Stock Returns and Exchange Rate Volatility in ASEAN-5: Evidence from a Panel ARDL Model

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ABSTRACT

Exchange-rate volatility represents an important source of uncertainty for investors and firms, particularly in emerging financial markets that are increasingly integrated with global trade and capital flows. This study examines the dynamic relationship between stock returns and exchange rate volatility in the ASEAN-5 countries, namely Indonesia, Malaysia, the Philippines, Singapore, and Thailand. Specifically, the study examines the long-run relationship, short-run dynamics, adjustment processes, and causal relationships between exchange-rate volatility and stock returns across the ASEAN-5 economies. Using weekly data, exchange-rate volatility is estimated through an asymmetric T-GARCH model, while the dynamic relationship is examined using the panel Autoregressive Distributed Lag (ARDL) model with the Pooled Mean Group (PMG) estimator. The findings reveal a statistically significant negative long-run relationship between exchange-rate volatility and stock returns, indicating that persistent exchange-rate uncertainty is associated with weaker stock-market performance over the long run. In contrast, exchange-rate volatility exhibits a positive and statistically significant relationship with stock returns in the short run, suggesting that the effects of exchange-rate volatility differ across adjustment horizons. The individual-country results further confirm the existence of long-run equilibrium relationships, although the relatively low explanation rate of exchange-rate volatility indicates that other domestic and international factors also contribute to stock-return movements. The Panel Granger Causality Test identifies a unidirectional predictive relationship from exchange-rate volatility to stock returns. However, the Pairwise Dumitrescu–Hurlin Panel Causality Test indicates that the causal relationships are heterogeneous across the ASEAN-5 economies. Overall, the findings highlight the importance of considering exchange-rate uncertainty, time horizons, and country-specific characteristics when examining stock-market dynamics in ASEAN. The study suggests that future research should account for cross-sectional dependence and unobserved common factors and employ approaches such as the Dynamic Common Correlated Effects estimator and wavelet analysis to further examine these relationships across different time horizons.

Keywords: ASEAN-5, Stock returns, Exchange rate volatility, Panel Autoregressive Distributed Lags model

INTRODUCTION

The relationship between stock markets and exchange rates has attracted considerable attention in financial economics because both markets play important roles in the functioning of an open economy (Xie, Chen, & Wu, 2020) (Ehrmann, Fratzscher, & Rigobon, 2011) (Nieh & Lee, 2001). Exchange rate movements can influence stock-market performance through several channels, including international trade, corporate profitability, imported input costs, and international capital flows. At the same time, developments in stock markets may affect exchange rates through changes in investors' wealth, portfolio allocation, and cross-border capital movements. The interaction between these two markets is therefore potentially bidirectional, and its nature may vary across economies and over time. This relationship is particularly important for emerging and highly open economies, where financial markets are more exposed to international capital movements and external economic shocks (Lu, Liu, & Zhou, 2022).

The ASEAN-5 economies, comprising of Indonesia, Malaysia, the Philippines, Singapore, and Thailand, provide an important setting for examining this relationship. This is because these economies are closely integrated through regional trade, investment, and financial linkages, while simultaneously differing in their economic structures, financial-market development, exchange-rate arrangements, and exposure to international markets.

Such differences may result in heterogeneous responses of stock markets to exchange-rate movements and uncertainty. Moreover, the ASEAN-5 economies have experienced various episodes of financial and economic turbulence during the study period, including the European sovereign debt crisis, shifts in US monetary policy, the COVID-19 pandemic, and subsequent global monetary tightening. These developments provide a relevant context for examining whether exchange-rate uncertainty is associated with stock-market performance and whether its effects differ between the short run and the long run.

The theoretical relationship between the two markets can be explained through the flow-oriented and portfolio-balance approaches. The flow-oriented approach proposed by Dornbusch and Fischer (1980) suggests that exchange-rate movements affect stock-market performance through their effects on international competitiveness, trade flows, and corporate earnings. For example, a depreciation of the domestic currency may improve the competitiveness of export-oriented firms, while simultaneously increasing the domestic-currency cost of imported inputs and foreign-denominated obligations. Consequently, exchange-rate uncertainty may affect investors' expectations regarding future corporate cash flows and stock returns. This mechanism is potentially important for the ASEAN-5 economies given their integration into regional and global production and trade networks. In contrast, the portfolio-balance approach emphasizes the role of financial assets and international capital movements, proposed by Branson (1983) and Frankel (1983). Changes in stock-market conditions may alter investors' wealth and portfolio preferences, leading to capital flows that subsequently influence exchange rates. From this perspective, the relationship between stock markets and exchange rates may operate in both directions. The relevance of this channel is further supported by the increasing integration of ASEAN-5 financial markets with international investors and global financial conditions.

In addition, The Efficient Market Hypothesis (EMH) by Fama (1970), provides an additional perspective by suggesting that financial-market prices incorporate available information. Accordingly, if exchange-rate information is rapidly incorporated into stock prices, changes in exchange-rate conditions may be reflected in stock returns without persistent predictable patterns. With that, the EMH highlights the role of information transmission, whereby exchange-rate developments and other macroeconomic information may be incorporated into stock prices as investors revise their expectations. Nevertheless, the strength and direction of these mechanisms may differ across the ASEAN-5 economies due to differences in economic structure, financial-market development, exchange-rate arrangements, trade exposure, and the degree of integration with international capital markets. Therefore, examining the ASEAN-5 economies as a panel allows the study to assess both the common long-run relationship and country-specific short-run dynamics between exchange-rate uncertainty and stock-market returns, recognising that these economies may respond differently to exchange-rate conditions. With that, examining exchange rate volatility rather than merely exchange rate changes therefore provides additional insight into how currency markets uncertainty is transmitted to stock markets performance.

The remainder of this paper is organised as follows. Section 2 synthesises the findings of previous empirical studies and identifies the research gaps addressed in this study. Section 3 discusses the data sources and econometric methodology employed, followed by the presentation and discussion of the empirical findings. Section 4 concludes the study by highlighting the key implications and providing recommendations for future research.

LITERATURE REVIEW

The relationship between exchange rates and stock markets has received considerable attention in international finance because movements in exchange rates can influence corporate earnings, competitiveness, investment decisions, and international capital flows. The empirical literature, however, does not establish a uniform relationship between the two markets. Consistent with these competing channels, early empirical studies report negative, positive, and bidirectional relationships across different countries and time periods. Ajayi and Mougoué (1996), for example, provide evidence of dynamic interactions between stock prices and exchange rates in developed economies, while Granger et al. (2000) document heterogeneous causal relationships across Asian markets during the Asian financial crisis. Similarly, Phylaktis and Ravazzolo (2005) show that stock prices and exchange rates are closely linked in Pacific Basin markets, although the direction of the relationship varies across countries. Taken together, these findings indicate that the interaction between the two markets is context-dependent rather than governed by a single transmission mechanism.

The evidence from emerging Asian markets further demonstrates the importance of country-specific economic and financial characteristics. Pan et al. (2007) find significant dynamic linkages between exchange rates and stock prices across several East Asian markets, although the direction of causality differs among countries and periods. Chue and Cook (2008) similarly demonstrate that exchange-rate exposure in emerging markets varies considerably over time, suggesting that firms and financial markets do not respond uniformly to currency movements. Bartram and Bodnar (2012), using a broad international sample, further show that exchange-rate exposure is conditional on country and firm characteristics and may vary according to market conditions. These findings are particularly relevant to ASEAN economies because the region combines highly integrated financial markets with substantial differences in economic structure, trade dependence, exchange-rate regimes, and financial-market development. Consequently, evidence obtained from one ASEAN economy cannot necessarily be generalized to the others, and the aggregate ASEAN relationship may conceal important country-level differences.

The ASEAN literature provides further support for this heterogeneous relationship. Early evidence for Malaysia indicates that stock prices and exchange rates may interact through both short- and long-run channels. Ibrahim (2000), for instance, finds evidence of cointegration and Granger causality between stock prices and exchange rates in Malaysia. Hatemi-J and Roca (2006), examining ASEAN-4, demonstrate that the interaction between the two markets differs between favourable and unfavourable market conditions, highlighting the importance of market regimes. Harjito and McGowan (2007) also report different directions of causality across ASEAN countries, reinforcing the argument that the relationship is country-specific. More comprehensive ASEAN-5 evidence is provided by Liang et al. (2013), who find a significant relationship between stock prices and exchange rates using a panel framework, while Liang et al. (2015) show that the direction of interaction varies across individual ASEAN-5 economies when bootstrap panel causality methods are employed. These studies collectively suggest that ASEAN-5 markets share regional financial linkages but do not necessarily respond to exchange-rate movements in the same manner.

Recent research continues to confirm this heterogeneity while providing more dynamic perspectives on the relationship. Chancharat and Suwannapak (2024), using linear and nonlinear ARDL models and daily data covering ASEAN+6 markets, find evidence supporting both goods-market and portfolio-balance mechanisms. Their results indicate that the goods-market channel is supported for Indonesia and Singapore, whereas the portfolio-balance channel is identified in countries including Malaysia. Importantly, the study finds short-run interaction between exchange rates and stock markets across the ASEAN+6 economies, while the direction and strength of the relationship differ across countries. This evidence is consistent with earlier ASEAN research but also demonstrates that the coexistence of different transmission mechanisms remains relevant in more recent periods. Thus, the existing literature does not provide a single explanation for stock market–exchange rate interactions in ASEAN; instead, the evidence points toward heterogeneous responses associated with country characteristics and changing market conditions.

An additional issue emerging from the literature is the distinction between exchange-rate movements and exchange-rate uncertainty. A change in the exchange rate represents an observed currency movement, whereas exchange-rate volatility reflects uncertainty surrounding future currency movements. This distinction is important because uncertainty can affect stock returns through channels that differ from those associated with the direction of exchange-rate changes. Higher currency uncertainty may increase uncertainty surrounding firms' future cash flows, particularly for companies involved in international trade or exposed to foreign-currency liabilities. Exchange-rate volatility can also influence imported input costs, export revenues, investment decisions, and foreign portfolio investment. Consequently, the effect of exchange-rate volatility on stock returns cannot necessarily be inferred from evidence based solely on exchange-rate levels or returns. This distinction provides a basis for examining exchange-rate volatility as a separate source of financial uncertainty rather than treating it simply as another measure of exchange-rate movement.

The literature on exchange-rate volatility and stock-market behaviour has consequently expanded through the use of conditional volatility models and multivariate financial-market approaches. Studies employing GARCH-family models generally demonstrate that exchange-rate uncertainty is time-varying and may exhibit asymmetric responses to currency shocks. Such evidence is important because positive and negative exchange-rate innovations may not generate equivalent changes in uncertainty. In the ASEAN context, Jaroenwiriyakul and

Sethapramote (2022) examine the sensitivity of ASEAN-5 bank-stock returns to exchange-rate and interest-rate risks using panel data, providing evidence that currency risk is relevant to stock-market performance. Although the focus on bank stocks limits direct generalization to aggregate stock indices, the findings reinforce the importance of incorporating exchange-rate risk into the analysis of ASEAN equity markets.

More recent studies provide stronger evidence that volatility relationships are dynamic and heterogeneous across ASEAN markets. Umoru et al. (2025), for example, examine eight ASEAN stock markets and incorporate exchange-rate volatility into an analysis of stock-return dynamics using FIGARCH-DCC and ARDL models. Their findings indicate that the influence of exchange-rate volatility differs across the countries examined, supporting the presence of heterogeneous financial-market responses rather than a uniform regional effect. Similarly, Kiatmanaroch and Puarattanaarunkorn (2025) examine volatility transmission among Thailand, Malaysia, Indonesia, and the Philippines during quantitative easing and quantitative tightening periods using a copula-based GARCH framework. Their findings show that the dependence structure of financial-market volatility changes across monetary-policy regimes, with exchange-rate returns exhibiting stronger cross-country correlation during the quantitative-tightening period. These recent findings indicate that exchange-rate uncertainty is not constant over time and that the interaction between currency and equity markets may become more pronounced under changing global financial conditions.

The recent literature therefore provides two important insights. First, the relationship between exchange rates and stock markets remains heterogeneous across ASEAN economies. Second, exchange-rate volatility contains information beyond the actual direction of currency movements and may represent an important source of uncertainty for stock-market participants. Nevertheless, these two strands of literature have often developed separately. Studies examining stock-price and exchange-rate relationships commonly focus on exchange-rate levels, returns, causality, or nonlinear adjustments, while volatility-oriented studies frequently emphasize volatility transmission, conditional correlations, or risk spillovers. For example, Chancharat and Suwannapak (2024) focus on dynamic stock-price and exchange-rate interactions using ARDL models, whereas Umoru et al. (2025) incorporate exchange-rate volatility into broader volatility and liquidity models. This suggests that there remains scope to more directly examine whether exchange-rate uncertainty itself has a systematic relationship with conventional stock returns while simultaneously distinguishing long-run and short-run dynamics.

A further limitation concerns the treatment of cross-country heterogeneity. A number of existing studies either analyse individual countries separately or impose relatively homogeneous panel relationships. However, ASEAN-5 economies are exposed to common regional and global shocks while differing in their economic structures, financial-market development, trade composition, and exchange-rate arrangements. A common regional shock may therefore generate different short-run responses across Indonesia, Malaysia, the Philippines, Singapore, and Thailand even when the markets share a similar long-run relationship. Recent evidence of country-specific effects in ASEAN reinforces the importance of this distinction. Chancharat and Suwannapak (2024) identify different transmission mechanisms across ASEAN+6 countries, while Umoru et al. (2025) report differences in the influence of exchange-rate volatility across ASEAN markets. Thus, an empirical framework that imposes identical short-run responses across countries may overlook important differences in the speed and direction of adjustment.

The methodological choices in the existing literature also reveal an opportunity for further investigation. GARCH-family models are useful for estimating time-varying exchange-rate volatility, while ARDL models are appropriate for distinguishing short-run dynamics from long-run equilibrium relationships. However, these approaches address different aspects of the empirical problem. A volatility model can generate a measure of exchange-rate uncertainty but does not, by itself, establish how that uncertainty affects stock returns over different horizons. Conversely, conventional ARDL or causality models can examine dynamic relationships but may treat exchange-rate movements without explicitly modelling the conditional volatility associated with currency uncertainty. The combination of an asymmetric T-GARCH model with a panel ARDL framework therefore provides a way to link the measurement of exchange-rate uncertainty with the subsequent analysis of stock-return dynamics. In addition, the Pooled Mean Group estimator is particularly relevant when countries are expected to share a common long-run relationship but may exhibit heterogeneous short-run responses and adjustment speeds.

In sum, the literature indicates that the relationship between exchange rates and stock markets is neither universally positive nor negative and cannot be adequately explained by a single theoretical channel. The evidence from ASEAN-5 consistently points toward heterogeneous interactions, while recent studies increasingly emphasize volatility, nonlinear adjustment, and changing financial-market conditions. Nevertheless, comparatively limited attention has been given to the relationship between exchange-rate volatility and aggregate stock returns in ASEAN-5 using a framework that simultaneously captures asymmetric currency uncertainty, a common long-run relationship, and heterogeneous short-run adjustment. This study addresses this gap by first generating exchange-rate volatility using an asymmetric T-GARCH model and subsequently incorporating the estimated volatility series into a panel ARDL model estimated using the PMG approach. This framework enables the study to examine whether exchange-rate uncertainty is associated with conventional stock returns in the long run, whether the short-run response differs across ASEAN-5 economies, and how quickly individual markets adjust following deviations from the long-run equilibrium. In doing so, the study extends the existing literature from the conventional question of whether exchange rates and stock markets interact toward a more specific examination of how exchange-rate uncertainty is transmitted to stock returns and how this relationship evolves across countries and time horizons.

DATA AND METHODOLOGY

Data Sources

The Morgan Stanley Capital International (MSCI) stock indices and nominal exchange rate for ASEAN-5 were collected through Bloomberg, coverage the study timeframe from January 8, 2010, to April 25, 2025, with data frequency of weekly basis. The MSCI index is a financial benchmark that tracks the performance of a specific group of stocks from global stock markets. Meanwhile, total 799 data observations were collected for each ASEAN-5 country. The stock returns of the study will be computed using equation (1), where R_t denotes as the current return at time t, P_t denotes as the current price at time t, and P_{t-1} refers to the previous price at $t-1$. Equation (2) will be used to transform the negative values into logarithms form in order to maintain the sign of x (Busse & Hefeker, 2007).

$$R_t = \frac{P_t - P_{t-1}}{P_{t-1}}$$	(1)
$$y = \ln\left(\sqrt{(x^2+1)}\right)$$	(2)

Exchange rate uncertainty was measured using the conditional variance generated from a standard T-GARCH (p,q) model as shown in equation (3) with the ARCH and GARCH terms of $\alpha_i \varepsilon_{t-i}^2$ and $\beta_i h_{t-i}$ and γ represents the leverage terms. The model was estimated assuming that the innovation term follows the Generalized Error Distribution (GED), which provides a flexible distributional specification that can accommodate deviations from normality and different degrees of tail thickness in exchange rate. The non-negative parameter restrictions were imposed and the sum of α_i, β_i, and $\gamma_i/2$ must less than one. $\gamma > 0$ imply the presence of asymmetric effects while $\gamma < 0$ implies that the positive shocks may have a larger impact on volatility.

$$h_t = \alpha_0 + \sum_{i=1}^{p} \beta_i h_{t-i} + \sum_{i=1}^{q} \alpha_i \varepsilon_{t-i}^2 + \sum_{i=1}^{q} \gamma_i I_{t-i} \varepsilon_{t-i}^2$$	(3)
$$h_t = \alpha_0 + \beta_1 h_{t-1} + \alpha_1 \varepsilon_{t-1}^2 + \gamma_i I_{t-1} \varepsilon_{t-1}^2$$	(4)

Yet, T-GARCH (1,1) model is employed to measure exchange rate volatility due to it s accommodates both volatility persistence and asymmetric responses to exchange rate shocks. Also, the GARCH (1,1) structure provides a parsimonious representation of volatility dynamics by incorporating one lag of the squared innovation and one lag of the conditional variance, thereby capturing both short-run shock effects and the persistence of volatility. Given the weekly exchange rate data for the ASEAN-5 countries, the T-GARCH (1,1) specification shown in equation (4) therefore provides a relatively simple yet flexible framework for generating the conditional variance used as the exchange rate volatility (EXRVOL) measure. To assess the adequacy of the estimated volatility models, post-estimation diagnostic tests were conducted, including the ARCH-LM test, Correlogram, and Squared Correlogram. The RCH-LM test evaluates whether additional ARCH effects remain in the residuals,

while the Correlogram and Squared Correlogram assess residual serial correlation and remaining dependence in the squared residuals, respectively.

Table 1 shows the T-GARCH (1,1) model estimation and diagnostic test results for ASEAN-5 exchange rate volatility variables. Based on the results, the ARCH-LM test fails to reject the null hypothesis of no remaining ARCH effects for all five ASEAN-5 exchange rates, with p-values ranging from 0.106 to 0.904. The Correlogram and Squared Correlogram results likewise indicate that no significant residual serial correlation or remaining ARCH effects are detected. Therefore, the diagnostic results suggest that the estimated T-GARCH (1,1) models adequately capture the conditional volatility dynamics and provide statistically appropriate EXRVOL measures for the subsequent Panel ARDL analysis.

Table 1: T-GARCH (1,1) Estimation and Diagnostic Test Results for ASEAN-5 Exchange Rate Volatility.

Variable	Const.	ARCH term (α_i)	GARCH term (β_i)	Leverage Term (γ_i)	$\alpha_i + \beta_i + \gamma_i/2$	ARCH-LM test	Correlogram	Square Correlogram
MYR	0.000003***	0.188***	0.823***	-0.079**	0.972	2.612	P	P
	(0.000)	(0.000)	(0.000)	(0.034)		(0.106)	0.626	0.105
SGD	0.000003***	0.222***	0.841***	-0.183***	0.972	0.187	P	P
	(0.001)	(0.000)	(0.000)	(0.000)		(0.665)	0.495	0.664
IDR	0.000004***	0.299***	0.824***	-0.299***	0.974	0.126	P	P
	(0.000)	(0.000)	(0.000)	(0.000)		(0.723)	0.395	0.722
THB	0.00002***	0.274***	0.499***	-0.148*	0.699	0.015	P	P
	(0.002)	(0.001)	(0.000)	(0.084)		(0.904)	0.109	0.904
PHP	0.000002***	0.102***	0.865***	-0.059*	0.938	1.268	P	P
	(0.007)	(0.000)	(0.000)	(0.078)		(0.259)	0.665	0.258

Note: ***, **, and * denote significance level at 1%, 5%, and 10%, respectively. Values in the parentheses represent the corresponding p-values. The ARCH-LM test is used to examine the presence of ARCH effects in the exchange rate series Both the Correlogram and Square Correlogram tests are used to examine the presence of autocorrelation issues of the variables. The term P denotes “Pass” and indicates that the estimated exchange rate volatility variables have passed the autocorrelation diagnostic tests.

Econometric Model

The dynamic heterogeneous panel co-integration model also known as the Panel Autoregressive Distributed Lags (ARDL) model. The heterogeneous panel tangibly refers to the panel data set that is large or small number of groups (firms, industries, countries, etc.) and a large number of observations, but the number of groups is less than the number of observations (N < T). Meanwhile, the heterogeneous panel co-integration model was carried out by three alternative estimators, namely Mean Group estimator (MG), Pooled Mean Group estimator (PMG), and Dynamic Fixed Effect estimator (DFE) in order to examine both long-run and short-run interaction between the variables.

The pooled mean group is an intermediate estimator between mean group and dynamic fixed effect estimators proposed by Pesaran, Shin, and Smith (1999). Yet, the PMG estimator is particularly relevant to the ASEAN-5 setting because the countries may share common long-run economic and financial relationships while differing in their short-run responses to exchange-rate shocks. This approach allows the intercepts, short-run coefficients and error variance to differ freely across the entire cross-section but constrains the long-run coefficients to be the same (homogeneous). There are often good reasons to expect the long-run equilibrium relationships between variables to be similar across groups, due to their financial markets are exposed to common international conditions, while their economic structures, exchange-rate arrangements, trade exposure, financial-market development, and foreign-investor participation differ. Noted that the number of time periods (T) must be large enough such that can estimate the model for each group separately. The PMG framework therefore enables the study to identify whether exchange-rate volatility has a common long-run association with conventional stock returns while simultaneously capturing country-specific short-run adjustments.

Following Pesaran *et al.* (1999), the general panel ARDL((p,q)) specification can be expressed as equation (5) with time, $t = 1, 2, \cdots, T$, and group, $i = 1, 2, \cdots, N$. The $SR_{i,t}$ refers to the dependent variable for group i at time t, $EXRVOL_{i,t}$ is $K \times 1$ vector of explanatory variables for group i at time t, $\lambda_{i,j}$ and $\delta_{i,j}$ are the coefficient for dependent and independent variables, both p and q denote as the optimal lag order for dependent and independent variables, μ_i is individual specific fixed effects parameter and ε is the error term.

$$SR_{i,t} = \sum_{j=1}^{p} \lambda_{i,j} SR_{i,t-j} + \sum_{j=0}^{q} \delta'_{i,j} EXRVOL_{i,t-j} + \mu_i + \varepsilon_{i,t} \quad (5)$$

The equation (5) can be re-parameterized in to an error correction equation shows in equation (6). φ_i represents the group specific speed of adjustment coefficient which measures the speed at which the values of $y_{i,t}$ and $x_{i,t}$ return back to equilibrium levels, θ'_i refers to the long-run coefficient between $SR_{i,t}$ and $EXRVOL_{i,t}$, the terms of $SR_{i,t-1} + \theta'_i EXRVOL_{i,t}$ represent the error correction terms, $\lambda^*_{i,j}$ and $\delta^{*\prime}_{i,j}$ defines the short-run dynamic coefficients of the lagged dependent and independent variables.

$$\Delta SR = \varphi_i\left(SR_{i,t-1} + \theta'_i EXRVOL_{i,t}\right) + \sum_{j=1}^{p-1} \lambda^*_{i,j} \Delta SR_{i,t-j} + \sum_{j=0}^{q-1} \delta^{*\prime}_{i,j} \Delta EXRVOL_{i,t-j} + \mu_i + \varepsilon_{i,t} \quad (6)$$

The relevance of the PMG approach is further supported by the objective of the present study, which is not only to determine whether exchange-rate volatility affects stock returns, but also to establish whether the effect differs between the short and long run. The estimated ECT provides an additional measure of how rapidly each ASEAN-5 stock market responds when a deviation from the long-run relationship occurs. Consequently, the Panel ARDL-PMG framework provides a suitable empirical approach for examining the dynamic transmission of exchange-rate uncertainty to conventional stock returns while accounting for both regional commonality and country-level heterogeneity.

Moreover, one of the advantages of the panel ARDL approach is that it could be used even when the variables are integrated in different orders, $I(0), I(1)$ or mixed. Additionally, both long-run and short-run interaction between variables could be obtained simultaneously. The pooled mean group (PMG) and mean group (MG) estimators produce consistent estimates in spite of the possible presence of endogeneity due to the lags of dependent and independent variables (Pesaran *et al.*, 1999). In order to select the best suited estimator for panel ARDL model, the Hausman test is used to make comparison between PMG, MG, and dynamic fixed effect (DFE) estimators in terms of efficiency and consistency.

The Pairwise Dumitrescu–Hurlin (D–H) Panel Causality Test proposed by Dumitrescu and Hurlin (2012) is employed to examine the direction of Granger causality between the variables in the panel. The test extends the conventional Granger causality framework to heterogeneous panel data by allowing the causal relationships and dynamic coefficients to differ across individual cross-sectional units. The test is based on individual Wald statistics that are averaged across the cross-sectional units, thereby allowing the analysis to account for heterogeneity across countries. The null hypothesis states that there is no homogeneous Granger causality from one variable to another across the panel. Rejection of the null hypothesis indicates that the variable Granger-causes the other variable for at least some cross-sectional units. Accordingly, the pairwise D–H test is applied to identify the direction of predictive relationships between stock returns and exchange rate volatility.

RESULTS AND FINDINGS

Table 2 reports the panel unit-root test results from the Levin–Lin–Chu (LLC) and Im–Pesaran–Shin (IPS) tests for the ASEAN-5 economies. The results show that the stationarity of stock returns (SR) and exchange rate volatility (EXRVOL) depends on whether an intercept or a deterministic trend is included in the test. Both variables are stationary after first differencing across all specifications, while some tests also indicate stationarity at level. These findings suggest that the variables may have different orders of integration. Therefore, the Panel ARDL approach is suitable for further analysis, as it can accommodate a combination of I(0) and I(1) variables, provided that none of the variables is integrated of order two, I(2). The unit-root tests thus provide an initial assessment of the data before the Panel ARDL estimation and bounds test are conducted.

Table 2: Panel Unit Root Test Results for ASEAN-5.

	LLC				IPS			
	At Level		First Difference		At Level		First Difference	
	Intercept	Trend	Intercept	Trend	Intercept	Trend	Intercept	Trend
SR	-42.17	-67.88	-85.24***	-65.76***	-51.26	-50.17***	-61.63***	-69.35***
	(0.142)	(0.421)	(0.000)	(0.000)	(0.108)	(0.000)	(0.000)	(0.000)
EXRVOL	-44.97	-61.49	-85.05***	-70.33***	-48.16***	-48.11	-61.02***	-71.33***
	(0.239)	(0.264)	(0.000)	(0.000)	(0.000)	(0.174)	(0.000)	(0.000)

Note: ***, **, and * denote significant at 1%, 5%, and 10% confidence level, respectively. The values in the parentheses, ( ), refer to the p-value.

Table 3 reports the optimal lag length selection results on the sequential modified likelihood ratio (LR) test, financial prediction error (FPE), Akaike information Criterion (AIC), Schwarz information Criterion (SC), and Hannan-Quinn information Criterion (HQ). The results show some variation across the selection criteria. The FPE, SC, and HQ criteria identify lag 2 as the optimal lag order, whereas the LR test and AIC select lag 3. Given that the AIC is widely used for dynamic model specification and tends to accommodate richer lag structures, lag 3 is selected as the optimal lag length for the subsequent Panel ARDL analysis. This selection provides a basis for capturing the dynamic adjustment between stock retunes and exchange rate volatility while avoiding an unnecessarily restrictive lag stutter.

Table 3: Optimal Lag Length Section Criteria.

Lag	LogL	LR: sequential modified LR test statistics	Final Prediction Error (FPE)	Akaike Information Criterion (AIC)	Schwarz Information Criterion (SC)	Hannan-Quinn Information Criterion (HQ)
0	-13675	NA	3.369	6.89	6.894	6.891
1	1165.22	29658.6	0.0019	-0.5902	-0.574	-0.581
2	1181.62	32.763	0.0018*	-0.5995	-0.575*	-0.589*
3	1199.77	36.232*	0.00191	-0.601*	-0.569	-0.584

Note: * indicates lag order selected by the criterion.

Table 4 presents the results of the dynamic relationship between stock returns and exchange rate volatility in the ASEAN-5 economies. The Hausman test results indicate that the null hypotheses cannot be rejected for any of the three estimator comparisons: MG versus PMG (p = 0.1979), MG versus DFE (p = 0.9883), and DFE versus PMG (p = 0.9377). Given these results and the assumption of common long-run coefficients across the ASEAN-5 countries, the PMG estimator is retained as the preferred specification for examining the dynamic relationship between stock returns and exchange rate volatility. In addition, the statistically significant F-statistic indicates that the model is jointly significant.

Table 4: Panel ARDL Estimates and Panel Granger Causality Tests Results.

	ASEAN-5			Individual Effect				
	PMG	MG	DFE	Malaysia	Singapore	Indonesia	Philippines	Thailand
LONG-RUN RELATIONSHIPS								
EXRVOL	-0.117***	-0.12***	-0.155***	-1.847***				
	(0.001)	(0.001)	(0.002)	(0.0021)				
CONST	13.646***	8.768***	10.745***	13.646***				
	(0.000)	(0.000)	(0.000)	(0.000)				

SHORT-RUN RELATIONSHIPS								
D(SR(-1))	-0.052	0.078*	-0.047	0.015	0.022	-0.139***	-0.085**	-0.098***
	(0.113)	(0.089)	(0.104)	(0.669)	(0.5342)	(0.0001)	(0.0161)	(0.0056)
D(EXRVOL)	0.014**	0.008**	0.015***	0.011***	0.019***	0.007***	0.022***	0.019***
	(0.025)	(0.011)	(0.000)	(0.000)	(0.000)	(0.0064)	(0.000)	(0.000)
D(EXRVOL(-1))	-0.003	-0.004*	-0.003*	-0.001	0.004***	-0.003	0.006***	0.001
	(0.104)	(0.062)	(0.058)	(0.288)	(0.0039)	(0.1123)	(0.0023)	0(.4986)
ECT(-1)	-0.076***	-0.077***	-0.063***	-0.0003***	-0.0005***	-0.0007***	-0.0006***	-0.0007***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.0017)	(0.000)	(0.000)
R-squared				0.165	0.143	0.057	0.114	0.18
F-statistic				52.348***	43.949***	15.882***	34.056***	58.121***
Bound Test				18.123	20.955	6.048	23.175	32.601
Durbin-Watson stat				1.992	2.011	2.008	1.997	1.987
Hausman Test								
MG vs PMG	1.66 (0.1979)							
MG vs DFE	0.04 (0.9883)							
DFE vs PMG	1.26 (0.9377)							
Panel Granger Causality Test								
EXRVOL does not Granger Cause SR	221.491*** (0.000)							
SR does not Granger Cause EXRVOL	2.145 (0.1172)							
Pairwise Dumitrescu Hurlin Panel Causality Tests								
EXRVOL does not homogeneously cause SR	112.714*** (0.000)							
SR does not homogeneously cause EXRVOL	4.69*** (0.0028)							

Notes: ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively. The values in parentheses represent p-values. The lower-bound I(0) and upper-bound I(1) critical values for the bounds test at the 1% significance level are 4.940 and 5.580, respectively. The Durbin–Watson statistic is reported as a diagnostic measure of first-order serial correlation, with values close to 2 suggesting no substantial first-order autocorrelation. The Hausman tests compare the Mean Group (MG), Pooled Mean Group (PMG), and Dynamic Fixed Effects (DFE) estimators. The null hypothesis for each comparison is that the restrictions imposed by the more constrained estimator are valid, while the alternative favours the less constrained estimator. The Hausman test results are interpreted using the corresponding p-values. The prefix D. denotes the first difference of the respective variable, while the notation (-1) indicates a one-period lag. The R-squared, F-statistic, bounds-test statistic, and Durbin–Watson statistic are reported for the individual-country estimations but are not available for the ASEAN-5 panel as a whole in the raw output generated by EViews Version 14.

The PMG estimation results reveal a statistically significant negative long-run relationship between stock returns and exchange rate volatility across the ASEAN-5 economies. The error correction term is also negative and statistically significant, suggesting that stock returns adjust to deviations from the estimated long-run relationship over time. These findings should be interpreted alongside the bounds-test results and unit-root evidence to ensure that the long-run specification is appropriate. In the short run, exchange rate volatility exhibits a positive and

statistically significant relationship with stock returns. The contrasting short- and long-run results suggest that the relationship between exchange rate volatility and stock market performance varies across adjustment horizons. In the short run, exchange rate fluctuations may create trading opportunities or coincide with adjustments in export competitiveness and firms' foreign-currency revenues and costs. Over the longer term, however, persistent exchange rate uncertainty may increase investment risk and exert downward pressure on stock market performance. This interpretation is consistent with recent studies highlighting the links between exchange rate volatility and stock market dynamics across ASEAN financial markets. For instance, Umoru et al. (2025) examine the role of exchange rate volatility in explaining stock-return dynamics across ASEAN markets, while Kiatmanaroch and Puarattanaarunkorn (2025) report stronger co-movement in exchange rate volatility among ASEAN emerging markets during periods of global monetary tightening.

In terms of the individual effects, the bounds test provides evidence of a long-run relationship between stock returns and exchange rate volatility in all five ASEAN economies, as the test statistics exceed the upper-bound critical value of 5.580 for Malaysia (18.123), Singapore (20.955), Indonesia (6.048), the Philippines (23.175), and Thailand (32.601). These results support the existence of a long-run relationship between the variables in each country. However, the relatively low explanation rate of exchange rate volatility on stock returns, with all countries recording values below 20%, suggests that exchange rate volatility alone accounts for only a limited proportion of movements in stock returns. This is reasonable given that ASEAN stock markets are also influenced by other domestic and international factors, including interest rates, capital flows, commodity prices, global financial conditions, and economic policy uncertainty. Recent evidence indicates that external policy uncertainty from major economies such as the United States and China affects ASEAN stock markets differently across countries, highlighting the heterogeneous nature of the region's financial markets (Lean et al., 2024). The relatively slow but statistically significant speed of adjustment further indicates that although short-run deviations from the long-run equilibrium are corrected, the adjustment process is gradual. This may reflect differences in financial-market structures, exchange-rate arrangements, capital mobility, and the degree of exposure to international financial conditions across the ASEAN-5 economies. The IMF similarly notes that Southeast Asian emerging economies are particularly exposed to external financial and real shocks, which can generate capital-flow movements and exchange-rate volatility.

For the short-run interactions, all ASEAN-5 countries exhibit positive and statistically significant relationships between exchange rate volatility and stock returns. This finding suggests that exchange rate volatility may have a positive short-term association with stock-market returns, although the magnitude of this relationship differs across countries. Such differences can be related to the diverse economic structures of the ASEAN-5 economies. Export-oriented economies may benefit from currency movements through improved external competitiveness, while economies with greater dependence on imported inputs or foreign-denominated liabilities may face different transmission effects. Moreover, the ASEAN-5 financial markets are increasingly influenced by global monetary and financial conditions. For instance, Bank Negara Malaysia reports that movements in global monetary policy in 2024 affected portfolio flows and contributed to fluctuations in the Malaysian ringgit, while domestic economic resilience helped cushion the impact of these external financial spillovers. At the regional level, the ASEAN+3 Macroeconomic Research Office (AMRO) also highlights that ASEAN+3 financial markets remain exposed to global policy uncertainty, trade developments, and financial-market volatility. Therefore, the positive short-run relationship observed across the ASEAN-5 should be interpreted as evidence of a dynamic market response rather than as a uniform long-term effect of exchange rate volatility on stock returns.

Moreover, the Panel Granger Causality Test indicates a unidirectional predictive relationship between exchange rate volatility (EXRVOL) and stock returns (SR) in the ASEAN-5 panel. The null hypothesis that EXRVOL does not Granger-predict SR is rejected at the 1% significance level, whereas the null hypothesis that SR does not Granger-predict EXRVOL cannot be rejected. This finding suggests that past information on exchange rate volatility provides statistically significant predictive information for stock returns, beyond the information captured by the specified model. However, this result should be interpreted as evidence of predictive precedence rather than structural economic causation. From a theoretical perspective, the finding is consistent with the flow-oriented approach, which proposes that exchange rate movements may be associated with stock-market performance through international trade, export competitiveness, corporate earnings, and capital flows. It is also relevant to the portfolio-balance perspective, which emphasises the interaction between exchange rates,

international asset positions, and investors' portfolio allocation decisions. These theoretical perspectives provide possible explanations for the observed predictive relationship, but the Granger causality results alone cannot establish the underlying transmission mechanisms. Previous studies on ASEAN-5 markets have likewise reported relationships between exchange rates and stock prices, although their direction and strength vary according to the economic conditions and characteristics of individual countries.

The Pairwise Dumitrescu–Hurlin (D–H) Panel Causality Test provides additional evidence that the predictive relationships between exchange rate volatility and stock returns are heterogeneous across the ASEAN-5 economies. Both null hypotheses of homogeneous non-causality are rejected, indicating that the predictive relationships may differ across countries. Following Dumitrescu and Hurlin (2012), rejection of the homogeneous non-causality hypothesis suggests that a predictive relationship exists for at least some cross-sectional units, without requiring the relationship to be present in the same form across all countries. Therefore, the D–H results indicate that the predictive interactions between stock returns and exchange rate volatility are heterogeneous rather than uniform across the ASEAN-5 economies. This heterogeneity is economically plausible given differences in exchange-rate arrangements, financial-market development, trade structures, capital-market openness, and exposure to international financial conditions. Although ASEAN-5 economies share exposure to global financial cycles, their responses to exchange-rate movements and capital-flow shocks may differ because of country-specific monetary frameworks and domestic financial conditions. These differences provide potential economic context for the heterogeneous results, although the D–H test does not identify the specific factors responsible for the observed variation.

Taken together, the two tests provide complementary evidence on the predictive relationship between exchange rate volatility and stock returns in the ASEAN-5 panel. The conventional Panel Granger Causality Test identifies a panel-level predictive relationship running from EXRVOL to SR, while the D–H test indicates that predictive relationships in both directions may exist across the cross-sectional units and are not homogeneous across countries. Importantly, rejection of both D–H null hypotheses does not establish bidirectional predictive relationships in every ASEAN-5 economy. Instead, it indicates that homogeneous non-causality can be rejected in both directions, with the existence and direction of the relationships potentially varying across countries. Overall, the findings highlight the importance of considering both panel-level predictive relationships and cross-country heterogeneity when examining the interaction between exchange rate volatility and stock returns. While the results are compatible with trade-related and financial-market explanations discussed in the flow-oriented and portfolio-balance perspectives, they should not be interpreted as establishing structural economic causation or confirming either transmission mechanism.

5. CONCLUSION

Overall, the findings demonstrate that the relationship between exchange rate volatility and stock returns in the ASEAN-5 economies varies across adjustment horizons and countries. The PMG estimation results reveal a positive and statistically significant short-run relationship but a negative and statistically significant long-run relationship, suggesting that the association between exchange rate volatility and stock returns differs over time. The negative and statistically significant error correction term indicates that stock returns adjust to deviations from the estimated long-run relationship, while the individual-country bounds test results support the existence of long-run relationships in all five economies. Furthermore, the conventional Panel Granger Causality Test identifies a unidirectional predictive relationship running from exchange rate volatility to stock returns. In contrast, the Dumitrescu–Hurlin test rejects the homogeneous non-causality hypotheses in both directions, indicating that the predictive relationships are heterogeneous across the ASEAN-5 economies rather than uniform across countries. These findings are consistent with the flow-oriented and portfolio-balance perspectives, which offer possible explanations for stock market and exchange rate interactions through trade, corporate earnings, capital flows, and portfolio adjustments. From a policy perspective, monetary and financial authorities should monitor exchange rate volatility, particularly during periods of heightened global financial uncertainty. Firms and financial institutions with substantial foreign-currency exposure may also benefit from appropriate exchange rate risk-management and hedging practices. Given the heterogeneous findings, policymakers should consider country-specific economic structures, exchange-rate arrangements, trade exposure, and financial-market conditions rather than assume that exchange rate volatility affects all ASEAN-5 stock markets in the same way.

Despite these contributions, several limitations provide opportunities for future research. First, future studies could explicitly examine cross-sectional dependence among ASEAN-5 economies, as common global shocks, regional trade linkages, and international capital flows may influence stock returns and exchange rate volatility across countries simultaneously. Estimators such as the Dynamic Common Correlated Effects (DCCE) approach could be considered to account for unobserved common factors and cross-sectional dependence, subject to the suitability of the estimator and the data. Second, wavelet analysis could be employed to examine how the relationship between exchange rate volatility and stock returns varies across short-, medium-, and long-term horizons. Future research could also incorporate additional explanatory variables, including interest rates, inflation, commodity prices, capital flows, global financial-market volatility, and economic policy uncertainty, to provide a more comprehensive explanation of stock-return dynamics. Finally, comparisons between ASEAN and other regional or developed markets could help determine whether the observed relationships reflect broader international patterns or characteristics specific to Southeast Asian economies. These extensions would deepen understanding of exchange rate–stock market interactions and provide further evidence to support policies aimed at strengthening financial-market resilience.

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Conflict of Interest

Authors declared that there is no conflict of interests.