP), and Official Exchange Rate (Ln_ER) refuse to be stationary at the initial level, only reaching their stationarity point after undergoing first differencing, classifying all three as I(1) variables. Paradoxically but consistently, the Inflation indicator (INF) achieved stationarity in the raw data, making it the only I(0) variable in this model. The most decisive and heartening finding from all these unit root tests is the absence of any variables entering the I(2) integration zone. With the elimination of the I(2) variable threat, an absolute green light is given to the ARDL model to continue with further regression algorithms.

Table 1. Results of the Panel Unit Root Test.

Variabel	LLC test		ADF-Fisher test	
	Level	1st Difference	Level	1st Difference
ES	-1,0517	-6,3162***	10,9082	31,7918***
Ln_COP	-2,5881***	-6,9420***	10,6328	40,0066***
Ln_ER	-2,5134***	-4,5548***	15.2199	38,6040***
INF	-3,4629***	-9,7763***	19,4681**	60,9547***

Moving beyond stationarity, the analysis focuses on cross-border dependence, revealing high economic interconnection among neighboring countries. The Breusch-Pagan LM and Pesaran CD tests yield p-values of 0.0000, confirming deep intra-ASEAN economic integration. This evidence supports the crisis contagion hypothesis: a commodity price shock in Vietnam can quickly cause inflation in Indonesia and Malaysia. This regional domino effect justifies using the PMG estimator rather than standard panel regressions, which treat each country in isolation.

Table 2. Results of the Cross-sectional Dependence Test.

Variabel	Breusch-Pagan LM	Pesaran scaled LM	Pesaran CD
ES	109.6686***	22.28658***	10.20566***
Ln_COP	160.0000***	33.54102***	12.64911***
Ln_ER	108.0427***	21.92302***	12.01639***
INF	107.0371***	21.69814***	10.15423***

The validation analyses verify convergence of all variables, with the Kao Residual cointegration test showing a long-term relationship among the determinants. The algorithm's t-statistic of -2.0524 exceeds the statistical threshold of 0.0201, mathematically guaranteeing that, in spite of short-term fluctuations, there is a constant fundamental economic balance that guides the variables back to balance.

Table 3. Kao Cointegration Panel Test Results.

Metode	t-Statistic	Prob.
ADF	-2,0524**	0,0201

ARDL Panel Model Estimation

Armed with full confidence after completing all basic mathematical assumption validations, the top-level analysis stage involving the estimation of primary causality was executed directly. The econometric iteration mechanism precisely established PMG(1,1,0,0) as the most superior and comprehensive specification framework; a model design that emerged as the absolute winner from the lengthy selection process due to its information criterion scores considerably exceeding the best standard thresholds of Akaike and Schwarz. The signif, which reveals the coefficients of the parameters, is presented within two key economic balance terms: the long-term equation, which measures chronic impacts, and the short-term shock equation, which captures acute effects during crisis periods. The results of the parameter significance tests are summarized in these two equilibrium dimensions, as shown in Table 4.

Table 4. Long-term and short-term estimation results of the ARDL panel model.

Variable	Coefficient	Std. Error	t-Statistic	Prob. *
Long Run Equation				
Ln_COP	1,4905***	0,2758	5,4040	0,0000
Ln_ER	-0,0457*	0,0236	-1,9368	0,0568
INF	0,0373	0,0255	1,4621	0,1481
C	-5,0379***	1,1930	-4,2230	0,0001
Short Run Equation				
COINTEQ	-0,4303**	0,1689	-2,5472	0,0130
D(Ln_COP)	0,8967**	0,4011	2,2356	0,0284

Analysis of the estimated results for the equilibrium trajectory length clarifies the paradox of dependence on external energy. The global oil price indicator (Ln_COP) shows a substantial and statistically significant positive elasticity with respect to increases in energy

subsidy funds in these countries. A coefficient of 1.4905 with a probability of 0.0000 indicates that each 1% increase in international oil prices is associated with an increase in subsidies relative to GDP of almost 1.5%.

In contrast to oil prices, the exchange rate variable (Ln_ER) empirically supports the theory with a negative coefficient. This result is statistically significant at the 10% level, with a coefficient of -0.0457 (probability 0.0568). This result suggests that currency depreciation requires the government to reduce energy subsidy budgets by 0.0457%. Inflation (INF) does not exhibit a statistically significant relationship with the subsidy budget, as indicated by a positive coefficient of 0.0373 and a probability of 0.1481. These results imply that fluctuations in inflation in traditional markets do not structurally affect the long-term supply of subsidized fuel.

Moving the focus from long-term telescopic observation to microscopic monitoring reveals anomalous behavior of variables that change drastically in market panic sentiment. The jump in crude oil prices, as reflected in D(Ln_COP), remains sharp and keeps influencing daily changes in energy subsidy expenditure. The shock coefficient of 0.8967, with a p-value of 0.0284, indicates the government's reflexive psychology when Arab oil prices surge, resulting in approximately 89% loss. Funds from the State Budget (APBN) reserves are immediately used for subsidies as a sedative to prevent large-scale protests.

An interesting fact that warrants extra attention concerns the forced-cleaning mechanism implemented by the regression software, in which both the determinants of the inflation rate instrument and the foreign exchange rate indicator are automatically sorted and then removed from the algorithmic loop of the short-term transmission model. The elimination of these items reveals an undeniable field fact: these two domestic macroeconomic forces apparently lack the high-velocity shock effects that are loaded with extraordinary political pressure to compel the finance minister to revise the draft of the State Budget (APBN) regulation plan overnight.

Among the wilderness of data tabulation, the most crown jewel discovery at the heart of econometrics anatomy is held without a doubt by the Error Correction Term (COINTEQ) parameter. Acting like a steel anchor for the entire system of economic rationality caught in waves, this steady-state stability adjustment term proudly records a coefficient of -0.4303. This parameter value simultaneously meets two absolute requirement clauses: first, its position is strictly negative (as a strong gravitational signal pulling back toward the initial safe baseline point), and second, its value is statistically significant with a p-value of 0.0130.

Discussion of Research Results

Based on the regression results, the discussion focuses on interpreting the empirical findings demonstrating the vulnerability of the ASEAN-5 region's fiscal structure to external shocks.

The Effect of Global Oil Prices

The highly elastic effect of global oil prices (1.49% in the long term) affirms the position of this region's countries as pure price takers. When there is an increase in the international market (demonstrated by a short-term shock elasticity of 0.89%), government authorities have no discretionary room other than to deplete the state budget reserve funds to keep retail petrol prices stable so as not to trigger social unrest. This finding replicates the consensus of studies by Eleyan et al. (2022) and Nusair & Olson (2021), which indicate that global oil shocks consistently trigger asymmetric disturbances that force a reactive expansion of the fiscal stance lacking structural mitigation.

The Influence of Exchange Rates

The anomalous nature is academically identified in the analysis of the exchange rate. Institutionally, weekly/monthly currency depreciation does not immediately alter the State Budget (as shown by its short-term insignificance) because operational losses from the BUMN Energy exchange-rate difference temporarily absorb it. However, in the long-term equilibrium, persistent currency depreciation (a 1% weakening) will actually significantly reduce the subsidy allocation percentage by 0.04%. This supports Bloom's (2021) thesis, which holds that exchange rate depreciation doubles the burden of principal and interest payments on foreign debt. To avoid sovereign default risks, the government is compelled to cut and rationalize populist budgets, including the removal of energy subsidies, to secure its remaining foreign exchange liquidity.

The Effect of Inflation Rate

Interestingly, the pace of domestic inflation is not a significant determinant of subsidy allocation. This lack of correlation is concrete evidence of the successful agenda of separating macroeconomic policy in the ASEAN-5 countries. Through the Inflation Targeting Framework (ITF) regime, independent central banks have proven capable of absorbing and anchoring price expectations using a mix of interest rate policies (Han et al., 2020), without requiring the finance ministry to issue excessive 'blank cheque' subsidies solely to curb inflation.

Fiscal Recovery Speed (Error Correction Term)

The ARDL model's strength in measuring fiscal resilience is supported by an absolute ECT value of 0.4303. This metric indicates the level of institutional adaptation. When fiscal disequilibrium results from external crises, the ASEAN-5 countries' state budgets exhibit a self-correction rate of 43.03% per year. Practically, an average duration of approximately 2.3 years after the shock is required to neutralize the crisis burden and bring the energy subsidy share back towards the bounds of fairness in the structural equilibrium.

5. CONCLUSION AND RECOMMENDATIONS

This study finds long-term structural cointegration between financial indicators and energy subsidy budget allocation in the ASEAN-5 countries. The recovery rate of the State Budget (APBN) from the shocks of the global crisis is recorded at 43.03% per year, showing a transition period of approximately 2.3 years to restore fiscal resilience. Global oil prices are the dominant determinant, imposing massive burdens on the national treasury, both during short-term panics and in periods of extended stability. Conversely, chronic exchange-rate depreciation pressures gradually force the government to cut energy subsidy margins to focus on foreign debt repayment. On the other hand, inflation has no significant impact, indicating the success of the central bank's efforts to curb domestic price pressures absent burdening fiscal instruments.

Based on the reality of these vulnerabilities, it is recommended that governments in the ASEAN-5 region systematically cease blanket subsidies (product price subsidies) and fully transition to direct cash assistance schemes targeting the bottom decile of the population. Funds saved from the national budget should be reallocated as incentives for investment in domestic clean energy infrastructure to break the chain of dependence on fossil fuel imports. For future macroeconomic research, it is advised to expand the panel model through integrating variables such as the tax revenue ratio (fiscal space capacity) and the effects of electoral political calendars, which often trigger biases in populist spending policies.

Expression of Thanks

The author expresses the highest appreciation to the Faculty of Economics and Business, Bina Bangsa University, for facilitating the research and supplying comprehensive academic guidance. This article is an intellectual derivation of the author's undergraduate thesis study.

REFERENCES

Baltagi, B. H. (2021). Econometric Analysis of Panel Data (6th ed.). Switzerland: Springer Nature. doi: https://doi.org/10.1007/978-3-030-53953-5

Black, S., Celniak, W., Huitron, A. G., & Antipa, P. C. (2025). Underpriced and Overused: Fossil Fuel Subsidies Data 2025 Update. International Monetary Fund. doi: https://doi.org/10.5089/9798229034715.001

Bloom, N. (2021). Comment on ‘‘Trade shocks and the shifting landscape of U.S. manufacturing”. Journal of International Money and Finance, 114. doi: https://doi.org/10.1016/j.jimonfin.2021.102371

Eleyan, M. I., Çatık, A. N., & Ballı, E. (2022). Do the time-varying effects of oil prices affect the trade balances of ASEAN-5 countries? Energy Sources, 17(1). doi: https://doi.org/10.1080/15567249.2022.2053898

Ha, J., Kose, M. A., & Ohnsorge, F. (2023). One-stop source: A global database of inflation. Journal of International Money and Finance, 137. doi: https://doi.org/10.1016/j.jimonfin.2023.102896

Han, M. S., Biying, Y., Cudjoe, D., & Yuan, Q. (2020). Investigating willingness-to-pay to support solar energy research and development in Myanmar. Energy Policy, 146. doi: doi.org/10.1016/j.enpol.2020.111820

Hidthiir, M. H., Ahmad, Z., Lun, L. K., Mansur, M., Abubakr, A. A., & Sahal, M. S. (2024). Determinants of Government Debt in ASEAN-5 Nations: An ARDL Analysis of Economic Factors. Qubahan Academic Journal, 4, 252–265. doi: https://doi.org/10.48161/qaj.v4n4a1119

International Monetary Fund. (2026, 22 April). Climate Change | Fossil Fuel Subsidies. Retrieved from International Monetary Fund: https://www.imf.org/en/topics/climate-change/energy-subsidies

Jain, V. (2025). Provision of Energy Subsidies in Asia: Recent Trends, Patterns and the Determinants. Millennial Asia. doi: https://doi.org/10.1177/09763996251338097

Jain, V. (2025). Provision of Energy Subsidies in Asia: Recent Trends, Patterns and the Determinants. Economic and Political Weekly, 60(26), 13–20. doi: https://doi.org/10.1177/09763996251338097

Kao, C. (1999). Spurious Regression and Residual-Based Tests for Cointegration in Panel Data. Journal of Econometrics, 90(1), 1-44. doi: https://doi.org/10.1016/S0304-4076(98)00023-2

Kushneel, P., & Ephraim, M. M. (2021). Energy poverty and obesity. Energy Economics, 101, 105428. doi: https://doi.org/10.1016/j.eneco.2021.105428

Lowder, T., Lee, N., & Leisch, J. E. (2020). COVID-19 AND THE POWER SECTOR IN SOUTHEAST ASIA: IMPACTS AND OPPORTUNITIES. USAID-NREL. Retrieved from https://docs.nrel.gov/docs/fy20osti/76963.pdf

Maghfiroh, U., Jayadi, A., & Dumauli, M. T. (2024). The Effect of Money Supply on Exchange Rate in ASEAN-5: Empirical Test of Dornbusch Overshooting Model. Jurnal Ilmu Ekonomi Terapan, 9. doi: https://doi.org/10.20473/jiet.v9i1.51854

Mahi, M., Phoong, S. W., Ismail, I., & Isa, C. R. (2019). Energy–Finance–Growth Nexus in ASEAN-5 Countries: An ARDL Bounds Test Approach. Sustainability Journal, 12(1), 1–16. doi: doi:10.3390/su12010005

Ng, D. T., Wu, W., Leung, J. K., Chiu, T. K., & Chu, S. K. (2024). Design and validation of the AI literacy questionnaire: The affective, behavioral, cognitive, and ethical approach. Br J Educ Technol, 55, 1082–1104. doi:10.1111/bjet.13411

Nusair, S. A., & Olson, D. (2021). Asymmetric oil price and Asian economies: A nonlinear ARDL approach. Energy, 219. doi: https://doi.org/10.1016/j.energy.2020.119594

Pham, T. A., Nguyen, T. T., Nasir, M. A., & Huynh, T. L. (2020). Exchange rate pass-through: A comparative analysis of inflation-targeting & non-targeting ASEAN-5 countries. The Quarterly Review of Economics and Finance, 87, 158–167. doi: https://doi.org/10.1016/j.qref.2020.07.010

Rogers, C., Murakami, V. A., Nastali, I., & Oak, E. (2026, 2 April). Regional Supply Chain Exposures to Middle East Conflict. Retrieved from Explore S&P Global: https://www.spglobal.com/market-intelligence/en/news-insights/research/2026/04/regional-supply-chain-exposures-middle-east-conflict

Sumarno, T. B., & Sanchez, L. (2021). How Indonesia Can Achieve Both a COVID-19 Recovery and Its Climate Targets. International Institute for Sustainable Development (IISD). Retrieved from https://www.iisd.org/system/files/2021-10/indonesia-achieve-covid-19-recovery-climate-targets.pdf

Suryadi, B., Wahyono, A. D., Rawi, S., Pranadi, A. D., & Swandaru, A. (2020). Economic Assistance to Electricity Customers in the ASEAN Member States during the COVID-19 Pandemic. ASEAN Center for Energy, 14. doi: http://dx.doi.org/10.13140/RG.2.2.28151.44966

Taha, I. M. (2025). A Comprehensive Guide to The ARDL Bounds Testing Approach for Cointegration Analysis. Cairo, Egypt: Cairo University.

Tan, Y., & Uprasen, U. (2023). Asymmetric effects of oil price shocks on income inequality in ASEAN countries. Energy Economics, 126, 107033. doi: https://doi.org/10.1016/j.eneco.2023.107033

World Bank Group. (2026, 20 May). Inflation, consumer prices (annual %). Retrieved from World Bank Group: https://data.worldbank.org/indicator/FP.CPI.TOTL.ZG

World Bank Group. (2026, 24 May). Official exchange rate (LCU per US$, period average). Retrieved from World Bank Group: https://data.worldbank.org/indicator/PA.NUS.FCRF

World Bank Group. (2026, 24 May). World Bank Commodities Price Data (The Pink Sheet). Retrieved from World Bank Group: https://thedocs.worldbank.org/en/doc/18675f1d1639c7a34d463f59263ba0a2-0050012025/world-bank-commodities-price-data-the-pink-sheet

Yan, S. C., Robert, M., & Khoon, G. S. (2019). An augmented autoregressive distributed lag bounds test for cointegration. Economic Modeling, 80, 130–141. doi: https://doi.org/10.1016/j.econmod.2018.11.001

Yuniar, I. A. (2021). Penerapan Regresi Data Panel Dinamis untuk Pemodelan Ekspor dan Impor di Asean. Seminar Nasional Official Statistics, 2021(1), 111-119. doi: https://doi.org/10.34123/semnasoffstat.v2021i1.784