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Comparison of Exchange Rate Determinants in ASEAN-5 Countries

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Abstract

The exchange rate is a macroeconomic variable highly susceptible to external shocks, yet its determinants in ASEAN-5 have not been comprehensively analyzed during a multi-shock period encompassing the COVID-19 pandemic, Federal Reserve monetary tightening, and the Russia-Ukraine conflict simultaneously. This study aims to analyze the determinants of the bilateral nominal exchange rate against the US dollar in Indonesia, Malaysia, Thailand, Vietnam, and the Philippines over the period January 2020 to February 2026, using Panel ARDL with the Pooled Mean Group (PMG) estimator combined with individual country-level ARDL estimation. The results show significant heterogeneity in responses across countries. Gold prices emerge as the most dominant long-run determinant, yet with an asymmetric impact weakening the exchange rates of Indonesia and Thailand through capital flight to safe-haven assets, while strengthening the Malaysian ringgit and the Philippine peso. Oil prices weaken the exchange rates of Thailand and Vietnam as net oil importers, but are not significant in Malaysia, a net oil exporter. Inflation confirms the Purchasing Power Parity mechanism in Indonesia, whereas in the Philippines it instead strengthens the peso due to an aggressive interest rate response. Exports to China paradoxically weaken the exchange rates of Thailand and Vietnam due to the high import content within global value chains. All Error Correction Term coefficients are significantly negative, with adjustment speeds varying across countries, reflecting differences in monetary policy capacity and flexibility in the region. These findings confirm that ASEAN exchange rate stabilization requires an approach tailored to each country's economic structure and monetary policy regime.

INTRODUCTION

The bilateral exchange rate against the US dollar has long served as a barometer of external pressure for open developing economies. Since the collapse of the Bretton Woods system in 1971 and the subsequent dominance of floating exchange rate regimes, currency movements have no longer been determined by institutional convention but rather by the interaction among macroeconomic fundamentals, market expectations, and balance-of-payments structures that often move rapidly and unpredictably (Frenkel, 1986). The consequences are not always gradual the 1997–1998 Asian currency crisis demonstrated that accumulated depreciation pressure can collapse the foundations of seemingly robust economies: Thailand recorded an output contraction of 13%, Indonesia 13.5%, and Malaysia 7%, within less than two years (Radelet & Sachs, 1998). This experience confirmed that exchange rate instability is not merely a monetary issue but a systemic risk with direct implications for employment, poverty, and a country's fiscal capacity. This urgency is further amplified by the ever-expanding scale of the global foreign exchange market; the Bank for International Settlements (2022) recorded daily transaction volumes reaching USD 7.5 trillion in 2022, nearly double the figure of the previous decade, reflecting how deeply integrated cross-border financial markets have become and how rapidly shocks from one global financial center can propagate to the periphery.

For ASEAN-5 countries Indonesia, Malaysia, Thailand, Vietnam, and the Philippines which rely on exports and foreign capital inflows for growth, this speed of transmission is not an abstract statistic but a reality that can alter foreign exchange reserve positions, external debt costs, and domestic purchasing power at any moment. Each country bears this burden differently. The Indonesian rupiah has historically been one of the most volatile currencies in the region, reflecting structural vulnerability to foreign capital reversals stemming from a persistent current account deficit and dependence on commodity exports (Octavia & Soelistyo, 2025). The Malaysian ringgit shows a different pattern: as a net oil exporter, a surge in oil prices actually provides a stabilizing effect on the trade balance, although the ringgit remains vulnerable to shifts in investor sentiment toward emerging market assets (Handoyo et al., 2023). The Thai baht and the Vietnamese dong, whose economies are deeply integrated into export-oriented global manufacturing value chains directed toward China, face depreciation pressure from two directions simultaneously: weakening external demand and rising energy import costs. The Philippine peso, on the other hand, has its own buffer in the form of substantial migrant worker remittances, yet remains vulnerable to tightening global financial conditions that suppress these transfer flows. The fact that these five countries exhibit markedly different depreciation patterns when facing identical global shocks, as shown in Figure 1, is precisely the phenomenon that proves most challenging to explain.

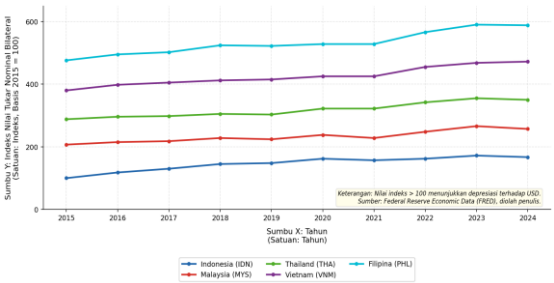

Figure 1. Development of ASEAN-5 Bilateral Nominal Exchange Rates against the US Dollar, 2015–2024 *Source: FRED (processed data)*

The period from January 2020 to February 2026 brought pressures rarely seen in the region's history: three large-scale external shocks arrived within a very narrow window, with mutually reinforcing transmission mechanisms. The COVID-19 pandemic, which erupted in March 2020, triggered a simultaneous reversal of capital flows from emerging markets toward safe-haven assets, rapidly weakening regional exchange rates (Bayangos & Jansen, 2010). As economic activity began to recover, the Federal Reserve's monetary tightening of 525 basis points throughout 2022–2023 dramatically altered interest

rate differentials and once again drew capital out of ASEAN toward dollar-denominated instruments (Faudot, 2023). Russia's invasion of Ukraine in February 2022 then compounded the pressure from a different angle: oil prices surged to nearly USD 139 per barrel and gold prices exceeded USD 2,000 per troy ounce in March 2022, worsening the current account deficits of net energy-importing countries in the region while simultaneously diverting capital flows toward safe-haven commodities (World Bank, 2022). What distinguishes this period from previous crisis episodes is not merely the magnitude of each shock, but their simultaneity and interaction a feature that renders generalizations drawn from single-crisis studies inadequate.

Theoretically, the determinants of exchange rates under such layered pressures can be approached through three complementary frameworks. Purchasing Power Parity (PPP) theory asserts that inflation divergence between countries will ultimately be reflected in long-run nominal exchange rate adjustments (Jamal et al., 2025). The Mundell-Fleming model explains how balance-of-payments shocks particularly surges in energy prices that widen the current account deficit generate depreciation pressure through external adjustment mechanisms (Salguero, 2026). Portfolio Balance theory, meanwhile, emphasizes the role of shifts in global investors' portfolio composition: as uncertainty rises, capital movement toward safe-haven assets pressures developing-country currencies regardless of their underlying fundamentals (Bouoiyour et al., 2018; Camanho et al., 2018). These three approaches are consistent in identifying the direction of depreciation pressure, yet they offer no satisfactory explanation for the phenomenon that stands out most prominently in the ASEAN-5 data: why countries with comparable levels of openness and regional integration respond to the same shocks with vastly different degrees of depreciation.

This explanatory gap is not unrelated to the limitations of existing empirical studies. Prior research such as Octavia and Soelistyo (2025) and Handoyo et al. (2023) employed aggregate panel estimation that assumes homogeneity in adjustment dynamics across countries, leaving the structural heterogeneity inherent to ASEAN-5 undecomposed at the individual level. On the variable side, no study has yet incorporated bilateral exports to three partners with distinct geopolitical orientations China as the dominant manufacturing hub, the United States as the primary consumption market, and Iran as a partner whose trade relations are frequently shaped by international sanctions dynamics within a single ASEAN exchange rate model specification. Yet trade partner composition determines the extent to which external demand shocks are transmitted to each country's foreign exchange market through foreign exchange flows and concentration risk. Moreover, no study has specifically analyzed the three shocks of 2020-2026 within a single integrated estimation framework, leaving the inter-shock interactions that distinguish this period unexamined. Based on these three gaps, this study formulates the following main research questions: (1) How do world oil prices, gold prices, domestic inflation, and bilateral exports to major partners affect the ASEAN-5 bilateral nominal exchange rate against the US dollar in the short and long run? (2) How large is the heterogeneity in exchange rate responses among ASEAN-5 countries to the same external shocks? (3) How quickly does each country's exchange rate return to long-run equilibrium following a shock.

This study aims to analyze the determinants of the ASEAN-5 bilateral nominal exchange rate against the US dollar over the period January 2020 to February 2026 using the Panel ARDL-Pooled Mean Group (PMG) approach combined with individual country-level ARDL estimation. Specifically, this study identifies the short-run and long-run effects of world oil prices, gold prices, domestic inflation, and bilateral exports to China, Iran, and the United States on each country's exchange rate; measures the degree of heterogeneity in responses across countries; and analyzes the speed of adjustment toward post-shock equilibrium. Through a combination of estimation frameworks and a more

comprehensive variable scope than previous studies, this research is expected to provide a relevant empirical contribution to the literature on developing-country exchange rate determinants, while also serving as a basis for formulating more adaptive monetary policy responses in the ASEAN region.

The choice of the PMG estimator developed by Pesaran et al. (1999) is based on two methodological considerations. Unlike the Mean Group estimator, which estimates models separately for each country, PMG assumes homogeneity of long-run coefficients across countries while allowing for heterogeneity in short-run adjustment dynamics, thereby producing more efficient estimates when the long-run homogeneity assumption holds a condition confirmed by the Hausman test in this study. In addition, Panel ARDL has the advantage of handling a mixture of I(0) and I(1) variables without requiring strict stationarity pre-testing, while simultaneously identifying cointegration relationships and error correction dynamics. The relevance of this approach is further strengthened by the findings of Idialis and Putra (2021), which show that the socioeconomic characteristics of ASEAN countries are heterogeneous, making an estimator that accommodates short-run heterogeneity the most appropriate choice given the region's structural realities.

With this analytical framework, this study is expected to produce a more complete map of ASEAN-5 exchange rate determinants: not only identifying which variables are significant in aggregate, but also mapping how the strength and direction of their influence vary across countries according to each country's economic structure and monetary policy regime. These findings are ultimately expected to serve as a more solid empirical basis for regional monetary authorities in designing well-targeted policy responses to future external shocks.

LITERATURE REVIEW

Purchasing Power Parity (PPP) Theory

Purchasing Power Parity (PPP) theory serves as an important model for understanding the factors that influence exchange rates over the long run (Ong, 2024). The relative PPP proposition holds that shifts in the nominal exchange rate between two countries should reflect differences in their inflation rates: the currency of a country experiencing higher inflation is expected to lose value to a corresponding degree, ensuring that relative price competitiveness is maintained (Monadjemi & Lodewijks, 2021). This relationship can be represented mathematically as $\Delta S/S = \pi - \pi^*$, where π denotes domestic inflation and π^* denotes the inflation rate of the partner country. Within the ASEAN context, the applicability of PPP is influenced by each country's exchange rate policy and the degree of intervention by monetary authorities (Siddharth et al., 2024). In a detailed panel analysis covering 63 countries, Siddharth et al. (2024) state that the PPP relationship holds in the long run, although short-run variations occur due to market dynamics and national policies. This study highlights inflation as a key factor explaining the PPP transmission mechanism related to long-run exchange rate fluctuations among the five ASEAN countries.

Mundell-Fleming Model

The Mundell-Fleming model extends the IS-LM framework to a small open economy setting that allows free cross-border capital movement (Siddharth et al., 2024). This model provides a fundamental analytical basis for examining how external disturbances affect exchange rates (Lahiri et al., 2006). Within this framework, the exchange rate results from the simultaneous equilibrium of the goods market (IS), the money market (LM), and the balance-of-payments condition (BP) (Salguero, 2026). Under a floating exchange rate system, shifts in the trade balance such as an oil price surge that worsens the current account deficit for energy-importing countries can place direct downward pressure on the domestic currency (Salguero, 2026). This model is highly relevant to this study because it helps explain how fluctuations in global oil and commodity prices affect the balance of payments and exchange rates of specific ASEAN countries (Taufani et al., 2022). Commodity-exporting countries such as Malaysia exhibit different exchange rate

reactions compared to energy-importing countries such as Thailand and the Philippines when facing similar commodity price changes (Handoyo et al., 2023). This variation illustrates the structural differences that support the use of the Pooled Mean Group (PMG) estimator in this analysis.

Portfolio Balance Theory

Portfolio Balance theory explains the role of safe-haven assets in exchange rate dynamics through investor portfolio adjustment mechanisms (Camanho et al., 2018). As economic and geopolitical uncertainty rises, investors tend to shift their investments from high-risk assets in emerging markets toward assets considered safer, including gold and US government bonds (Baur & Lucey, 2006). This process triggers capital outflows from ASEAN, which in turn places pressure on the devaluation of regional currencies (Nguyen et al., 2022). Nozari and Novick (2017) emphasize the asymmetric response of gold prices to global uncertainty, in which negative shocks to market confidence have a far greater impact than comparable positive shocks. In this study, gold prices are used as a proxy for the level of global uncertainty and as an indicator of the intensity of the flight-to-safety phenomenon, which directly affects capital flows and exchange rate pressure in the ASEAN region (Wang et al., 2021).

World Oil Prices and Exchange Rates

The relationship between world oil prices and exchange rates in the ASEAN region has been the focus of numerous empirical studies, with mixed findings depending on each country's position as a net oil exporter or importer (Kisswani & Fikru, 2023). Butt et al. (2020) found a significant asymmetric relationship between palm oil prices and the exchange rates of the Indonesian rupiah and the Malaysian ringgit, in which the impact of price declines is greater than that of equivalent price increases. Handoyo et al. (2023) confirm that exchange rate volatility in ASEAN-5 is highly sensitive to global commodity price fluctuations through the trade balance channel, with effects varying depending on each country's export structure. During the period covered by this study, the decline in oil prices at the onset of the COVID-19 pandemic (2020) and the surge to around USD 139 per barrel in March 2022 following Russia's invasion of Ukraine exerted differing pressures on exchange rates across the five ASEAN countries, making this variable highly relevant as a key determinant in the estimated model.

World Gold Prices and Global Uncertainty

Gold has historically functioned as an indicator of global economic uncertainty, influencing exchange rate dynamics in developing countries through capital flow mechanisms (Bouoiyour et al., 2018). The rise in gold prices above USD 2,000 per troy ounce in March 2022, coinciding with the escalation of the Russia-Ukraine conflict, correlated with significant depreciation of regional currencies, reflecting the strength of the flight-to-safety mechanism in global investors' response to geopolitical shocks (Kiley, 2018). Ogawa and Luo (2025) find that global risk factors one proxy of which is the gold price have a significant impact on exchange rate fluctuations in the ASEAN+4 region, with intensity varying depending on the level of capital market openness in each country. Le et al. (2024) also confirm that global liquidity spillovers in the Asia-Pacific region are influenced by risk factors partly reflected in gold price movements, through both policy channels and market mechanisms.

Global Commodity Prices and Domestic Inflation

Global commodity prices represent external terms-of-trade conditions that directly affect the foreign exchange earnings and trade balances of ASEAN countries that still rely on primary commodity exports (Gruss & Kebhaj, 2019). The findings of Kalsum et al. (2025) empirically confirm that global commodity price volatility has a substantial impact on Indonesia's trade balance, with spillover effects that also influence exchange rate pressure. Meanwhile, domestic inflation predicted by PPP theory as a long-run exchange rate determinant has had its relevance confirmed by Octavia and Soelistyo (2025), who found that inflation significantly affects exchange rates in ASEAN-5 over the 2013–2023 period. The substantial differences in inflation rates

among ASEAN countries during 2020-2025, driven by differing post-pandemic fiscal stimulus policies and uneven energy price pass-through, further reinforce the relevance of inflation as an explanatory variable in this study (Pham et al., 2023).

METHODOLOGY

1. Type and Source of Data

   This study uses monthly panel data covering five ASEAN countries Indonesia, Malaysia, Thailand, the Philippines, and Vietnam over the period January 2020 to February 2026, sourced from several international institutions and global economic databases. The dependent variable is the bilateral nominal exchange rate against the US dollar (EXR), measured as the natural logarithm of the local currency unit per US dollar (LCU/USD) and obtained from the IMF. On the independent variable side, bilateral export values to three geopolitically distinct partner countries are included: exports to China (EXC), exports to Iran (EXI), and exports to the United States (EXA), each expressed as the natural logarithm of export value in millions of US dollars and sourced from UN Comtrade. World Brent crude oil prices (OIL) are expressed as the natural logarithm of price in USD per barrel and obtained from the U.S. Energy Information Administration (EIA). World spot gold prices (GOLD) are expressed as the natural logarithm of price in USD per troy ounce, while domestic inflation (INF) is measured as the monthly CPI growth rate in percent; both variables are sourced from the Federal Reserve Economic Data (FRED). All price and export variables are log-transformed so that estimated coefficients can be interpreted as elasticities, with the exception of inflation, which is retained in its original percentage form as it already constitutes a relative measure of price change.

2. Empirical Model Specification

   The empirical model estimated in this study draws on the theoretical frameworks of Purchasing Power Parity (PPP), Mundell-Fleming, and Portfolio Balance. The baseline model specification is:

$$\ln EXR_{it} = \beta_{0i} + \beta_{1i} \ln EXC_{it} + \beta_{2i} \ln EXI_{it} + \beta_{3i} \ln EXA_{it} + \beta_{4i} \ln OIL_{it} + \beta_{5i} \ln GOLD_{it} + \beta_{6i} INF_{it} + \varepsilon_{it}$$

where each component is defined as follows. $\ln EXR_{it}$ is the natural logarithm of the bilateral nominal exchange rate of country i's currency against the US dollar at period t, where an increase in value reflects depreciation of the domestic currency (dependent variable). $\ln EXC_{it}$ is the natural logarithm of country i's bilateral export value to China at period t, in millions of US dollars. $\ln EXI_{it}$ is the natural logarithm of country i's bilateral export value to Iran at period t, in millions of US dollars. $\ln EXA_{it}$ is the natural logarithm of country i's bilateral export value to the United States at period t, in millions of US dollars. $\ln OIL_{it}$ is the natural logarithm of the Brent crude oil price at period t, in US dollars per barrel. $\ln GOLD_{it}$ is the natural logarithm of the world spot gold price at period t, in US dollars per troy ounce. INF_{it} is country i's monthly Consumer Price Index (CPI) growth rate at period t, which is not log-transformed since it is already a relative measure of price change, expressed in percent. The index i denotes the sample country (1 = Indonesia, 2 = Malaysia, 3 = Thailand, 4 = Vietnam, 5 = Philippines), while t denotes the monthly time period from January 2020 to February 2026. β_{0i} is the country-specific intercept capturing individual fixed effects. β_{1i} through β_{6i} are long-run coefficients estimated homogeneously across countries under PMG restrictions. ε_{it} is the model residual, assumed to be normally distributed with a mean of zero.

This study uses monthly data frequency, resulting in a total of 74 time periods per country, or 370 observations overall. All price and export variables are transformed into natural logarithms so that the coefficients can be interpreted as elasticities, except for the inflation variable (INF), which remains in

percentage terms since it is already a relative measure.

3. Panel ARDL-PMG and Country-Level ARDL Estimation Procedure

Estimation was carried out through five sequential stages. First, a cross-sectional dependence (CSD) test was conducted prior to the stationarity test using the xtcd2 procedure developed by Juodis and Reese (2021). This test is a prerequisite because the presence of CSD determines the appropriate choice of stationarity test; if CSD is detected, first-generation tests that assume independence across panels, such as Levin-Lin-Chu (LLC), become invalid. Second, a panel stationarity test was conducted using the Fisher-type test based on the Augmented Dickey-Fuller (ADF) approach developed by Maddala and Wu (1999), which does not require independence across panels and allows the autoregressive coefficient to be panel-specific, making it more robust under CSD conditions. The test was performed at the level and first-difference forms to identify the order of integration of each variable, whether I(0) or I(1). Third, the Pedroni (1999) panel cointegration test was used to confirm the existence of a long-run equilibrium relationship among the variables.

Fourth, the main estimation uses the Pooled Mean Group (PMG) estimator of Pesaran, Shin, and Smith (1999) within the Panel ARDL framework. The PMG estimator assumes homogeneity of long-run coefficients across countries but allows for heterogeneity in short-run coefficients, constants, and error variances, thereby producing more efficient estimates than MG when the long-run homogeneity assumption holds. The Error Correction Model (ECM) representation for each country is shown below, where $\Delta \ln EXR_{it}$ is the first difference of the logarithm of country i's exchange rate at period t; φ_i is the Error Correction Term (ECT) coefficient measuring the speed of adjustment toward long-run equilibrium, expected to be negative and statistically significant; $ECT_{i,t-1}$ is the one-period lagged residual from the long-run cointegration relationship, representing the deviation from equilibrium in the previous period; λ_{ij} is the short-run coefficient for the j-th lag of the dependent variable (change in exchange rate), heterogeneous across countries; δ_{ij} is the vector of short-run coefficients for the j-th lag of the independent variables $\Delta X_{i,t-j}$, which includes changes in $\ln EXC_{it}$, $\ln EXI_{it}$, $\ln EXA_{it}$, $\ln OIL_{it}$, $\ln GOLD_{it}$, and INF_{it}, also heterogeneous across countries; μ_i is the country-specific fixed effect; and ε_{it} is the model residual.

$$\Delta \ln EXR_{it} = \varphi_i ECT_{i,t-1} + \Sigma_j \lambda_{ij} \Delta \ln EXR_{i,t-j} + \Sigma_j \delta_{ij}' \Delta X_{i,t-j} + \mu_i + \varepsilon_{it}$$

The PMG long-run coefficients are obtained through pooled estimation across countries using maximum likelihood, while the short-run coefficients are estimated separately for each country. The optimal lag length was selected based on the Akaike Information Criterion (AIC) with a maximum lag of 2. In addition to the panel PMG estimation, this study also conducts individual ARDL estimation for each country (Indonesia, Malaysia, Thailand, Vietnam, and the Philippines) to allow a more detailed comparison of exchange rate determinants across countries. Country-level ARDL estimation produces long-run and short-run coefficients specific to each country, thereby identifying structural heterogeneity not captured by the panel estimation. The coefficient φ_i measures the speed at which the exchange rate adjusts toward long-run equilibrium following a shock, expected to be negative and statistically significant; a value closer to −1 indicates faster adjustment. $\bar{\theta}$_PMG denotes the pooled long-run coefficient estimate across countries (homogeneous), while $\bar{\theta}$_ARDL denotes the country-specific long-run coefficient (heterogeneous).

Fifth, a robustness check was conducted by comparing the PMG results against the Mean Group (MG) estimator of Pesaran and Smith (1995)

as well as the country-level ARDL results. The Hausman test was used to choose between PMG and MG: if the null hypothesis of long-run coefficient homogeneity cannot be rejected, PMG is more efficient and is the preferred estimator; conversely, if H0 is rejected, MG is more consistent. Under conditions of a limited panel dimension (small N), a negative chi² value (degenerate Hausman) commonly occurs, and its interpretation is conducted substantively based on the magnitude of the difference.

RESULT AND DISCUSSION

Result

1. Descriptive Statistics

Table 4.1 presents descriptive statistics for all research variables across the five ASEAN commodity-exporting countries over the period January 2020–February 2026 (N=370).

Table 4.1 Descriptive Statistics

Variable	Mean	Std. Dev	Min	Max	N
Exchange Rate	5.520	3.597	1.364	10.616	370
Exports to China	7.901	0.745	5.386	9.003	370
Exports to Iran	2.387	0.992	-1.975	5.205	370
Exports to the US	7.919	0.895	3.747	9.662	370
Oil Price	4.239	0.304	3.046	4.761	370
Inflation	2.653	1.929	-3.440	8.700	370
Gold Price	7.680	0.281	7.353	8.521	370

Source: Stata output

2. Normality Test

A normality test was conducted to determine whether the model residuals are normally distributed. In this study, the normality test uses the Shapiro-Wilk test with the null hypothesis that the residuals are normally distributed. If the Jarque-Bera probability (p-value) is greater than the 5% significance level (α = 0.05), the null hypothesis cannot be rejected and the residuals are considered normally distributed.

Table 4.2 Shapiro-Wilk Normality Test Results

Variable	Obs	W	V	z	Prob>z	Remark
Exchange Rate	370	0.76064	61.457	9.764	0.000	Not Normal
Exports to China	370	0.87867	31.152	8.153	0.000	Not Normal
Exports to Iran	370	0.95543	11.444	5.779	0.000	Not Normal
Exports to the US	370	0.94231	14.813	6.391	0.000	Not Normal
Oil Price	370	0.88162	30.395	8.095	0.000	Not Normal
Inflation	370	0.98248	4.499	3.566	0.000	Not Normal
Gold Price	370	0.81619	47.194	9.138	0.000	Not Normal

Source: Stata output

The Shapiro-Wilk normality test in Table 4.2 shows that all variables reject the null hypothesis of normal distribution at the 5% significance level (Prob>z < 0.05), indicating that all variables are not normally distributed. This does not pose a problem, as the PMG estimator relies on asymptotic

theory, which is valid for large N and does not require data normality (Pesaran et al., 1999).

3. Unit Root Test
   Before estimation, a unit root test was conducted using the Fisher Augmented Dickey-Fuller (Fisher-ADF) method to determine the order of integration of each variable and to avoid spurious regression (Granger & Newbold, 1974). The test was performed at the level and first-difference forms with an intercept and 2 lags.

Table 4.3 Fisher-ADF Unit Root Test Result

Variable	Level (p-value)	First Difference (p-value)	Integration
Exchange Rate	0.879	0.000	I(1)
Exports to China	0.336	0.002	I(1)
Exports to Iran	0.00	—	I(0)
Exports to the US	0.062	0.003	I(1)
Oil Price	0.011	—	I(0)
Inflation	0.079	0.000	I(1)
Gold Price	1.000	0.000	I(1)

Source: Stata outpu

The Fisher-ADF test in Table 4.3 shows that exports to Iran and oil prices are stationary at level I(0), while the exchange rate, exports to China, exports to the US, inflation, and gold prices are stationary at first difference I(1). No variable is integrated of order two, I(2). This combination of I(0) and I(1) is consistent with the requirements of the Panel ARDL-PMG method, which can be applied without requiring a uniform order of integration across variables (Pesaran et al., 1999).

4. Pedroni Cointegration Test

Table 4.4 Pedroni Cointegration Test Results

Statistic	Value	p-value
Modified Phillips-Perron t	-1.626	0.052
Phillips-Perron t	-9.908	0.000
Augmented Dickey-Fuller t	-1.946	0.026

Source: Stata output

Table 4.4 shows that two of the three Pedroni statistics are significant at the 5% level (Phillips-Perron t: p=0.000; ADF t: p=0.026), leading to rejection of the null hypothesis of no cointegration. A long-run equilibrium relationship exists among the variables in the panel, confirming the appropriateness of using an Error Correction Model within the Panel ARDL-PMG framework (Pedroni, 1999).

5. Estimator Selection: Hausman Test

Table 4.5 Hausman Test Results

Description	Value
chi2(6)	-15.78
Prob > chi2	—
Conclusion	PMG Selected

Source: Stata output

The negative chi2 value of −15.78 indicates that the variance-covariance matrix is not positive definite, which commonly occurs in panels with small groups. This condition does not preclude the use of the more efficient estimator (Schreiber, 2008); therefore, Pooled Mean Group (PMG) is selected as the primary estimator.

6. Country-Level ARDL Estimation
   Table 4.6 presents a summary of the individual ARDL estimation results

for each country using optimal lag selection based on AIC.

Table 4.6 Country-Level ARDL Estimation Results (Long-Run and Short-Run)

Variable	Indonesia	Malaysia	Thailand	Vietnam	Philippines
LR					
Exports to China	-0.023	-0.192	-0.461* (0.070)	-0.259** (0.048)	0.017
Exports to Iran	0.041	-0.012	-0.019	-0.189** (0.034)	0.001
Exports to the US	-0.161	0.094	0.114	-0.053	0.008
Oil Price	0.076	0.117	0.226** (0.032)	0.247*** (0.005)	0.003
Inflation	-0.076** (0.19)	0.010	-0.005	-0.003	0.018*** (0.00)
Gold Price	-0.556** (0.017)	0.244*** (0.022)	-0.340* (0.080)	0.041	0.142*** (0.00)
SR					
D.Exports to China	-	-	0.034** (0.035)	0.032** (0.049)	-
D.Oil Price	-0.139*** (0.00)	-0.119*** (0.00)	-	-0.043** (0.023)	-
D.Gold Price	-	-	-0.133** (0.041)	-0.267*** (0.00)	-
ADJ (ECT)	-0.118** (0.01)	-0.167** (0.14)	-0.112** (0.022)	-0.155*** (0.003)	-0.998*** (0.000)
ARDL Model	(1,0,0,0,1,2,0)	(1,0,0,0,1,0,2)	(1,2,0,0,1,1,1)	(2,1,0,2,1,0,2)	(1,0,0,0,0,2,0)
R-squared	0.5423	0.5420	0.3659	0.5471	0.9997

Source: Stata output

The country-level ARDL estimation results show that the effects of macroeconomic variables on the exchange rate are heterogeneous. In the long run, oil prices have a significant positive effect in Thailand and Vietnam, while gold prices are significantly negative in Indonesia and Thailand, but positive in Malaysia and the Philippines. Inflation is significantly negative in Indonesia and positive in the Philippines. Exports to China are significantly negative in Thailand and Vietnam. In the short run, oil prices have a significant negative effect in Indonesia, Malaysia, and Vietnam; gold prices are negative in Thailand and Vietnam; and exports to China are positive in Thailand and Vietnam. The ECT coefficients for all countries are significantly negative, confirming the existence of long-run equilibrium correction, with the highest adjustment speed observed in the Philippines.

Discussion

1. Indonesia

   In the long run, domestic inflation is shown to have a negative and significant effect on the rupiah exchange rate, confirming the operation of the Purchasing Power Parity mechanism in Indonesia. Kuncoro (2025) confirms that central bank intervention in Indonesia is

effective in correcting exchange rate misalignment based on PPP, particularly through sell interventions aimed at reducing rupiah overvaluation. When inflationary pressure rose as occurred during the post-pandemic recovery phase, when massive fiscal stimulus drove up domestic prices the rupiah's purchasing power eroded, and the foreign exchange market responded with consistent depreciation pressure. Bank Indonesia did raise interest rates in response, yet fundamental signals regarding currency purchasing power dominate long-run investor behavior more than short-run yield incentives (Prasetyo et al., 2022). An empirical study by Anggrayni (2025) using a VECM approach shows that only consumer price inflation has a significant short-run effect on the rupiah exchange rate, while all independent variables show significant long-run effects. This finding confirms the limitations of Purchasing Power Parity theory in explaining short-run exchange rate dynamics in Indonesia, where structural and non-economic factors also play an important role alongside conventional economic variables.

Gold prices have a negative and significant long-run effect on the rupiah, confirming gold's function as a safe-haven asset that draws capital out of Indonesia during periods of heightened global uncertainty. This finding is supported by dynamic correlation analysis during the pandemic, which shows a weak negative relationship between the exchange rate and gold prices in Indonesia, indicating that gold functions as an alternative hedging asset. This mechanism operates most strongly during two episodes: first, at the peak of COVID-19 pandemic uncertainty in 2020, when global investors simultaneously withdrew exposure from all emerging markets; and second, when Russia's invasion of Ukraine in February 2022 pushed gold prices above two thousand dollars per troy ounce and triggered a wave of global flight-to-quality that pressured the rupiah simultaneously with rising energy import costs (Palumbo, 2025; Syahri & Robiyanto, 2020).

In the short run, oil prices instead strengthen the rupiah a dynamic that appears paradoxical but can be explained through several buffering mechanisms operating simultaneously. Government energy subsidies delay the transmission of oil price increases to the domestic real economy, so the negative impact on the trade balance is not immediately felt in the foreign exchange market (Arintoko et al., 2024). Bank Indonesia's responsive interventions in the foreign exchange market, together with long-term oil import contract structures, dampen exchange rate volatility within short time windows. This dynamic is likely most pronounced during the period of aggressive Federal Reserve tightening throughout 2022–2023, when Bank Indonesia proactively managed rupiah stability amid capital outflow pressure triggered by widening global interest rate differentials (Kisswani & Fikru, 2023b). The rupiah's adjustment speed toward long-run equilibrium is relatively low compared to other ASEAN countries, indicating structural rigidity in Indonesia's foreign exchange market stemming from routine Bank Indonesia interventions, limited market depth, and partial capital restrictions that slow the price correction process (IMF, 2016).

2. Malaysia

Malaysia displays a fundamentally different pattern from other ASEAN countries, rooted in its structural position as the only net oil exporter in the region. In the long run, oil prices have no significant effect on the ringgit a finding that initially appears surprising but carries strong underlying logic. When global oil prices surged due to Russia's invasion of Ukraine, Malaysia simultaneously experienced an increase in oil export earnings that offset rising energy import costs, making the net effect on the trade balance and foreign exchange

pressure relatively small and statistically insignificant in the long run (Karunanithi, 2019). Fah and Shi (2017) found that oil price fluctuations have a significant positive short-run impact on the Malaysian economy, but their impact on the Malaysian ringgit is less significant, confirming the ringgit's resilience to oil price shocks.

Gold prices emerge as the most significant long-run determinant of the ringgit, with a direction of influence opposite to that observed in Indonesia and Thailand. A rise in gold prices correlates with ringgit appreciation, a pattern that reflects Malaysia's role as a regional gold trading hub in Southeast Asia. Studies show that during periods of uncertainty, Malaysia has the highest positive correlation between gold prices and the stock index among ASEAN countries, indicating gold's more integrated role within Malaysia's financial system. When gold prices rise, capital inflows into Malaysia's domestic gold market increase, creating demand for the ringgit that supports its appreciation (Kai et al., 2017).

This mechanism runs counter to the flight-to-quality mechanism that dominates in Indonesia and Thailand, and shows that gold functions as a hedging instrument for investors in the Malaysian market, rather than merely as a signal of uncertainty that triggers capital flight (Yun & Tsen, 2026). In the short run, rising oil prices temporarily strengthen the ringgit as expected for an oil-exporting country, where higher prices for the main export commodity directly increase foreign exchange inflows and support currency appreciation within a short time window. The ringgit's adjustment speed is higher than that of Indonesia and Thailand, reflecting Malaysia's relatively deeper and more responsive foreign exchange market, although periodic Bank Negara Malaysia interventions still create a degree of rigidity (Butt et al., 2023).

3. Thailand

Thailand shows high sensitivity to oil prices and exports to China, directly reflecting two key structural vulnerabilities in its economy: its position as a net energy importer and its deep manufacturing export dependence on demand from China (Harnphattananusorn, 2022). In the long run, rising oil prices consistently weaken the baht through a predictable mechanism: rising energy import costs erode the trade balance surplus, increase foreign exchange needs, and accumulate depreciation pressure. Studies show that Thailand has a significant negative correlation between the exchange rate and the stock index, reflecting the Thai economy's vulnerability to external factors. This impact is most pronounced during the period of Russia's invasion of Ukraine, which pushed oil prices to their highest level in a decade, sharply worsening Thailand's energy deficit (Palupi & Purwono, 2024).

The finding that exports to China actually weaken the baht in the long run is a paradox that can be unraveled through the realities of the global value chains underlying the Thai economy (Wang & Houde, 2025). Thailand's manufacturing exports to China contain an extremely high proportion of imported production inputs electronic components, raw materials, and spare parts so net foreign exchange earnings from these export activities are far smaller than the recorded gross export value. Many bilateral transactions are settled in renminbi rather than US dollars, so the conversion to dollars places additional pressure on the baht. When the COVID-19 pandemic disrupted global supply chains in 2020–2021, Thailand actually experienced an increase in imports of replacement components from China, further weakening its net foreign exchange position (Durongkaveroj, 2022).

In the short run, rising gold prices pressure the baht through the safe-haven mechanism that diverts capital from the Thai market, while rising exports to China provide a temporary appreciation effect before value-chain

effects erode foreign exchange gains in the long run. The baht's adjustment speed, the lowest among ASEAN-5, reflects active intervention by the Bank of Thailand and a foreign exchange market structure that is relatively less liquid compared to the Philippines and Vietnam (Halim et al., 2026).

4. Vietnam

Vietnam shows a pattern similar to Thailand as a net oil importer with manufacturing dependence on China, but with an additional unique characteristic significant sensitivity to exports to Iran not found in any other ASEAN country. In the long run, rising oil prices consistently weaken the dong through a mechanism identical to that of Thailand: a growing energy import bill erodes foreign exchange reserves and pressures the exchange rate. As a net energy importer with a high degree of trade openness, Vietnam is highly vulnerable to oil price shocks that raise import costs and place pressure on inflation and the exchange rate (Trang et al., 2017). Conflict in the Middle East that threatens shipping lanes through the Strait of Hormuz further amplifies this risk, given that roughly 80% of Vietnam's crude oil is imported from that region. The surge in oil prices following Russia's invasion of Ukraine, which worsened Vietnam's energy deficit at the same time as Federal Reserve monetary tightening drew capital outward, created a dual pressure on the dong that has proven difficult to contain in the long run (Thai, 2026). Exports to China also weaken the dong in the long run through the same value-chain mechanism observed in Thailand the high import content of inputs from China embedded in Vietnam's export products results in net foreign exchange earnings far smaller than gross export value, while renminbi-to-dollar conversion creates additional pressure (Trading Economics, 2025).

The significant negative long-run effect of exports to Iran on the dong distinguishes Vietnam from the other four countries. This finding reflects the geopolitical risk embedded in trade relations with Iran. This is reinforced by the fact that escalating tensions in the Middle East raise investors' risk premiums and may disrupt energy supply chains, directly affecting Vietnam's import costs and exchange rate stability. As tensions rise in the Strait of Hormuz the strategic passage connecting the Persian Gulf to the Indian Ocean, through which roughly one-third of global oil trade flows disruptions to this shipping route directly affect the smooth flow of Vietnam's exports to Iran (Yaputera & Suryanto, 2026). Repeated threats to the Strait of Hormuz, arising in the context of tensions between Iran and Western powers, increase investors' geopolitical risk premium on assets exposed to Iran as a trade partner, including the currencies of countries with significant trade ties to it. For international investors, Vietnam's exposure to Iran a partner frequently under international sanctions pressure translates into an additional risk factor that pressures perceptions of the dong, regardless of the relatively small trade volume involved (Handoyo et al., 2023). In the short run, both oil and gold prices pressure the dong, indicating that Vietnam is highly vulnerable to the simultaneity of energy and global financial shocks that characterizes the 2020–2026 period.

5. Philippines

The Philippines shows characteristics most distinct from the other four ASEAN countries, stemming from a unique economic structure driven by domestic consumption and migrant worker remittances rather than commodity exports or manufacturing integrated into global value chains. Remittances from overseas Filipino workers reached USD 32.11 billion in 2025, creating a stable foreign exchange flow that reduces the peso's sensitivity to external shocks such as oil prices (Carare et al., 2025). Consequently, external variables such as oil prices and bilateral exports have no significant effect on the peso empirical confirmation that the

determinants of the Philippine exchange rate are domestic rather than external in nature.

Inflation and gold prices significantly drive the peso in the long run, but in a direction opposite to the typical ASEAN pattern. High inflation is instead correlated with peso appreciation a paradox explained by the highly aggressive policy response mechanism of the Bangko Sentral ng Pilipinas (BSP). This is consistent with Kuncoro's (2025) finding that central bank intervention in the Philippines, particularly purchase interventions, is effective in correcting peso undervaluation and maintaining exchange rate stability. The BSP actively manages the exchange rate to dampen inflation fluctuations, which explains the peso's strong response to inflationary pressure (Kuncoro, 2025). When inflation surged in 2022–2023 as a lagged effect of rising global energy and food prices, the BSP raised its benchmark interest rate dramatically to anchor inflation expectations. This significant rate increase attracted foreign portfolio investment inflows into peso-denominated Philippine debt instruments, increasing demand for the domestic currency and supporting peso appreciation even amid high inflationary pressure (IMF, 2022). This aggressive policy response successfully broke the typical transmission chain in which high inflation usually leads to depreciation through the PPP mechanism and replaced it with transmission through the financial capital channel.

Research on dynamic conditional correlation during the pandemic shows that the Philippines has a significant negative correlation between the exchange rate and the stock index, reflecting the effectiveness of BSP policy in managing exchange rate volatility amid external shocks. The peso's extreme adjustment speed reflects highly active monetary policy intervention, not superior market efficiency. As every exchange rate deviation from equilibrium is immediately addressed through a combination of interest rate adjustments and foreign exchange market intervention by the BSP, the model statistically captures this very rapid correction mechanism in the form of an ECT coefficient approaching one. This finding confirms that in the case of the Philippines, aggressive monetary policy rather than external fundamental conditions is the primary determinant of exchange rate dynamics during the 2020–2026 multi-shock period (Arisandhi & Robiyanto, 2022).

CONCLUSION

The Panel ARDL-PMG estimation results show that the determinants of ASEAN-5 exchange rates are heterogeneous, with no single variable applying uniformly across countries. Gold prices consistently emerge as the strongest long-run determinant, yet with an asymmetric direction weakening the rupiah and the baht while strengthening the ringgit and the peso reflecting differing market perceptions of gold across countries. Oil prices pressure the exchange rates of Thailand and Vietnam as net importers, while exports to China paradoxically weaken both countries' currencies due to the high import content within global value chains. Inflation confirms PPP only in Indonesia, while differences in adjustment speed across countries reflect disparities in monetary policy capacity and flexibility within the region.

This heterogeneity confirms that exchange rate stabilization in ASEAN cannot be addressed through a single uniform approach each country needs to tailor its policy framework to its own economic structure and sources of vulnerability. Indonesia needs to remain vigilant against inflationary pressure on the rupiah; Thailand and Vietnam need to promote energy diversification and increase export value-added; while the Philippines needs to ensure that reliance on high interest rates does not come at the expense of long-run investment. At the regional level, these findings reinforce the need for more concrete ASEAN monetary coordination through the expansion of Local Currency Settlement arrangements

and joint commodity buffer mechanisms to reduce the region's vulnerability to external shocks.

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