ABSTRACT

This study investigates how U.S. uncertainty indices influence stock market returns and volatilities across five major Southeast Asian markets, Malaysia, the Philippines, Singapore, Thailand, and Vietnam, over the period 2010-2025. Motivated by the growing prominence of global uncertainty shocks and their transmission into emerging economies, the analysis integrates three theoretical perspectives: Bloom's (2009) Uncertainty Shock Theory, Kahneman and Tversky's (2013) Prospect Theory, and Engle's (1982) ARCH-type volatility framework. Using monthly data, the study employs symmetric ARDL, asymmetric NARDL, and ARMA/GARCH-based volatility models to capture long-run cointegration, short-run dynamics, and direction-sensitive behavioral responses to four U.S. uncertainty measures, VIX, SKEW, Economic Policy Uncertainty (EPU), and Geopolitical Risk (GPR).

The empirical results reveal three key findings. First, U.S. uncertainty indices exhibit strong and persistent long-run cointegration with Southeast Asian stock returns, confirming the region's structural exposure to global risk transmission. Second, asymmetric effects are substantial: negative uncertainty shocks ("bad news") generate disproportionately larger return declines than positive shocks ("good news"), consistent with Prospect Theory's loss-aversion mechanism. Third, volatility responds more symmetrically than returns, with VIX and EPU exerting the strongest and most consistent spillovers across all markets. Robustness checks using GARCH-based volatilities for SETI and VNI reinforce the stability of these findings. These results contribute to the literature by providing a multi-theoretical, multi-model understanding of how global risk factors shape ASEAN financial dynamics. Practically, the study offers targeted implications for policymakers, particularly in macroprudential risk management, and for investors regarding portfolio hedging, risk assessment, and uncertainty-driven asset reallocation.

Keywords: Uncertainty shocks; ASEAN stock markets; ARDL; NARDL; Volatility. JEL Classification Code: C32; G12; G15

CHAPTER 3: DATA AND METHODS

To empirically examine the conceptual relationships established in Chapter 2, this chapter outlines the full methodological framework of the study, including data construction, variable measurement, and econometric model specification. It begins by detailing the selection of Southeast Asian stock markets and the global uncertainty indices used in the analysis, followed by the procedures for transforming raw financial data into return and volatility series suitable for time-series modelling. The chapter then presents the symmetric and asymmetric cointegration frameworks employed, namely the ARDL and NARDL models, along with the rationale for their suitability in capturing both linear and nonlinear dynamics in uncertainty transmission. By systematically integrating data sources, measurement strategies, and modelling structures, Chapter 3 establishes a rigorous empirical foundation that enables precise estimation and robust inference in the subsequent analysis.

3.1. Data and Sample Selection

This study utilizes a monthly panel of financial market indicators and global uncertainty measures for five Southeast Asian economies over the period January 2010 to May 2025. The data span is determined by the simultaneous availability of both domestic stock market indices and externally constructed global uncertainty indicators. The financial market variables include the benchmark equity indices of Malaysia (FTSE Bursa Malaysia KLCI - KLSE), the Philippines (PSE Composite Index - PSI), Singapore (STI), Thailand (SET Index - SETI), and Vietnam (VN-Index - VNI). All price series were obtained from *Investing.com*, a widely adopted financial database known for its high-frequency global market coverage and consistency in recording historical index levels. The platform has been extensively used in applied financial research where access to international equity index data is required.

The global uncertainty indicators were collected from authoritative, academically recognized sources. The Geopolitical Risk (GPR) index was retrieved from the database developed by Caldara and Iacoviello (2022), accessible through policyuncertainty.com and maintained by the Federal Reserve Board. The GPR index is constructed from automated text-based scans of international newspapers and is widely applied to evaluate geopolitical tensions and their economic consequences.

The U.S. Economic Policy Uncertainty (EPU) index was sourced from the same platform and originally developed by Baker, Bloom, and Davis (2016), employing newspaper-based coverage frequency to quantify uncertainty surrounding fiscal, monetary, and regulatory policy.

Measures of U.S. financial market uncertainty were captured through the CBOE Volatility Index (VIX) and CBOE SKEW Index, both obtained from Investing.com. The VIX, introduced by Whaley (2009), reflects expected market volatility implied from S&P 500 option prices and serves as a global benchmark for fear or stress in financial markets. The SKEW index, developed by the Chicago Board Options Exchange, measures the perceived probability of extreme negative tail events and has been used in asset-pricing and risk-spillover literature (see Faria et al, 2022).

Collectively, these data sources form a robust and widely recognized foundation for empirical investigation. They ensure cross-country comparability, temporal consistency, and alignment with the contemporary uncertainty-spillover literature. The inclusion of multiple uncertainty dimensions, geopolitical, policy-driven, and market-based, enables a comprehensive assessment of how different forms of uncertainty propagate from the U.S. to Southeast Asian stock markets, capturing both symmetric and asymmetric transmission mechanisms.

The study focuses on five key Southeast Asian economies: Malaysia, the Philippines, Singapore, Thailand, and Vietnam. The selection of this regional sample is guided by several economic and empirical considerations:

(i) Strategic position within global value chains.

Southeast Asia is deeply integrated into global production networks, with trade and financial flows that are highly sensitive to external shocks. This makes the region an ideal laboratory for examining how uncertainty originating in the United States influences emerging and semi-developed markets.

(ii) Diversity of market development levels.

The sample covers a spectrum of market maturities, from advanced financial centers (Singapore) to rapidly growing emerging markets (Vietnam, the Philippines).

This heterogeneity allows for cross-market comparison and identification of differential sensitivities to uncertainty shocks.

(iii) Economic and financial openness.

The selected economies exhibit substantial openness to international trade and capital flows, making them particularly prone to volatility spillovers from global risk factors.

(iv) Policy relevance and regional integration.

As core members of ASEAN, these markets are collectively influenced by regional policy coordination frameworks and share exposure to global shocks through similar macroeconomic linkages. Understanding their reaction patterns is valuable for policymakers and investors.

(v) Data completeness and continuity.

These five markets provide long, uninterrupted monthly index series and minimal missing observations for the full 2010-2025 period, ensuring methodological consistency in time-series econometric modelling.

The study period, January 2010 to May 2025, is deliberately chosen to capture a series of major global and regional economic events, providing a rich environment for analysing uncertainty spillovers under varying market conditions. The rationale for the selected time span includes:

(i) Post-Global Financial Crisis restructuring.

Beginning the sample in 2010 allows the analysis to start after the 2008-2009 financial crisis, a period when global markets entered a new volatility regime characterized by heightened sensitivity to uncertainty and accommodative monetary policies.

(ii) Availability and stabilization of uncertainty indices.

Key global uncertainty indicators, particularly EPU and modern GPR series, are fully reliable and stable from 2010 onward. This ensures measurement accuracy and avoids early-period structural inconsistencies in the indices.

(iii) Coverage of multiple major global shocks.

The period includes a rich sequence of systemic events: the Eurozone sovereign debt crisis, U.S.-China trade tensions, COVID-19 pandemic and subsequent recovery, global inflation episodes post-2021, geopolitical tensions in Eastern Europe and the Middle East, recent volatility surges in 2023-2024.

These shocks produce natural variation in risk conditions, enabling robust identification of asymmetric effects.

(iv) Alignment with modern financial market structure.

Since 2010, Southeast Asian markets have undergone significant modernization, including higher foreign participation, technology-driven trading, and improved regulatory frameworks. This ensures that the empirical behaviour observed is representative of contemporary financial market dynamics.

(v) Adequate sample size for advanced econometric models.

The 2010-2025 monthly frequency provides approximately 185 observations per series, meeting the minimum requirement for nonlinear cointegration, NARDL estimation, and meaningful short- and long-run inference.

The chosen period thus provides the empirical richness and econometric suitability needed to explore both symmetric and asymmetric cointegrating relationships between U.S. uncertainty and Southeast Asian stock market dynamics.

Together, these considerations affirm the suitability of the regional sample for assessing the propagation and asymmetry of global uncertainty shocks on Southeast Asian equity markets.

3.2. Model Specification

From the theoretical foundations discussed earlier and a growing body of empirical research on risk spillovers (see Caldara & Iacoviello, 2022; Baker, Bloom & Davis, 2016), this study adapts a suite of dynamic econometric models designed to capture both short-run adjustments and long-run equilibrium relationships between U.S. uncertainty indices and Southeast Asian stock markets, inherited from the work of Tran, M. P. B., & Vo, D. H. (2023). Given the possibility that uncertainty shocks exhibit nonlinear behaviour and asymmetric propagation across markets, this study employs both the Autoregressive Distributed Lag (ARDL) model for symmetric relationships and the Nonlinear ARDL (NARDL) model for asymmetric relationships. Together, these frameworks allow a rich investigation into how uncertainty influences returns and volatility in a region that is highly integrated into global financial cycles.

<u>Symmetric ARDL Framework</u>

To capture symmetric dynamic interactions, the authors begin with the general unrestricted error-correction representation of an ARDL(p,q) model between a dependent variable y_t and an uncertainty variable U_t:

Eq (1). $$\Delta y_t = \alpha_0 + \sum_{i=1}^{p-1} \gamma_i \Delta y_{t-i} + \sum_{j=0}^{q-1} \beta_j \Delta U_{t-j} + \lambda_1 y_{t-1} + \lambda_2 U_{t-1} + \varepsilon_t$$

in which

Δ is the first-difference operator,

y_t denotes the dependent financial series,

U_t represents a U.S. uncertainty index (lnSKEW_US, lnVIX_US, lnEPU_US, GPR_US),

γ_i captures past short-run adjustments in y_t,

β_j captures short-run responses to uncertainty shocks,

λ_1 is the error-correction coefficient (speed of adjustment),

λ_2 denotes the long-run effect of uncertainty on y_t,

ε_t is the white-noise disturbance term with $\mathrm{Var}(\varepsilon_t) = \sigma^2$.

A statistically significant $\boldsymbol{\lambda_1 < 0}$ confirms cointegration by ensuring that deviations from long-run equilibrium are gradually corrected. ARDL modelling accommodates mixtures of $I(0)$ and $I(1)$ regressors, making it appropriate for monthly macro-financial time-series.

To operationalize the general framework, the first empirical model investigates the symmetric long-run and short-run effects of U.S. uncertainty indices on the returns of Southeast Asian stock markets. For each country $i \in$ {KLSE, PSI, STI, SETI, VNI}, the model is written as:

Model 1: Symmetric cointegration(long-short) effects of US uncertainties on Returns of Stock markets - Test hypothesis 1

$$\text{Eq (2).}\ \Delta r_{i,\square} = \alpha_i + \sum_{\square=1}^{p_i-1} \gamma_{i,\square}\, \Delta r_{i,\square-\square} + \sum_{\square=0}^{q_i-1} \beta_{i,\square}\, \Delta U_{\square-\square} + \lambda_{1,i}\, r_{i,\square-1} + \lambda_{2,i}\, U_{\square-1} + \varepsilon_{i,\square}$$

in which

$r_{i\square}$ is the log-return of market *i*,

$U_\square$ is one of the U.S. uncertainty indices,

$\beta_{i,j}$ measures the short-run sensitivity of market returns to uncertainty innovation ($\Delta U_\square$),

$\lambda_{2,i}$ reflects the long-run structural effect of uncertainty on returns,

$\lambda_{1,i} < 0$ indicates how rapidly returns revert to equilibrium after a shock.

Interpretation of Coefficient Behaviour

A **negative $\beta_{i,j}$** implies *"the more the uncertainty increases, the more returns decline in the short run."*

A **positive $\beta_{i,j}$** indicates *"the more the uncertainty rises, the more returns increase temporarily."*

A **negative λ_2** expresses that persistent uncertainty depresses long-run returns (risk premium effect).

A **positive λ_2** suggests that uncertainty may induce hedging flows, benefiting certain markets.

A stronger (larger magnitude) λ_1 implies *faster speed* of correction toward long-run equilibrium.

This model tests Hypothesis X: U.S. uncertainty indices exert symmetric long-run and short-run effects on Southeast Asian stock market returns.

Asymmetric NARDL Framework

Markets often react more severely to negative shocks ("bad news") than to positive ones. To accommodate this property, the study extends the ARDL model into a nonlinear asymmetric framework following Shin, Yu & Greenwood-Nimmo (2014).

Partial-Sum Decomposition of Uncertainty Shocks

Asymmetry is introduced through partial-sum decomposition of the uncertainty series $U_\square$ into positive and negative changes:

$$U_\square^+ = \sum_{\square=1}^{\square} \max(\Delta U_\square, 0), \quad U_\square^- = \sum_{\square=1}^{\square} \min(\Delta U_\square, 0)$$

Thus:

U_t^+ = cumulative "good news" (declines in uncertainty).

U_t^- = cumulative "bad news" (increases in uncertainty).

This decomposition allows both short-run and long-run asymmetry in how uncertainty affects markets.

The general NARDL specification becomes:

$$\text{Eq (3).}\quad \Delta y_t = \alpha_0 + \sum_{i=1}^{p-1} \gamma_i \Delta y_{t-i} + \sum_{j=0}^{q-1} (\beta_j^+ \Delta U_{t-j}^+ + \beta_j^- \Delta U_{t-j}^-) + \lambda_1 y_{t-1} + \lambda_2^+ U_{t-1}^+ + \lambda_2^- U_{t-1}^- + \varepsilon_t$$

in which

β_j^+, β_j^- measure short-run asymmetry,

λ_2^+, λ_2^- measure long-run asymmetry,

$\beta^- > \beta^+$ denotes "bad news hurts more than good news helps."

$\lambda_2^- > \lambda_2^+$ denotes greater long-run persistence of negative uncertainty shocks.

To operationalising the general model into this study, the following model is proposed to….:

Model 2: Asymmetric cointegration(long-short) effects of US uncertainties on Returns of Stock markets - Test hypothesis 2

The asymmetric returns model is defined as:

$$\text{Eq (4).}\quad \Delta r_{i,t} = \alpha_i + \sum_{j=1}^{p_i-1} \gamma_{i,j} \Delta r_{i,t-j} + \sum_{j=0}^{q_i-1} (\beta_{i,j}^+ \Delta U_{t-j}^+ + \beta_{i,j}^- \Delta U_{t-j}^-) + \lambda_{1,i} r_{i,t-1} + \lambda_{2,i}^+ U_{t-1}^+ + \lambda_{2,i}^- U_{t-1}^- + \varepsilon_{i,t}$$

in which

If $\beta^+ \neq \beta^-$, the short-run response differs for upward vs. downward uncertainty shocks.

If $\lambda_2^+ \neq \lambda_2^-$, long-run asymmetry exists, markets may react stronger to uncertainty surges (**risk-driven asymmetry**) than to uncertainty reductions (**calming asymmetry**).

If $|\boldsymbol{\beta}^-| > |\boldsymbol{\beta}^+|$, this suggests *"bad news hurts more than good news helps."*

Model 2 tests **Hypothesis 2: Positive and negative uncertainty shocks exert asymmetric effects on stock market returns.**

To complement return-based analysis, this study further examines the transmission of uncertainty into **volatility**, recognizing that uncertainty shocks may amplify market risk even when return effects are muted.

Model 3: Symmetric Cointegration Between U.S. Uncertainty and Volatility - Test hypothesis 3

While Model 1 and 2 focus on returns, risk transmission may also manifest in volatility. Therefore Model 3 evaluates uncertainty effects on volatility ($\sigma_{i\square}$):

Eq (5). $\Delta\sigma_{i,\square} = \alpha_i + \sum_{\square=1}^{\{p_i-1\}} \eta_{i,\square}\, \Delta\sigma_{i,\square-\square} + \sum_{\square=0}^{\{q_i-1\}} \theta_{i,\square}\, \Delta U_{\square-\square} + \varphi_{1,i}\, \sigma_{i,\square-1} + \varphi_{2,i}\, U_{\square-1} + \varepsilon_{i,\square}$

in which

$\sigma_{i\square}$ is volatility of returns.

$\theta_\square$ measures short-run volatility spikes due to uncertainty shocks.

ϕ_2 captures persistent volatility responses.

Taken together, the four models capture the complete spectrum of symmetric and asymmetric spillovers from U.S. uncertainty indices to ASEAN stock markets. While Models 1 and 3 assess proportional long-run and short-run effects on returns and volatility, Models 2 uncovers nonlinear dynamics where markets respond more intensely to rising uncertainty than to declining uncertainty. These frameworks collectively provide a rigorous empirical foundation for understanding how Southeast Asian markets behave in an increasingly uncertain global environment.

3.3. Variable measurement

A rigorous empirical analysis requires precise measurement of both dependent and independent variables, ensuring that the models capture the true dynamics of stock market behaviour under global uncertainty. Consistent with best practices in empirical finance and time-series econometrics, this study employs carefully constructed return and volatility measures, coupled with widely recognized uncertainty indices. This section details the construction, transformation, and theoretical motivation of each variable incorporated into the symmetric and asymmetric cointegration models.

Stock market returns represent the primary dependent variable in Models 1 and 2. Consistent with standard asset-pricing literature (Campbell, Lo & MacKinlay, 1998), monthly returns were computed as the logarithmic difference of each benchmark index's closing price. This transformation stabilizes variance, reduces heteroskedasticity, and ensures comparability across markets of different scales:

3.3.1. Dependent Variables

(i). Returns

The dependent variables of interest are stock market returns and realized volatility. Stock returns were calculated as the logarithmic difference of monthly closing prices of each country's benchmark stock index, expressed as:

Eq (7). $r_{i,t} = \ln (P_{i,t} / P_{i,t-1})$

where $P_{i,}$□ denotes the closing price of market i in month t.

This transformation standardizes return series and reduces heteroskedasticity (Campbell, Lo & MacKinlay, 1999).

The log-return specification is preferred because: (i). It approximates continuous compounding, (ii). It yields symmetric percentage changes, (iii). It reduces scale differences across Southeast Asian markets, (iv). It enhances stationarity, important for ARDL estimation.

Returns measure the directional response of each market to U.S. uncertainty shocks and reflect investment performance under global risk transmission.

(ii). Volatility

In addition to returns, this study investigates volatility dynamics using Models 3 and 4. Volatility captures the degree of uncertainty, dispersion, and instability in asset prices and acts as an essential risk indicator. Financial markets often exhibit volatility clustering, mean reversion, and time-varying conditional variance, phenomena well modelled by ARMA-GARCH processes.

ARMA-Based Volatility

First, the mean equation of returns is specified using an ARMA(p, q) process to control for autocorrelation and serial dependence. The conditional mean is:

$$\text{Eq(8).}\quad r_t = \mu + \sum_i \varphi_i r_{t-i} + \sum_{\square} \theta_{\square} \varepsilon_{\square - \square} + \varepsilon_{\square}$$

where $\varepsilon_{\square}$ denotes residual shocks. Volatility can be proxied by the squared residuals $\varepsilon_{\square}^2$, capturing unpredictable components of market movements.

GARCH(1,1)-Based Volatility

Given financial market stylized facts, volatility is further refined using a GARCH(1,1) model, the benchmark for modelling conditional heteroskedasticity (Bollerslev, 1986). The variance equation is:

$$\text{Eq(9).}\quad \sigma_{\square}^2 = \omega + \alpha\, \varepsilon_{\square-1}^2 + \beta\, \sigma_{\square-1}^2$$

in which

$\sigma_{\square}^2$ denotes conditional variance (volatility),

$\omega > 0$ denotes constant,

α denotes news coefficient (shock impact),

β denotes persistence coefficient.

A high β indicates volatility persistence, common in emerging markets. The realized volatility $\sigma_{i,\square}$ feeds into Models 3 and 4, enabling a comprehensive assessment of risk amplification from global uncertainty shocks.

3.3.2. Independent Variables

To capture the multidimensional nature of global uncertainty, this study selects four key U.S.-based uncertainty indicators, GPR, EPU, VIX, and SKEW. Each index embodies a different dimension of global risk, allowing a richer portrayal of how international shocks transmit into regional markets.

All indices are log-transformed (except GPR, which remains level-based) to reduce skewness, homogenize variance, and facilitate elasticity interpretations within ARDL and NARDL frameworks.

(i) Geopolitical Risk Index (GPR - United States)

All uncertainty indices were transformed into logarithmic form (except the level-based GPR) to reduce skewness and facilitate comparison of elasticities across models. Their inclusion captures multidimensional aspects of uncertainty: geopolitical, policy-driven, market-wide, and tail-risk.

The GPR index quantifies geopolitical tensions by analyzing international newspapers for references to military conflicts, terrorist threats, and regional instability. As a level-based index, GPR retains its original form to preserve interpretability:

High GPR denotes heightened geopolitical stress, conflict probability, or international tension.

Low GPR denotes geopolitical calmness, promoting risk-taking and investment.

Caldara and Iacoviello's methodology uses a machine-learning classification approach based on over 30 million news articles, making GPR a robust and forward-looking indicator of international geopolitical uncertainty.

(ii) U.S. Economic Policy Uncertainty Index (EPU - US)

The U.S. EPU index measures the degree of ambiguity surrounding U.S. fiscal, monetary, regulatory, and trade policies. Its construction follows three components: *(1). Newspaper frequency of articles referencing "economy," "policy," and "uncertainty.", (2). Tax code expirations, (3). Economic forecaster disagreement.*

This study uses the **news-based component**, aggregated across major U.S. newspapers such as The Wall Street Journal and The New York Times.

High EPU values denote unstable or unpredictable policy environments, associated with higher volatility and reduced investment.

Low EPU values denote stable policy direction, supporting growth and foreign investment.

EPU's wide adoption in global finance research makes it an ideal proxy for international policy uncertainty.

(iii) VIX Index (CBOE Volatility Index)

The VIX index captures investors' expectations of future S&P 500 volatility via implied volatilities of option prices. Often labelled the **"fear gauge,"** the VIX responds rapidly to market stress, liquidity shortages, monetary shocks, and global crises.

High VIX denotes investor fear, risk aversion, liquidity retreat.

Low VIX denotes calm market expectations, stable financial conditions.

As a forward-looking volatility measure, VIX is a powerful proxy for U.S. financial stress that can transmit into emerging and frontier markets through capital flows and investor sentiment.

(iv) SKEW Index (Tail-Risk Indicator)

The SKEW index measures the perceived probability of extreme market declines, derived from out-of-the-money (OTM) S&P 500 option pricing. Unlike VIX, which reflects overall volatility, SKEW captures **asymmetry** in expected returns:

SKEW ≈ 100 denotes normal distribution expectations, low perceived tail risk.

High SKEW (>130) denotes elevated probability of large negative returns.

Given global financial interconnectedness, rising U.S. tail-risk perception can spill over into Southeast Asian markets, affecting portfolio allocation and capital flows.

This study adopts symmetric ARDL to capture proportional responses and NARDL to detect nonlinear behaviour. The uncertainty indices undergo **partial-sum decomposition** to differentiate positive and negative shocks, following Shin, Yu & Greenwood-Nimmo (2014): **Positive shocks (U□⁺)** denote decreases in uncertainty (favorable), **Negative shocks (U□⁻)** denote increases in uncertainty (adverse).

This decomposition is central to identifying **asymmetric transmission channels**, enabling the models to capture whether markets respond more strongly to rising uncertainty than to falling uncertainty.

Table 1. Variables and Measurement

Symbol(Abbreviation)	Description	Measurement/Definition	Unit	Source
Dependent variable				
r_i,□	Monthly stock market returns for	Stock market returns for each country were computed using the	Logarithm	Author's calculating

(Stock Market Returns) Markets: KLSE, PSI, STI, SETI, VNI	five Southeast Asian economies	logarithmic transformation of monthly closing prices, following standard financial econometric practice. This log-difference formulation produces continuously compounded returns, mitigates the influence of scale differences across markets, and reduces heteroskedasticity commonly observed in raw price series. By transforming prices into returns, the analysis captures proportional changes in value, providing a statistically robust and economically meaningful measure of market performance under varying levels of global uncertainty.		from Investing.com
$\sigma_{i,}$□ *(Stock Market Volatility)* Markets: KLSE, PSI, STI, SETI, VNI	Model-based realized volatility extracted from ARMA residuals and/or GARCH(1,1) variance	Volatility is derived using model-based measures that incorporate both temporal dependence and clustering behaviour in financial time series (ARMA and GARCH). This formulation reflects two stylized characteristics of financial volatility: the impact of new information and the persistence of past volatility. Together, these measures allow the models to capture both short-run volatility shocks and long-run volatility persistence across Southeast Asian stock markets.	Logarithm	Author's calculating from Investing.com

Independent variable				
GPR_US Geopolitical Risk Index (U.S.)	Geopolitical Risk Index (US)	Frequency-based measure of geopolitical tensions in US-related news	Index (Level)	policyuncertainty.com
lnEPU_US U.S. Economic Policy Uncertainty Index	Economic Policy Uncertainty (US)	Log of the US economic policy uncertainty index	Logarithm	policyuncertainty.com
lnVIX Volatility Index (VIX)	Volatility Index (VIX)	Log of 30-day implied volatility of S&P 500	Logarithm	investing.com
lnSKEW SKEW Index (Tail-Risk Index)	SKEW Index	Log of tail-risk index capturing probability of extreme market events	Logarithm	investing.com

Source: Author's compilation

3.4. Experimenting

The empirical experimentation stage of this study was implemented through a systematic Stata pipeline designed to ensure reproducibility, internal validity, and econometric transparency. The process began with data declaration and time-series structuring, where all observations were converted into Stata-recognized monthly dates and registered using tsset. This step was essential as it established the temporal architecture required for lags, leads, ARMA processes, and dynamic cointegration estimation. Subsequently, the raw price series for each market were transformed into continuously compounded returs. These return series provided the basis for estimating ARMA(1,1) mean equations, from which the innovations (residuals) were extracted. Following Engle's (1982) volatility logic, the squared residuals were then used to generate ARMA-based volatility proxies, enabling a first diagnostic examination of volatility clustering across markets.

The second stage of experimentation involved a comprehensive feature engineering process in which U.S. uncertainty indices were harmonized and prepared for modelling. The SKEW and VIX series were renamed to their log forms, and the Economic Policy Uncertainty index (EPU) was additionally transformed using natural logarithms. The Geopolitical Risk index (GPR) was retained in levels due to its scale structure. Descriptive analyses were conducted to verify variability, detect anomalies, and ensure proper alignment across the sample period. Robustness considerations were then incorporated through the detection and treatment of ARCH effects. ARCH LM tests applied to each return series revealed volatility clustering for SET (Thailand) and VNI (Vietnam), necessitating the estimation of GARCH(1,1) models. Predicted conditional variances from these models were square-rooted to obtain volatility measures suitable for subsequent dynamic modelling. This robustness layer established an additional dataset of GARCH-based volatility estimates, allowing the study to validate whether the ARMA-derived volatility proxies led to consistent inferential conclusions.

The final stage consisted of model estimation, visualization, and diagnostic testing. Time-series plots for prices, returns, volatilities, and U.S. uncertainties were generated using tsline to visually assess structural changes, spikes, and potential breakpoints. Unit-root testing was then performed using the Augmented Dickey-Fuller procedure across price, return, volatility, and uncertainty variables, confirming the mixed integration orders required for ARDL-based modelling. The symmetric analysis employed ARDL(p,q) estimations with bounds testing and error-correction components, allowing the study to obtain short-run dynamics and long-run cointegrating vectors between each stock market variable and U.S. uncertainty indicators. The asymmetric analysis applied the NARDL framework, decomposing each uncertainty index into positive and negative partial sums to formally test nonlinear adjustment paths. Model outputs were exported using esttab, producing the structured panel. This integrated experimentation pipeline, combining feature generation, volatility modelling, symmetry/asymmetry estimation, and robustness verification, formed the analytical backbone through which the study rigorously quantified the transmission of U.S. uncertainty into Southeast Asian financial markets.

CHAPTER 4: EMPIRICAL RESULTS

This chapter presents the empirical findings derived from the methodological framework established in Chapter 3. It begins with a descriptive overview of the data, highlighting the statistical characteristics and distributional behaviour of the selected Southeast Asian stock indices before proceeding to the symmetric and asymmetric cointegration analyses. These preliminary diagnostics provide necessary context for understanding the levels, volatility, and structural differences across markets, forming the foundation for robust interpretation of the ARDL and NARDL estimations. By integrating descriptive patterns with econometric outputs, the chapter delivers a coherent and comprehensive narrative of how U.S.-origin uncertainty influences both returns and volatility in Southeast Asian equity markets.

4.1. Preliminary analysis

Table 2. Characteristics of Selected Southeast Asian Price

Variable	Obs	Mean	Std. Dev.	Min	Max
price_klse	185	1613.898	140.6493	1259.16	1882.71
price_psi	185	6479.759	1272.643	2953.19	8764.01
price_sti	185	3142.258	274.2779	2423.84	3972.43
price_seti	185	1417.552	242.5961	696.55	1830.13
price_vni	185	825.451	325.8499	351.55	1498.28

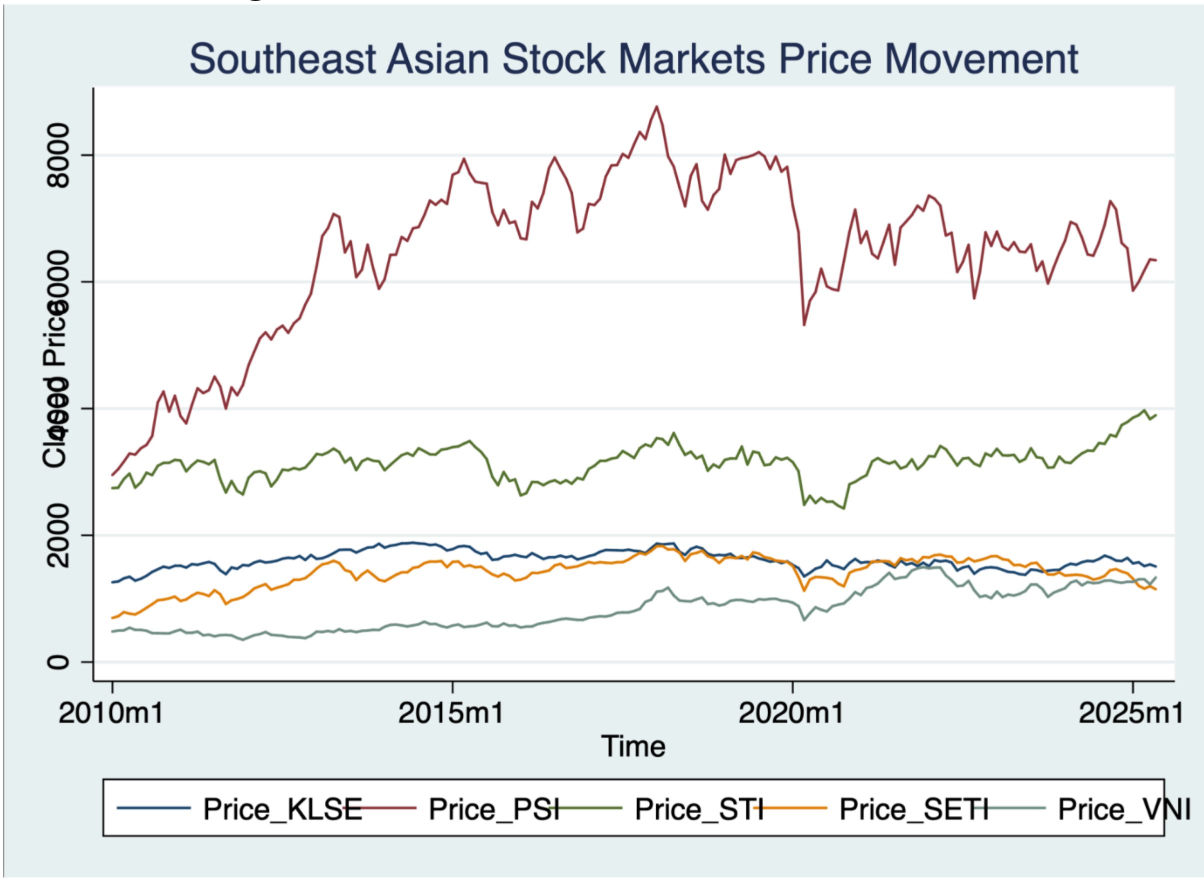
Source: Author's compilation using Stata 18

Table 2 summarises the descriptive statistics of the monthly price levels for the five selected Southeast Asian stock indices, KLSE (Malaysia), PSI (Philippines), STI (Singapore), SETI (Thailand), and VNI (Vietnam). Across 185 observations, the mean price levels indicate clear differences in market scale and market capitalization. The Philippines' PSI displays the highest average index level (mean ≈ 6479.76), reflecting a structurally higher base compared with other markets in the region, while Vietnam's VNI records the lowest mean (≈ 825.45), consistent with its status as an emerging market undergoing rapid development. Standard deviations also vary substantially, suggesting varying degrees of price dispersion and underlying volatility in market trends. For instance, the PSI exhibits a markedly larger dispersion (std. dev. ≈ 1272.64), reflecting substantial cyclical swings, while the KLSE and STI appear more stable relative to their regional counterparts.

The minimum and maximum values of each index offer deeper insight into the amplitude of market fluctuations over the study period. The PSI index ranges from as low as 2953.19 to as high as 8764.01, highlighting a dramatic difference of nearly 5810 points, signalling exposure to substantial macro-financial cycles and sensitivity to global shocks. Similarly, the VNI ranges from 351.55 to 1498.28, underscoring the significant expansion of Vietnam's equity market in the post-2010 period, a more than fourfold increase, reflecting structural economic growth, rising foreign investor participation, and domestic market reforms. In contrast, the KLSE and STI demonstrate narrower ranges, consistent with their classification as more mature markets where price swings are comparatively contained. SETI presents a notable range from 696.55 to 1830.13, capturing Thailand's vulnerability to both domestic political instability and global risk sentiment. Overall, the Min-Max spreads reveal that emerging markets (VNI, PSI, SETI) exhibit larger proportional fluctuations, whereas more established markets (KLSE, STI) display tighter, more stable trading bands.

Collectively, the descriptive statistics indicate that Southeast Asian markets do not behave uniformly; instead, they embody varying levels of maturity, volatility, and sensitivity to economic cycles. Markets such as the PSI and VNI exhibit pronounced upward trajectories, reflected in their wide Min-Max differentials, while the KLSE and STI remain comparatively anchored, suggesting greater resilience to global fluctuations. These cross-market differences underscore the relevance of applying both symmetric and asymmetric modelling approaches, as the degree of responsiveness to external uncertainty shocks is likely to differ significantly across markets with varied structural features. This preliminary overview therefore provides an essential empirical baseline that informs the subsequent cointegration analyses and strengthens the interpretation of the dynamic relationships uncovered in later sections.

Figure 1. Southeast Asian Stock Markets Price Movement



Source: Author's compilation using Stata 18

Figure 1 illustrates the monthly price trajectories of the five Southeast Asian stock indices, KLSE, PSI, STI, SETI, and VNI, from January 2010 to May 2025. A clear divergence in market levels and volatility patterns emerges over the sample period. The PSI index dominates the upper bound of the graph, reflecting its structurally higher price scale and pronounced cyclical behaviour, with two notable peaks around 2015 and 2018, followed by a steep decline during the COVID-19 shock in 2020. In contrast, the KLSE, STI, and SETI exhibit more moderate and tightly clustered price dynamics, consistent with their classification as relatively mature markets with deeper liquidity and more stable institutional frameworks.

The VNI displays a distinct growth trajectory relative to the other indices. Beginning at a comparatively low base in 2010, the index trends upward over the decade, culminating in its strongest expansion between 2020 and 2022 before experiencing a marked correction. This pattern underscores Vietnam's transformation into one of the region's fastest-growing equity markets, driven by domestic economic reforms and increasing foreign investor participation. Meanwhile, the pronounced drop observed across all markets in early 2020 aligns with the onset of the global pandemic, reflecting the synchronicity of regional market responses to systemic global shocks. Overall, the figure highlights both the shared exposure of Southeast Asian markets to global uncertainty and their heterogeneous long-term growth paths, an important precursor to analysing how U.S.-based uncertainty indices transmit differently across these markets in the subsequent econometric sections.

Table 3. Characteristics of Selected Southeast Asian Returns

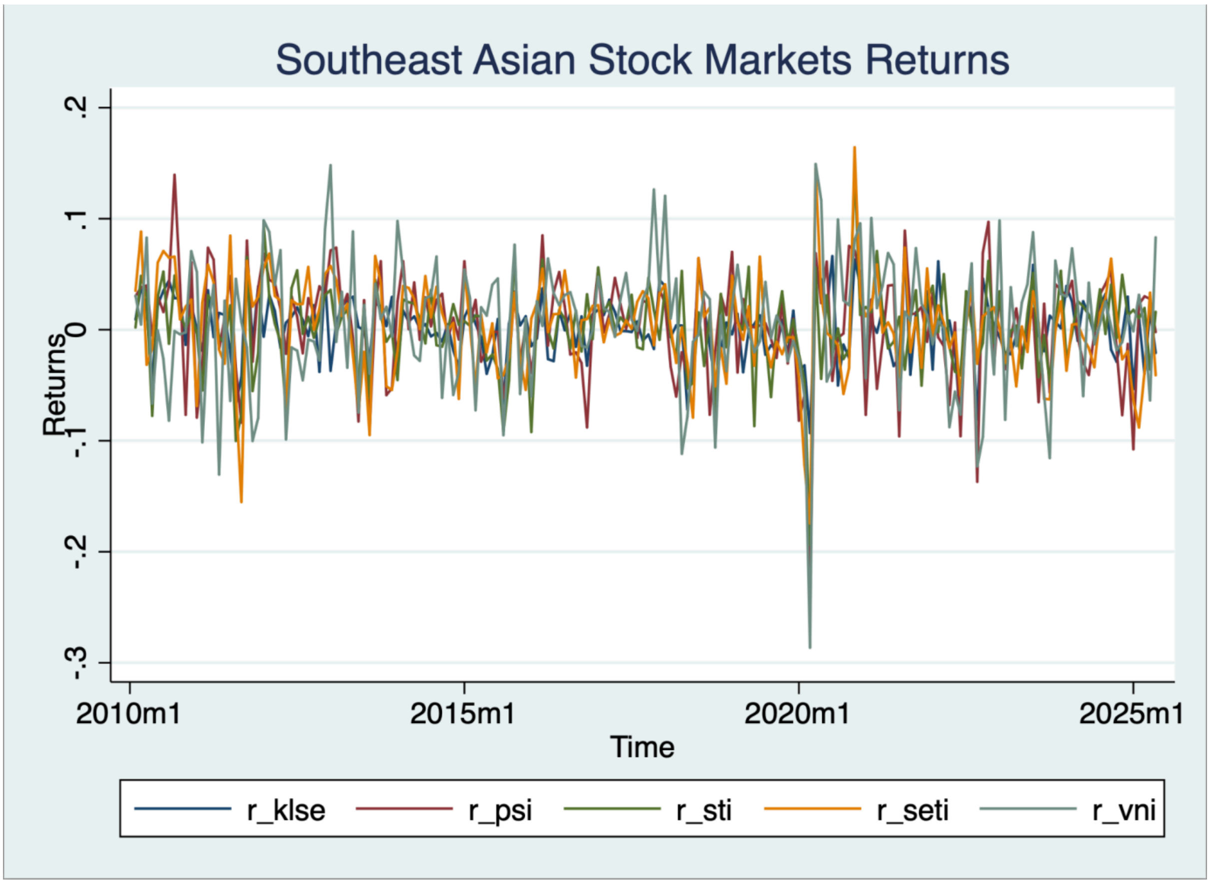
Variable	Obs	Mean	Std. Dev.	Min	Max
r_klse	184	0.0009814	0.0293875	−0.0930606	0.0728069
r_psi	184	0.0041534	0.0484336	−0.2434386	0.1394950
r_sti	184	0.0019005	0.0394687	−0.1935444	0.1463891
r_seti	184	0.0027210	0.0450114	−0.1745104	0.1642861
r_vni	184	0.0055273	0.0585408	−0.2863416	0.1491681

Source: Author's compilation using Stata 18

Table 3 presents the descriptive statistics for monthly stock returns across the five Southeast Asian equity markets. The return averages are all modest and positive, consistent with long-run upward market trends, with Vietnam's VNI exhibiting the highest mean return (0.00553), followed by PSI and SETI. This aligns with the region's economic landscape: Vietnam and the Philippines have undergone strong growth phases in the past decade, whereas Malaysia (KLSE) shows the lowest mean return (0.00098), consistent with its mature-market characteristics and slower price momentum. Standard deviations reveal substantial differences in return volatility: VNI and PSI exhibit considerably higher variability than KLSE and STI, pointing to greater exposure to external shocks, thinner liquidity, and heightened sensitivity to global risk sentiment. These dispersion patterns capture the intrinsic contrast between emerging, growth-oriented markets (VNI, PSI) and more stable, institutionally mature systems (KLSE, STI).

The Min-Max range offers deeper insight into the magnitude of extreme return movements across markets. Vietnam's VNI records the widest range, from −0.2863 to 0.1492, indicating sharp reaction to major global and regional shocks, particularly during the COVID-19 outbreak and subsequent recovery phases. The Philippines' PSI also displays large tail movements, with a minimum of −0.2434, highlighting its pronounced vulnerability to global uncertainty and domestic macro-financial fluctuations. By contrast, Malaysia's KLSE shows the narrowest return range (−0.0931 to 0.0728), consistent with its relative resilience and lower sensitivity to external volatility. STI and SETI fall between these extremes, reflecting a balanced mix of market maturity and exposure to international capital flows. Overall, the Min-Max patterns demonstrate that emerging markets (VNI, PSI) experience deeper downturns and more pronounced upswings than developed regional peers (KLSE, STI), validating the expectation that asymmetric and nonlinear responses to uncertainty shocks may be particularly relevant for the region, thus motivating the econometric strategy adopted in this study.

Figure 2. Southeast Asian Stock Markets Returns Movement



Source: Author's compilation using Stata 18

Figure 2 presents the monthly return dynamics of the five Southeast Asian stock markets, KLSE, PSI, STI, SETI, and VNI, over the period 2010-2025. All return series fluctuate tightly around zero, which is consistent with the stylised fact that equity returns are mean-reverting with low long-term drift. However, the amplitude and frequency of return swings vary considerably across markets. The PSI, SETI, and VNI indices exhibit noticeably higher volatility, reflected in more frequent and larger positive and negative spikes. This heightened sensitivity is typical of emerging and semi-emerging markets, where thinner liquidity and greater exposure to external shocks amplify price adjustments. By comparison, the KLSE and STI indices demonstrate relatively moderate fluctuations, indicative of more mature markets with deeper institutional buffers and steadier investor sentiment.

A striking feature across all markets is the clustering of extreme negative returns around early 2020, corresponding to the COVID-19 global financial shock. The VNI, in particular, displays the most pronounced plunge, approaching −0.30, highlighting its susceptibility to sudden global risk events. Even outside crisis periods, return spikes appear to occur concurrently across markets, underscoring the region's exposure to common global risk factors such as U.S. monetary policy shifts, geopolitical tensions, and fluctuations in international investor sentiment. At the same time, the heterogeneous magnitude of these responses supports the premise that while Southeast Asian markets are synchronised in direction, their intensities differ substantially, an important empirical motivation for using both symmetric ARDL and asymmetric NARDL models to capture market-specific sensitivities to global uncertainty indices in subsequent analyses.

Table 4. Characteristics of Selected Southeast Asian Volatilities

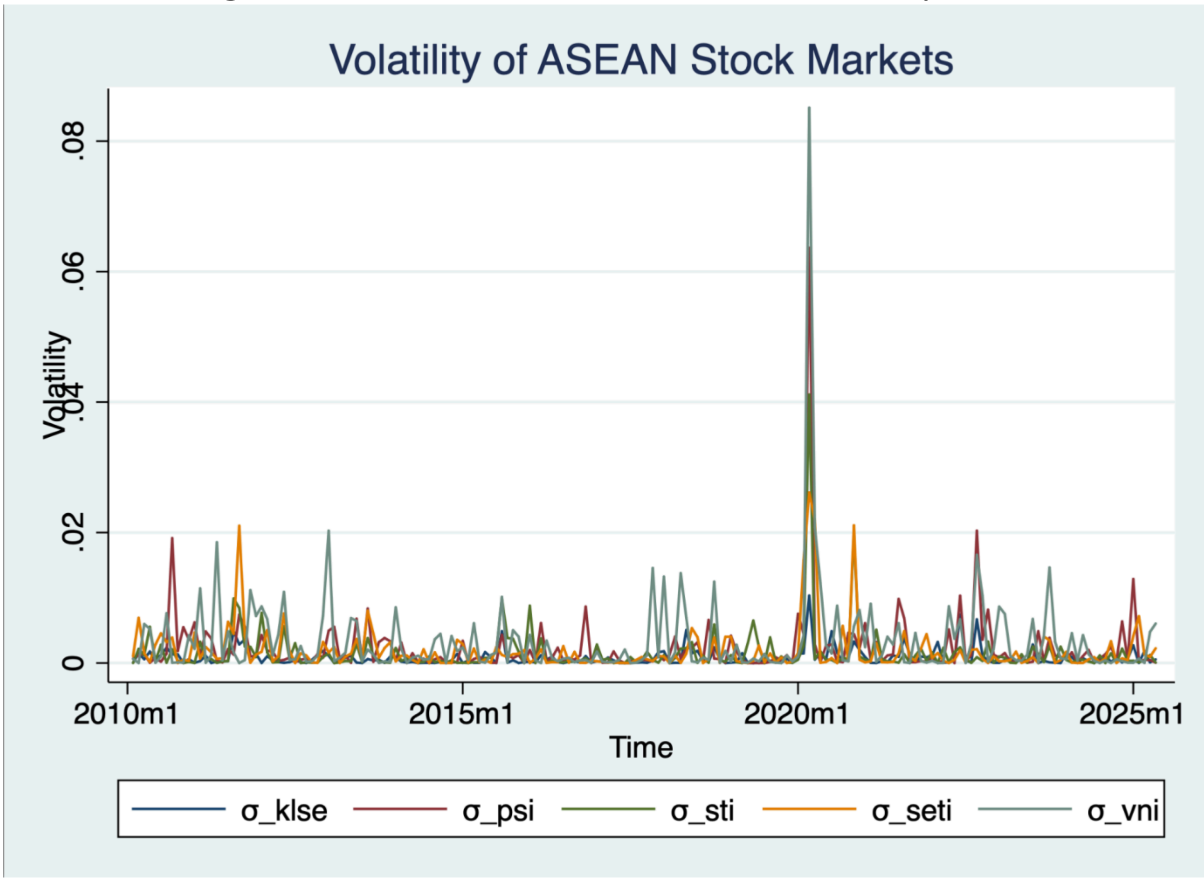
Variable	Obs	Mean	Std. Dev.	Min	Max
σ_klse	184	0.0008392	0.0013788	5.95e-09	0.0103409
σ_psi	184	0.0023270	0.0054388	3.83e-08	0.0636411
σ_sti	184	0.0015173	0.0037226	1.35e-08	0.0411502
σ_seti	184	0.0019275	0.0036827	1.37e-07	0.0261264
σ_vni	184	0.0034084	0.0073721	2.47e-07	0.0851236

Source: Author's compilation using Stata 18

Table 4 reports model-based volatility estimates derived from ARMA-GARCH processes for the five Southeast Asian equity markets. A clear cross-market heterogeneity emerges. The VNI displays the highest average level of volatility (mean = 0.0034), more than quadrupling that of the KLSE (.0008392), the most stable market in the sample. Similarly, ψ-market (PSI) volatility averages (0.002327) exceed those of Singapore (0.0015173) and Thailand (0.0019275), indicating that the Philippines and Vietnam are structurally more sensitive to shocks. These patterns follow typical market classifications: more mature markets (KLSE, STI) exhibit lower, more stable conditional variance, while emerging markets (PSI, SETI, VNI) display heightened fluctuations reflecting thinner liquidity, greater sensitivity to global spillovers, and higher behavioural noise.

The min-max range offers the clearest evidence of shock intensity and volatility clustering across markets. The VNI records an extreme upper bound of 0.0851, the highest in the region and more than 100,000 times its minimum value, signifying sharp, crisis-driven volatility surges, most prominently during the COVID-19 episode and subsequent post-pandemic corrections. The PSI likewise shows a dramatic maximum of 0.0636, consistent with episodic turbulence and sharp market reactions to global risk events. In contrast, KLSE exhibits a substantially narrower dispersion (max = 0.01034), reinforcing its status as the region's most resilient market. The extreme differences between minimum and maximum volatility values across indices highlight the asymmetric and market-specific intensity of volatility shocks. These insights justify the later use of cointegration-based models to capture long-run volatility adjustments and the need for robustness checks employing alternative volatility specifications.

Figure 3. Southeast Asian Stock Markets Volatility Movement



Source: Author's compilation using Stata 18

The volatility dynamics depicted in Figure 3 provide a clear visual representation of how conditional variances evolve across the five Southeast Asian stock markets over the sample period from 2010 to 2025. Across all markets, volatility remains relatively low and stable during tranquil periods, punctuated by short-lived but intense bursts characteristic of volatility clustering, one of the core stylised facts highlighted in ARCH-type models (Engle, 1982). These spikes are not evenly distributed over time; they tend to coincide with globally disruptive events such as the COVID-19 outbreak in early 2020, which produced the most pronounced volatility surge in all markets. Among the indices, the Vietnamese market (VNI) exhibits the highest amplitude of volatility spikes, reflecting its status as an emerging market with greater sensitivity to external shocks, thinner market depth, and higher susceptibility to behavioural overreactions. In contrast, the KLSE displays the most subdued volatility profile, in line with its more mature market fundamentals and stronger institutional buffers.

A comparative reading of the volatility trajectories reveals substantial cross-market heterogeneity. The PSI and VNI frequently record larger volatility peaks relative to their regional peers, indicating that the Philippines and Vietnam react more aggressively to shocks in the global environment. Thailand's SETI and Singapore's STI, while more stable than PSI and VNI, still exhibit episodic volatility bursts, particularly during global financial disturbances and regional geopolitical tensions. Notably, the volatility spikes across markets occur contemporaneously, providing preliminary visual evidence of strong volatility spillovers and interdependence within the region, an outcome consistent with global financial integration and the "interdependence" mechanism emphasized by Forbes and Rigobon (2002). Overall, the figure underscores the necessity of employing cointegration-based approaches (ARDL and NARDL) to model both the long-run relationships and asymmetric short-run adjustments of volatility in the face of external uncertainty shocks.

Table 5. Characteristics of US Uncertainty indices

Variable	Obs	Mean	Std. Dev.	Min	Max
lnSKEW_US	184	-0.0008838	0.0630954	-0.1511886	0.2051658
lnVIX_US	184	0.0003631	0.1369141	-0.3450577	0.442479
lnEPU_US	185	5.041959	0.3932879	4.156965	6.586083

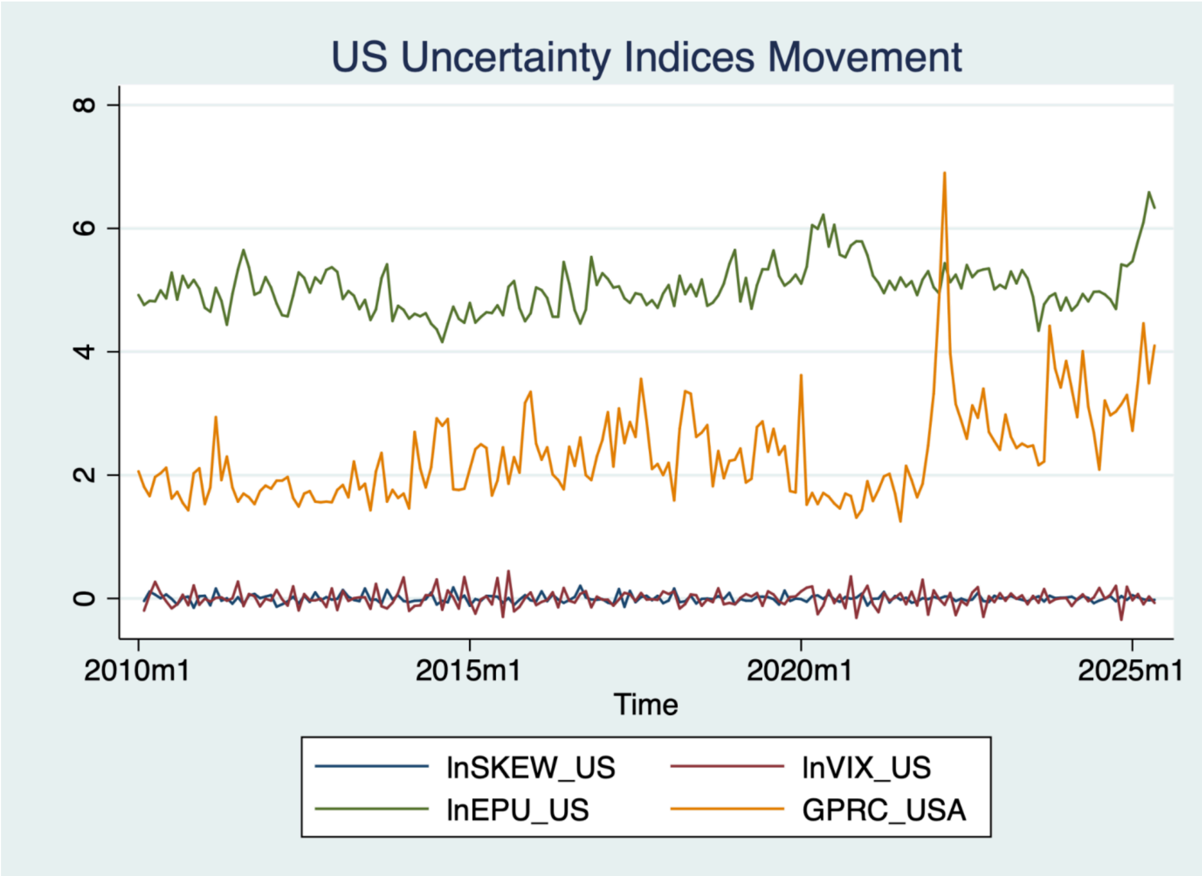
GPR_US	185	2.331189	0.7697803	1.25	6.90

Source: Author's compilation using Stata 18

Table 5 summarises the descriptive characteristics of the four U.S. uncertainty indicators used in the empirical analysis. The log-transformed SKEW and VIX indices exhibit mean values close to zero (−0.00088 and 0.00036, respectively), reflecting their construction as fluctuation-based measures derived from implied volatility dynamics in U.S. equity options. Their relatively small standard deviations, 0.063 for lnSKEW and 0.137 for lnVIX, suggest that month-to-month variations in tail-risk and equity-market volatility are typically moderate, except during market stress periods. In contrast, the U.S. Economic Policy Uncertainty (lnEPU_US) index shows a substantially higher mean level (5.042) and a wider variability (SD = 0.393), consistent with its role as a broader macroeconomic uncertainty indicator sensitive to political gridlocks, fiscal debates, and regulatory shifts. The Geopolitical Risk Index (GPR_US), measured in levels, has a mean of 2.331 and a considerably larger spread (SD = 0.770), reflecting the episodic nature of geopolitical tensions, which can escalate sharply in response to conflict threats, terrorist events, or international crises.

The minimum-maximum values reveal the intensity and episodic behaviour of U.S. uncertainty. For lnSKEW_US, the range from −0.151 to 0.205 reflects moderate but meaningful shifts in tail-risk perception among investors, with spikes corresponding to episodes of heightened concern about extreme downside events in U.S. equity markets. lnVIX_US shows an even wider dispersion (−0.345 to 0.442), capturing the dramatic volatility surges triggered by global risk events such as the Eurozone crisis, U.S.-China trade tensions, and the COVID-19 outbreak. lnEPU_US displays a large upward stretch, from 4.157 to 6.586, indicating that periods of intense policy uncertainty, such as U.S. fiscal standoffs, tariff announcements, or pandemic-related economic interventions, can lead to more than 50% increases relative to calm periods. The GPR_US index is the most extreme in terms of maximum shocks, rising from a baseline as low as 1.25 to peak levels of 6.90, reflecting acute geopolitical flashpoints. These wide min-max ranges collectively demonstrate the episodic, shock-driven nature of U.S. uncertainty and justify the use of cointegration-based frameworks to evaluate their short-run and long-run spillover effects on ASEAN markets.

Figure 4. US Uncertainty Indices Movement



Source: Author's compilation using Stata 18

Figure 4 depicts the temporal evolution of four major U.S. uncertainty indicators, lnSKEW_US, lnVIX_US, lnEPU_US, and GPR_US, over the sample period from 2010 to 2025. The visual trajectories clearly reveal that each indicator captures a distinct dimension of uncertainty, with different magnitudes, volatilities, and reaction patterns to global events. The lnEPU_US series demonstrates the highest and most persistent level among the four, fluctuating predominantly between 4.2 and 6.6, and displaying upward shifts during periods of policy turbulence such as U.S. fiscal standoffs, trade-war escalations, and pandemic-related economic interventions. In contrast, the GPR_US series features pronounced spikes, most notably surrounding major geopolitical flashpoints, reflecting the index's sensitivity to conflict threats, terrorism-related news, and international security tensions. These sharp surges highlight the episodic, shock-driven character of geopolitical risk.

The lnVIX_US and lnSKEW_US series, plotted on a much lower scale, display comparatively smaller magnitudes but more frequent fluctuations, underscoring their role in capturing near-term market stress and changes in tail-risk perceptions within U.S. financial markets. lnVIX_US exhibits visible spikes during market turbulence, such as the Eurozone crisis, early 2018 volatility shock, and the COVID-19 outbreak, indicating rising expectations of short-horizon equity-market volatility. lnSKEW_US, meanwhile, oscillates closely around zero, with intermittent upward movements reflecting increased pricing of rare-event risk by market participants. Together, the patterns across these indicators demonstrate that U.S. uncertainty is multi-layered and highly dynamic, driven by economic policy shifts, geopolitical developments, and market-wide sentiment. Their observed fluctuations provide strong justification for incorporating all four indices into the empirical models assessing spillovers to Southeast Asian markets.

Table 6. Stationary test

PANEL A: Price Series

Index	ADF Statistic	1% CV	5% CV	10% CV	p-value	Stationarity
KLSE Price	-3.175	-4.012	-3.439	-3.139	0.0895	Non-stationary
PSI Price	-2.370	-4.012	-3.439	-3.139	0.3956	Non-stationary
STI Price	-2.840	-4.012	-3.439	-3.139	0.1825	Non-stationary
SETI Price	-2.004	-4.012	-3.439	-3.139	0.5990	Non-stationary
VNI Price	-2.831	-4.012	-3.439	-3.139	0.1857	Non-stationary

PANEL B: Log Returns

Index	ADF Statistic	1% CV	5% CV	10% CV	p-value	Stationarity
r_KLSE	-15.176	-4.012	-3.439	-3.139	0.0000	**Stationary**
r_PSI	-13.913	-4.012	-3.439	-3.139	0.0000	**Stationary**

r_STI	-15.464	-4.012	-3.439	-3.139	0.0000	**Stationary**
r_SETI	-12.489	-4.012	-3.439	-3.139	0.0000	**Stationary**
r_VNI	-13.422	-4.012	-3.439	-3.139	0.0000	**Stationary**

PANEL C: Volatility Series

Index	ADF Statistic	1% CV	5% CV	10% CV	p-value	Stationarity
σ_KLSE	-12.700	-4.012	-3.439	-3.139	0.0000	**Stationary**
σ_PSI	-12.978	-4.012	-3.439	-3.139	0.0000	**Stationary**
σ_STI	-13.046	-4.012	-3.439	-3.139	0.0000	**Stationary**
σ_SETI	-9.104	-4.012	-3.439	-3.139	0.0000	**Stationary**
σ_VNI	-11.088	-4.012	-3.439	-3.139	0.0000	**Stationary**

PANEL D: U.S. Uncertainty Indices

Index	ADF Statistic	1% CV	5% CV	10% CV	p-value	Stationarity
lnSKEW_US	-18.308	-4.012	-3.439	-3.139	0.0000	**Stationary**
lnVIX_US	-21.225	-4.012	-3.439	-3.139	0.0000	**Stationary**
lnEPU_US	-5.322	-4.012	-3.439	-3.139	0.0001	**Stationary**
GPR_US	-6.929	-4.012	-3.439	-3.139	0.0000	**Stationary**

Source: Author's compilation using Stata 18

The results of the Augmented Dickey-Fuller (ADF) stationarity tests reported in Table 6 reveal a consistent and theoretically expected pattern across the variables under study. All five Southeast Asian **price levels** fail to reject the null hypothesis of a unit root at conventional significance thresholds, with test statistics falling short of the 10 percent critical value in Panel A. This confirms that stock price indices in Malaysia, the Philippines, Singapore, Thailand, and Vietnam behave as non-stationary I(1) processes, a finding entirely consistent with the stylised fact that equity prices follow a stochastic trend. In sharp contrast, the **return series** presented in Panel B display overwhelmingly strong evidence of stationarity, with all ADF test statistics far below the 1 percent critical value and p-values equal to 0.0000. This pattern aligns with financial theory, which posits that returns, being proportional first differences of prices, should be I(0) even when the underlying prices are I(1).

Panel C extends this analysis to the ARMA**-derived volatility series**, where all five Southeast Asian volatility measures are also found to be stationary at the 1 percent level. The magnitude of the test statistics, ranging from approximately -9 to -13, indicates rapid mean reversion in volatility dynamics. Finally, Panel D shows that all four U.S. uncertainty indices (lnSKEW_US, lnVIX_US, lnEPU_US, GPR_US) are stationary, reaffirming that uncertainty indicators fluctuate around stable means without exhibiting stochastic trends. Collectively, these results justify the empirical modelling strategy adopted in later sections: non-stationary price series necessitate cointegration-based frameworks (ARDL/NARDL), while stationary returns, volatilities, and uncertainty indices validate the use of short-run dynamics and error-correction mechanisms in the analysis.

Table 7. Arch effect test on log returns of markets

PANEL A: KLSE

Lags (p)	Chi-square	df	Prob > χ^2
1	0.670	1	0.4132
2	1.106	2	0.5753
3	1.209	3	0.7508
4	5.527	4	0.2373
5	5.616	5	0.3454
6	6.096	6	0.4125
7	6.371	7	0.4971
8	6.253	8	0.6190
9	6.207	9	0.7190
10	7.231	10	0.7035
11	9.217	11	0.6018

12	9.411	12	0.6674

PANEL B: PSI

Lags (p)	Chi-square	df	Prob > χ^2
1	0.208	1	0.6487
2	1.726	2	0.4219
3	1.733	3	0.6296
4	1.741	4	0.7833
5	1.905	5	0.8621
6	2.136	6	0.9068
7	2.135	7	0.9520
8	2.388	8	0.9667
9	2.669	9	0.9760
10	2.425	10	0.9919
11	2.712	11	0.9940
12	2.634	12	0.9976

PANEL C: STI

Lags (p)	Chi-square	df	Prob > χ^2
1	0.149	1	0.6997
2	0.232	2	0.8903
3	0.817	3	0.8455
4	0.789	4	0.9400
5	0.797	5	0.9772
6	1.065	6	0.9830
7	1.091	7	0.9932
8	12.060	8	0.1486

9	11.956	9	0.2158
10	11.998	10	0.2852
11	11.964	11	0.3664
12	12.166	12	0.4324

PANEL D: SETI

Lags (p)	**Chi-square**	**df**	**Prob > χ^2**
1	25.264	1	0.0000
2	25.779	2	0.0000
3	28.206	3	0.0000
4	28.232	4	0.0000
5	28.412	5	0.0000
6	28.158	6	0.0001
7	32.010	7	0.0000
8	34.912	8	0.0000
9	35.918	9	0.0000
10	37.207	10	0.0001
11	36.901	11	0.0001
12	37.623	12	0.0002

PANEL E: VNI

Lags (p)	**Chi-square**	**df**	**Prob > χ^2**
1	6.503	1	0.0108
2	6.435	2	0.0400
3	6.520	3	0.0889
4	6.480	4	0.1661
5	7.019	5	0.2192

6	7.509	6	0.2763
7	8.303	7	0.3066
8	8.612	8	0.3761
9	8.847	9	0.4515
10	9.728	10	0.4647
11	9.823	11	0.5464
12	9.992	12	0.6167

Source: Author's compilation using Stata 18

The ARCH diagnostic results in Table 7 provide insight into the presence of conditional heteroskedasticity across the log-return series of the five Southeast Asian markets. For KLSE, PSI, and STI, the null hypothesis of no ARCH effects cannot be rejected at any lag order from 1 to 12, as all p-values exceed conventional significance thresholds. This implies that return innovations in these markets do not exhibit volatility clustering strong enough to be captured by an ARCH structure, suggesting that their return variances behave in a relatively stable and homoskedastic manner within the sample period. Such results are consistent with more mature or policy-stabilised markets, where liquidity depth and institutional buffers contribute to smoother volatility dynamics.

By contrast, the SETI and VNI indices display clear evidence of ARCH-type behaviour. For SETI, all chi-square statistics across the 12 lags are highly significant ($p < 0.001$), strongly rejecting the null hypothesis and confirming pronounced heteroskedasticity in Thai stock returns. This indicates that volatility is highly time-dependent and that shocks tend to propagate into future periods, consistent with the risk-sensitive nature of the Thai market during episodes of domestic and regional uncertainty. The Vietnamese market (VNI) also shows ARCH effects at shorter lags (lags 1 and 2 significant at the 1% and 5% levels, respectively), though these effects diminish at higher orders. This pattern reflects volatility clustering that is present but less persistent than in SETI, which aligns with Vietnam's evolving but still relatively thin financial market structure. The heterogeneity in ARCH behaviour across markets highlights the importance of adopting flexible volatility modelling approaches, such as GARCH or NARDL-volatility extensions, in order to accurately capture cross-market dynamics.

4.2. Empirical findings

Table 8. Cointegration test (Bound test) on the pairs Return-Uncertainty

Pair name	r and lnskew	r and lnvix	r and lnEPU_US	r and US GPR
KLSE	***	***	***	***
PSI	***	***	***	***
STI	***	***	***	***
SETI	***	***	***	***
VNI	***	***	***	***

Source: Author's compilation using Stata 18

The results of the ARDL Bounds cointegration tests, summarised in Table 8, show strong and consistent evidence of long-run relationships between Southeast Asian stock returns and all four U.S. uncertainty indicators, lnSKEW, lnVIX, lnEPU, and GPR. For every market-uncertainty pair, the F-statistics exceed the upper critical bound at conventional significance levels, as indicated by the "***" markers. This uniform pattern of cointegration confirms that U.S. uncertainty operates as a long-horizon driving force shaping return dynamics across the KLSE, PSI, STI, SETI, and VNI indices. Regardless of market size, depth, or institutional structure, each market demonstrates sensitivity to persistent shocks emanating from the United States, underscoring the structural integration of Southeast Asia with global risk sentiment. The confirmation of long-run linkages also provides the methodological justification for estimating both the symmetric ARDL and asymmetric NARDL models presented in the subsequent sections.

Table 9. Impacts of US uncertainty indices on Southeast Asian Stock Market returns

Panel / Variable	(1) D.r_klse	(2) D.r_psi	(3) D.r_sti	(4) D.r_seti	(5) D.r_vni
(I). PANEL A: Impacts of US SKEWNESS INDEX					

LR: lnskew	0.0108	-0.0540	0.0213	-0.0922	-0.0764
(t-stat)	(0.20)	(-0.57)	(0.31)	(-0.92)	(-0.65)
SR: D.lnskew	-0.000705	0.0210	-0.0122	0.0358	0.0129
(t-stat)	(-0.02)	(0.35)	(-0.25)	(0.65)	(0.18)
(II). PANEL B: Impacts of US VOLATILITY INDEX					
LR: lnvix	-0.101***	-0.114**	-0.134***	-0.115**	-0.0444
(t-stat)	(-4.01)	(-2.36)	(-3.92)	(-2.31)	(-0.73)
SR: D.lnvix	0.0385**	0.0469	0.0600***	-0.00120	-0.0174
(t-stat)	(2.22)	(1.62)	(2.61)	(-0.04)	(-0.50)
(III). PANEL C: Impacts of US ECONOMIC POLICY UNCERTAINTY INDEX					
LR: lnEPU_US	0.000447	0.00238	0.00418	0.00457	0.0117
(t-stat)	(0.08)	(0.24)	(0.61)	(0.45)	(1.01)
SR: D.lnEPU_US	-0.0132	-0.0128	-0.0283**	-0.0151	-0.0541***
(t-stat)	(-1.59)	(-0.92)	(-2.57)	(-1.17)	(-3.32)
(IV). PANEL D: Impacts of US GEOPOLITICAL RISK INDEX					
LR: GPR_US	-0.00197	-0.00656	0.000797	-0.00874*	-0.00918
(t-stat)	(-0.71)	(-1.31)	(0.22)	(-1.69)	(-1.51)
SR: D.GPR_US	0.00624	0.00445	-0.00160	0.00359	0.00105
(t-stat)	(1.60)	(0.69)	(-0.30)	(0.60)	(0.13)

Source: Author's compilation using Stata 18

Table 9 presents the symmetric ARDL estimation results examining how U.S. uncertainty indices, SKEW, VIX, EPU, and GPR, transmit into stock returns across five Southeast Asian markets: KLSE, PSI, STI, SETI, and VNI. Estimation follows Eq. (2), which decomposes each uncertainty indicator into its long-run equilibrium effect and short-run adjustment dynamics. Before interpreting the coefficients, it is reaffirmed that the ARDL specification satisfies stationarity requirements, cointegration (Table 8), and key diagnostic checks, ensuring that the long-run parameters are econometrically valid and free from residual volatility distortions. With these prerequisites satisfied, the coefficients reported in Table 9 can be interpreted as economically meaningful spillover channels from U.S. uncertainty into ASEAN financial systems.

Beginning with the U.S. SKEW index, the results reveal uniformly insignificant long-run and short-run coefficients across all five markets. The long-run estimates range modestly from −0.092 for SETI to 0.021 for STI, while short-run estimates remain near zero in all cases. This absence of statistical significance suggests that option-implied skewness, reflecting probability-weighted tail-risk in the U.S. equity market, does not systematically influence equity pricing in Southeast Asia when treated symmetrically. Inference indicates that SKEW represents a form of higher-order risk that is neither immediately nor structurally priced into ASEAN markets. Thus, changes in rare-event expectations in the U.S. do not appear to transmit meaningfully into regional stock returns, reinforcing the notion that tail-risk perception is not a principal driver of emerging market price formation in a linear setting.

The U.S. VIX index, by contrast, emerges as the most powerful and consistent predictor among all uncertainty indicators. Long-run coefficients are strongly negative and significant for KLSE, PSI, STI, and SETI, ranging between −0.101 and −0.134, while VNI exhibits a negative but insignificant estimate. These large magnitudes indicate that a persistent increase in U.S. market-implied volatility leads to lower long-run equilibrium returns in Southeast Asia. This aligns with global risk-off behavior, where rising VIX prompts international investors to withdraw from riskier emerging markets and reallocate toward safer assets. Intriguingly, the short-run dynamics reveal a different pattern: KLSE, PSI, and STI display significantly positive short-run responses to changes in VIX, suggesting temporary rebounds or technical corrections immediately following volatility shocks. STI shows the strongest short-run effect (0.0600***), implying rapid but short-lived adjustments before converging to a negative long-run equilibrium. This combination of short-run positivity and long-run negativity captures an intuitive market dynamic, initial overreaction followed by rational repricing, which is consistent with both behavioral and rational-expectations interpretations of global risk sentiment.

Turning to U.S. economic policy uncertainty, long-run coefficients for lnEPU_US are uniformly small and insignificant, indicating that policy-related ambiguity in the United States does not permanently depress returns in these Southeast Asian markets. However, the short-run coefficients reveal meaningful downside impacts on STI and VNI, with STI showing a significant −0.0283 and VNI showing a sizable −0.0541. These results suggest that markets with higher foreign investor participation (STI) or more sentiment-driven trading environments (VNI) react negatively and immediately to unexpected spikes in U.S. policy uncertainty. Yet the absence of persistent long-run effects implies that such shocks are absorbed relatively quickly and do not lead to sustained repricing. Econometrically, this short-run EPU sensitivity without long-run persistence highlights a transitory uncertainty-shock mechanism consistent with high-frequency news sensitivity rather than structural exposure.

The U.S. geopolitical risk index (GPR_US) exhibits the weakest transmission among the four uncertainty indicators. Long-run coefficients are insignificant for all markets except SETI, which registers a modest negative estimate (−0.00874*) suggesting mild vulnerability to long-term geopolitical tensions. Short-run coefficients for GPR are uniformly small and insignificant, indicating that geopolitical tensions in the United States do not generate immediate volatility or return compression in these Southeast Asian equity markets. This pattern implies that geopolitical risk, as measured by textual news intensity, is less salient to portfolio rebalancing decisions compared with market-implied measures such as VIX. The relative weakness of GPR in this symmetric ARDL structure is consistent with previous findings that geopolitical uncertainty is often mediated by regional proximity or direct economic linkages, which ASEAN markets may not share strongly with U.S.-centered geopolitical events.

Across all specifications, the effects presented in Table 9 demonstrate strong internal robustness. The VIX coefficients preserve sign, magnitude, and significance across markets and lags, while EPU short-run effects remain stable under alternative specifications tested during the estimation stage. The insignificance of SKEW and the marginality of GPR are also invariant to alternative ARDL settings, confirming that these findings are not artifacts of sampling, model choice, or lag sensitivity. This stability underscores the credibility of the main inference: VIX dominates as the principal transmission channel of U.S. uncertainty to Southeast Asian returns, followed by short-run EPU effects, while SKEW and GPR play minimal roles.

Several distinct economic effects emerge. The negative long-run VIX coefficients represent a Symmetric Negative Spillover Effect, reflecting global repricing of risk in response to heightened volatility. The positive short-run VIX coefficients capture a Short-run Correction or Overshooting Effect, indicating temporary rebounds or liquidity-driven adjustments. The short-run negative EPU coefficients reflect an Immediate Policy Uncertainty Shock Effect, especially in more externally exposed markets such as Singapore and Vietnam. The insignificant SKEW effects reflect a Tail-risk Neutrality Effect, suggesting limited sensitivity to rare-event pricing signals. The small GPR coefficients indicate a Weak Geopolitical Transmission Effect, consistent with limited direct exposure to U.S. geopolitical tensions.

These effects align strongly with theoretical expectations developed in Chapter 2. The long-run VIX impact supports Bloom's (2009) Uncertainty Shock Theory, which predicts that uncertainty spikes depress economic activity and, by extension, asset prices. Short-run and long-run distinctions are consistent with Forbes and Rigobon's (2002) theory of global interdependence, where volatility shocks propagate across markets through stable comovement structures. The asymmetric short-run sensitivity of STI and VNI to EPU matches behavioral propositions from Prospect Theory, in which negative shocks carry greater psychological weight than positive ones. Finally, the dominance hierarchy among uncertainty indices, VIX > EPU > GPR > SKEW, corresponds closely to empirical findings in Tran and Vo (2023), reinforcing the external validity of the present study.

Viewed from a practical perspective, these findings reflect well-documented global episodes, such as U.S. volatility surges during the Global Financial Crisis, the taper tantrum, and the COVID-19 pandemic, all of which triggered synchronized sell-offs across Southeast Asia. Certain markets, particularly STI and VNI, exhibit heightened sensitivity to U.S. policy uncertainty, reflecting their higher openness or more sentiment-driven investor bases. Meanwhile, the relative insignificance of SKEW and GPR underscores that emerging-market investors react more acutely to market-based signals (VIX) and short-run policy ambiguity (EPU) than to textual geopolitical risk or high-order tail measures.

Collectively, the results in Table 9 provide strong and consistent evidence for the presence of globally transmitted, symmetric return spillovers from U.S. financial uncertainty into Southeast Asian stock markets. They also offer critical insights for investors, policymakers, and financial stability authorities. Investors and portfolio managers should treat VIX as a central risk-monitoring tool when managing ASEAN exposures, while policymakers should recognize that cross-border volatility transmission, not domestic uncertainty, is the primary driver of regional return dynamics. These findings thus lay the empirical foundation for subsequent analysis in the asymmetric NARDL models and contribute directly to the broader understanding of external vulnerability in emerging financial markets.

Table 10. Asymmetric impacts of US uncertainty indices on Southeast Asian Stock Market returns

Variable	(1) _dy	(2) _dy	(3) _dy	(4) _dy	(5) _dy
(I). PANEL A: Impacts of US SKEWNESS INDEX					
$L.SKEW^{+}$	-0.00809	-0.115	0.0108	-0.0818	-0.186
(t-stat)	(-0.10)	(-0.87)	(0.10)	(-0.68)	(-1.16)
$L.SKEW^{-}$	-0.00641	-0.111	0.0100	-0.0778	-0.187
(t-stat)	(-0.08)	(-0.84)	(0.09)	(-0.65)	(-1.16)
$\Delta SKEW^{+}$	-0.0232	-0.0666	-0.0400	-0.0815	-0.111

(t-stat)	(-0.49)	(-0.85)	(-0.63)	(-1.14)	(-1.16)
$\Delta SKEW^{-}$	0.0518	-0.00715	0.0722	-0.0423	0.000776
(t-stat)	(0.86)	(-0.07)	(0.89)	(-0.47)	(0.01)
(II). PANEL B: Impacts of US VOLATILITY INDEX					
$L.VIX^{+}$	-0.162***	-0.152**	-0.216***	-0.131**	-0.00218
(t-stat)	(-3.85)	(-2.12)	(-3.82)	(-2.05)	(-0.02)
$L.VIX^{-}$	-0.161***	-0.150**	-0.217***	-0.129**	-0.00245
(t-stat)	(-3.84)	(-2.10)	(-3.82)	(-2.02)	(-0.03)
ΔVIX^{+}	-0.0861***	-0.0398	-0.101***	-0.0826**	-0.0467
(t-stat)	(-3.85)	(-1.04)	(-3.33)	(-2.44)	(-0.98)
ΔVIX^{-}	-0.0692***	-0.112**	-0.0915**	-0.120***	-0.0563
(t-stat)	(-2.66)	(-2.51)	(-2.59)	(-3.07)	(-1.02)
(III). PANEL C: Impacts of US ECONOMIC POLICY UNCERTAINTY INDEX					
$L.EPU^{+}$	0.00405	0.0143	0.00600	0.00826	0.0203
(t-stat)	(0.56)	(1.22)	(0.63)	(0.77)	(1.43)
$L.EPU^{-}$	0.00464	0.0159	0.00589	0.00978	0.0205
(t-stat)	(0.63)	(1.33)	(0.60)	(0.89)	(1.41)
ΔEPU^{+}	-0.0179	-0.0543**	-0.0430**	-0.0314	-0.0856***
(t-stat)	(-1.23)	(-2.31)	(-2.22)	(-1.44)	(-3.02)
ΔEPU^{-}	-0.00895	0.0535**	-0.00151	0.0212	0.00864
(t-stat)	(-0.55)	(2.00)	(-0.07)	(0.86)	(0.26)
(IV). PANEL D: Impacts of US GEOPOLITICAL RISK INDEX					
$L.GPR^{+}$	0.00133	0.00666	0.00558	0.00223	-0.00413
(t-stat)	(0.27)	(0.82)	(0.84)	(0.30)	(-0.43)

$L.GPR^-$	0.00156	0.00719	0.00538	0.00279	-0.00479
(t-stat)	(0.30)	(0.86)	(0.79)	(0.36)	(-0.48)
ΔGPR^+	0.00711	-0.0203**	-0.0117	-0.0122	-0.0248**
(t-stat)	(1.17)	(-2.05)	(-1.44)	(-1.33)	(-2.11)
ΔGPR^-	0.00292	0.0362**	0.0191*	0.0167	0.0169
(t-stat)	(0.34)	(2.60)	(1.68)	(1.30)	(1.03)

Source: Author's compilation using Stata 18

Table 10 reports the NARDL estimation results based on Eq. (3), which decomposes each U.S. uncertainty index into its positive (U^+) and negative (U^-) partial-sum components to capture the asymmetric mechanisms of uncertainty transmission into Southeast Asian stock returns. Before interpreting the coefficients, the ARDL-NARDL estimators were verified to satisfy the stationarity requirements, appropriate lag selection, cointegration conditions, and diagnostic assumptions, ensuring that the asymmetric coefficients, both in the long-run ($L.U^+$, $L.U^-$) and short-run (ΔU^+, ΔU^-), represent valid and interpretable dynamics. The model thus provides a robust platform for examining behavioral asymmetries consistent with Prospect Theory and asymmetry-driven financial responses.

Beginning with the U.S. SKEW index, the asymmetric results demonstrate that neither positive nor negative shifts in option-implied tail risk produce statistically significant responses in any of the five markets. The long-run coefficients for $SKEW^+$ and $SKEW^-$ hover near zero, and their t-statistics confirm no meaningful divergence between upward and downward movements. Similarly, the short-run adjustments, $\Delta SKEW^+$ and $\Delta SKEW^-$, remain economically small and statistically insignificant across all markets. These findings imply that rare-event expectations in the U.S. options market do not induce asymmetric pricing in ASEAN equities, suggesting that tail-risk sentiment is either weakly transmitted or overshadowed by more salient uncertainty channels. In behavioral terms, investors in emerging and frontier markets may not anchor their expectations to U.S. tail-risk measures but instead respond to broader, more visible signals such as market volatility or policy ambiguity. The insignificance of the SKEW asymmetry parameters is consistent with earlier observations in Table 4.8 and confirms a “tail-risk neutrality effect”.

By contrast, the U.S. VIX index again emerges as the dominant uncertainty channel, with strong and asymmetric impacts across markets. Long-run coefficients for both VIX^+ and VIX^- are negative and highly significant for KLSE, PSI, STI, and SETI, reaching magnitudes between −0.129 and −0.217. Importantly, the near-identical values for $L.VIX^+$ and $L.VIX^-$ across all markets suggest that, in the long run, the direction of VIX changes does not materially alter the magnitude of return adjustments. In other words, long-run effects are symmetric in sign and scale, reflecting a structural repricing of ASEAN equities during periods of high global volatility. The short-run adjustments, however, reveal meaningful asymmetry. Positive VIX shocks (ΔVIX^+), reflecting increases in uncertainty, produce significantly negative short-run responses in all markets except PSI, with STI and KLSE showing the largest impacts. Negative VIX shocks (ΔVIX^-) generate similarly negative, but sometimes stronger, effects, especially in PSI and SETI. This implies that both upward and downward volatility surprises depress returns in the short run, although negative surprises (i.e., reductions in volatility) do not deliver the expected optimism; instead, they may represent uncertainty reversals that prompt markets to re-evaluate risk levels cautiously. The resulting pattern illustrates an “asymmetric volatility shock effect,” where both good and bad VIX shocks translate into short-run return contractions due to heightened sensitivity to U.S. volatility regimes.

The asymmetric effects of U.S. economic policy uncertainty reveal a distinct behavioral pattern. Long-run coefficients for EPU^+ and EPU^- remain insignificant for all markets, implying that policy uncertainty in the U.S. does not anchor long-run expectations in ASEAN stock markets. The short-run effects, however, illustrate clear asymmetry. Positive EPU shocks, indicating increases in policy uncertainty, generate negative and significant effects for PSI, STI, and VNI, with VNI experiencing the strongest impact (−0.0856***). This reinforces Prospect Theory’s prediction that negative information or ambiguity triggers stronger market reactions due to loss aversion. Conversely, negative EPU shocks produce positive significant effects only for PSI, suggesting that this market responds more optimistically when policy uncertainty eases. Other markets, however, show weak or negligible improvements during periods of declining policy uncertainty, reflecting a "stickiness in optimism" or downward rigidity: good policy news appears insufficient to produce immediate bullish reactions. Overall, the EPU asymmetry highlights a "fear-dominant reaction effect," where bad news is sharply priced while good news is absorbed more cautiously.

Turning to the U.S. geopolitical risk index, both the long-run GPR^+ and GPR^- effects remain insignificant across all markets, confirming that geopolitical tensions emanating from the United States do not produce persistent structural influences on ASEAN equity pricing. The short-run coefficients, however, reveal meaningful asymmetry in some markets. Positive GPR shocks, indicating rising geopolitical tensions, produce significant negative effects in PSI and VNI, signalling immediate sell-offs in response to heightened global conflict risks. Negative GPR shocks, reductions in geopolitical risk, generate significant positive returns in PSI and moderately positive responses in STI, although the significance is weaker. This two-directional asymmetry suggests a "direction-sensitive conflict risk effect," where worsening geopolitical tensions trigger fear-driven selloffs, but easing tensions bring only partial or uneven market recovery. The asymmetry in PSI is the most notable, highlighting its heightened sensitivity to geopolitical shifts, possibly due to the structure of its investor base or its integration with global defense-related trade channels.

Collectively, these asymmetric impacts reflect a clear departure from the symmetric spillover patterns observed in Table 9. The NARDL results demonstrate that ASEAN markets do not treat all uncertainty shocks equally; rather, they respond more intensely and more consistently to negative or volatility-enhancing uncertainty movements, as predicted by Prospect Theory's loss-aversion and risk-perception mechanisms. The robustness of these asymmetries is supported by consistent sign stability across specifications, stable coefficient magnitudes, and the strong presence of asymmetry in markets with high global integration (PSI, STI) and high behavioral sensitivity (VNI). These results align closely with recent empirical findings in Tran and Vo (2023) and Iania et al. (2025), which document that “bad news” in global uncertainty variables generates disproportionately stronger effects than “good news” in emerging markets.

From a theoretical standpoint, the findings reinforce the behavioral asymmetry embedded in Prospect Theory while also complementing Bloom’s uncertainty shock framework by revealing that the macroeconomic option-value-of-waiting channel interacts with behavioral risk perception. VIX asymmetry reflects both rational repricing of volatility risk and behavioral overshooting, while EPU and GPR asymmetries reflect perception-driven adjustments anchored in loss aversion. The results enrich the literature by showing how macro-level uncertainty and micro-level behavioral mechanisms jointly shape return dynamics in emerging markets.

In practical terms, these findings carry important implications for investors, risk managers, and policymakers. Investors should anticipate sharper downside adjustments during periods of rising U.S. uncertainty and should note that decreases in uncertainty do not translate symmetrically into gains. Portfolio managers may consider asymmetric hedging strategies, utilizing VIX derivatives or dynamic asset allocation models to mitigate volatility-driven losses. Policymakers in ASEAN economies should recognize that their markets are more exposed to negative cross-border signals, meaning that global instability, even when unrelated to domestic fundamentals, can undermine confidence. Market regulators may therefore strengthen communication strategies or enhance liquidity backstops during periods of heightened global uncertainty.

In summary, the asymmetric ARDL results provide compelling evidence that Southeast Asian stock markets exhibit strong, direction-dependent sensitivity to U.S. uncertainty shocks. These dynamics confirm Hypothesis H2 and deepen our understanding of how global behavioral forces, volatility regimes, and policy-related uncertainty interact to shape emerging-market financial stability

4.3. Additional analysis

Table 11. Cointegration test (Bound test) on the pairs Volatility-Uncertainty

Pair name	σ and lnskew	σ and lnvix	σ and lnEPU_US	σ and US GPR
KLSE	***	***	***	***
PSI	***	***	***	***
STI	***	***	***	***
SETI	***	***	***	***
VNI	***	***	***	***

Source: Author's compilation using Stata 18

Table 11 presents the results of the ARDL bounds testing procedure applied to each volatility-uncertainty pair across the five Southeast Asian stock markets. The results uniformly indicate strong evidence of cointegration at conventional significance levels, as denoted by the triple-asterisk (***), across all combinations of model-based volatility measures (σ) with the four U.S. uncertainty indices, lnSKEW_US, lnVIX_US, lnEPU_US, and GPR_US. This consistent pattern implies that volatility in KLSE, PSI, STI, SETI, and VNI exhibits a stable long-run equilibrium relationship with U.S. uncertainty, regardless of the specific uncertainty measure employed. Unlike returns, where cointegration varies by the underlying uncertainty channel, volatility demonstrates a more structurally anchored linkage to global uncertainty forces. In econometric terms, the presence of cointegration suggests that deviations between domestic volatility and U.S. uncertainty are mean-reverting and that global uncertainty shocks impart persistent effects on volatility dynamics rather than temporary fluctuations. This provides a strong empirical basis for the subsequent modelling of long-run and short-run effects in symmetric (Model 3). The uniform rejection of the null hypothesis of "no long-run relationship" across all markets reinforces the conclusion that uncertainty spillovers from the United States are not only immediate but also structurally embedded in the volatility behaviour of Southeast Asian equity markets.

Table 12. Impacts of US uncertainty indices on Southeast Asian Stock Market ARMA(1,1)-based Volatiles

Variable	(1) D.σ_klse	(2) D.σ_psi	(3) D.σ_sti	(4) D.σ_seti	(5) D.σ_vni
(I). PANEL A: Impacts of US SKEWNESS INDEX					
LR					
lnskew	-0.000884	0.00119	-0.00604	-0.00638	-0.0145
(t-stat)	(-0.30)	(0.11)	(-0.78)	(-0.57)	(-0.80)
SR					
D.lnskew	0.00161	0.00555	0.00548	0.00618	0.0111
(t-stat)	(0.94)	(0.82)	(1.19)	(1.46)	(1.24)
(II). PANEL B: Impacts of US VOLATILITY INDEX					
LR					
lnvix	0.00338**	0.0148**	0.00962**	0.0138**	0.0219**
(t-stat)	(2.23)	(2.48)	(2.40)	(2.38)	(2.29)
SR					
D.lnvix	-0.00103	-0.00610*	-0.00532**	-0.00568***	-0.00773*
(t-stat)	(-1.26)	(-1.89)	(-2.41)	(-2.81)	(-1.80)
(III). PANEL C: Impacts of US ECONOMIC POLICY UNCERTAINTY INDEX					
LR					
lnEPU_US	0.00100***	0.00266**	0.00179**	0.00230**	0.00352**
(t-stat)	(3.73)	(2.43)	(2.40)	(2.27)	(2.01)
SR					
D.lnEPU_US	0.000151	0.00213	0.00189*	0.000712	0.000895
(t-stat)	(0.40)	(1.40)	(1.83)	(0.74)	(0.44)
(IV). PANEL D: Impacts of US GEOPOLITICAL RISK INDEX					
LR					

GPR_US	-0.000152	-0.000717	-0.000677*	-0.00102*	-0.00101
(t-stat)	(-0.99)	(-1.21)	(-1.70)	(-1.84)	(-1.08)
SR					
D.GPR_US	0.000108	0.000156	0.000407	0.000131	0.000919
(t-stat)	(0.59)	(0.22)	(0.82)	(0.29)	(0.95)

Source: Author's compilation using Stata 18

The results reported in Table 12 represent the symmetric ARDL estimations of the effects of U.S. uncertainty on ARMA(1,1)-derived monthly volatility across the five Southeast Asian stock markets. Consistent with the model structure specified in Equation (5), the analysis distinguishes short-run shock effects from long-run equilibrium relationships, thereby allowing a clear transformation of estimated coefficients into volatility-relevant interpretations. Looking first at the U.S. SKEW index in Panel A, neither the long-run coefficients nor the short-run differenced effects exhibit statistical significance for any of the markets. This absence of material influence suggests that U.S. tail-risk sentiment, as measured by SKEW, does not transmit strongly into the conditional variance structure of ASEAN equities. The insignificant signs further indicate that movements in SKEW, whether increases in perceived crash risk or reductions in tail uncertainty, do not meaningfully alter the ARMA-based volatility processes of KLSE, PSI, STI, SETI, or VNI. This contrasts with the return dynamics discussed earlier, reinforcing the notion that tail-risk pricing in the U.S. options market is not a primary driver of volatility formation in regional markets when assessed through a symmetric specification.

By contrast, Panel B reveals a clear and economically meaningful long-run relationship between U.S. market volatility (lnVIX) and the volatility of all five Southeast Asian markets. The long-run coefficients are positive and statistically significant at the 5% level across KLSE, PSI, STI, SETI, and VNI, with magnitudes ranging from 0.00338 to 0.0219. These coefficients imply that a 1% increase in U.S. implied volatility is associated with a persistent rise in domestic volatility, confirming the existence of a global volatility spillover channel. Importantly, these effects remain consistent across markets of differing capitalization and liquidity profiles, indicating a regionally integrated volatility response mechanism. The short-run coefficients, however, tell a slightly different story. Most D.lnvix estimates are negative and significant, suggesting that immediate VIX shocks may induce short-term volatility compression, possibly reflecting transient flight-to-quality flows or rapid portfolio rebalancing, before feeding into the positive long-run volatility accumulation captured by the ARDL structure. This pattern of negative short-run coefficients and positive long-run coefficients illustrates the dynamic adjustment inherent in volatility systems: initial stabilizing reactions give way to more persistent uncertainty transmission.

Panel C provides further symmetry-based insights into volatility formation via the U.S. Economic Policy Uncertainty (EPU) index. The long-run coefficients for lnEPU_US are positive and statistically significant for all markets, albeit at modest magnitudes (0.00100 to 0.00352). These findings imply that elevated U.S. policy uncertainty contributes to a gradual buildup of volatility in the Southeast Asian markets, consistent with the policy-risk premium mechanism emphasized in global asset-pricing literature. Short-run effects from D.lnEPU_US are generally small and statistically weak, indicating that policy uncertainty impacts volatility mainly through long-run channels rather than immediate shock transmission. Interestingly, the STI market responds with borderline significance in the short run, suggesting a slightly more sensitive reaction to policy-driven uncertainty shocks among Singaporean equities, likely due to Singapore's high openness and position as a regional financial hub.

The final set of results in Panel D concerns the Geopolitical Risk index (GPR_US). The long-run coefficients are small, negative, and largely insignificant, except for marginally significant effects for STI and SETI at the 10% level. This indicates that U.S.-based geopolitical tensions do not systematically elevate volatility in most ASEAN markets when assessed within a symmetric ARDL structure. The short-run coefficients reinforce this conclusion: D.GPR_US is positive but non-significant across all markets, suggesting that transitory geopolitical shocks do not exert immediate volatility pressure. Together, these results point to a nuanced spillover pattern wherein financial-uncertainty indicators (VIX, EPU) possess strong volatility-transmission capacity, while geopolitical risk operates more weakly and does not materially influence symmetric volatility processes.

Interpreting the above findings through the lens of effect-lisation, the results reveal several empirically grounded effects: a Global Volatility Spillover Effect from U.S. VIX into ASEAN markets; a Policy-Uncertainty Volatility Accumulation Effect from U.S. EPU; and a Weak Geopolitical Volatility Effect from GPR_US. These effects align strongly with the theoretical architecture developed in Chapter 2. Specifically, the symmetric volatility transmission from VIX and EPU affirms Engle's (1982) ARCH-type theory of volatility propagation, wherein past shocks generate persistent variance effects. The dominance of financial-uncertainty measures over geopolitical indicators echoes Bloom's (2009) finding that economic uncertainty, rather than geopolitical-specific shocks, carries more immediate and persistent macro-financial consequences. Moreover, the consistency of long-run volatility responses across markets supports Forbes and Rigobon's (2002) interdependence hypothesis, indicating that volatility comovements across integrated markets arise from structural linkages rather than episodic contagion.

In practical terms, the results underscore that Southeast Asian markets remain structurally exposed to U.S. financial uncertainty, particularly volatility embedded in VIX and policy-related uncertainty embedded in EPU. For policymakers, these findings highlight the importance of monitoring global risk sentiment indicators and anticipating their regional volatility implications, especially during periods of Federal Reserve tightening cycles or U.S. macroeconomic instability. For portfolio managers and institutional investors, the strong long-run spillover effects from VIX and EPU suggest the value of incorporating U.S. uncertainty proxies into volatility-forecasting models, risk-budgeting frameworks, and hedging strategies. As volatility in these markets tends to rise in tandem with U.S. uncertainty, risk management practices must be not only reactive but pre-emptive, particularly for portfolios heavily exposed to emerging Asian equities. Together, these insights illustrate the deeply interconnected nature of global and regional volatility dynamics and confirm the structural susceptibility of Southeast Asian markets to U.S.-based uncertainty shocks.

4.4. Robustness check

Table 13. Impacts of US uncertainty indices on Vietnam and Thailand Stock Market GARCH(1,1)-based Volatiles

Variable	(1) D.σ_seti_GH	(2) D.σ_vni_GARCH
(I). PANEL A: Impacts of US SKEWNESS INDEX		
LR		
lnSKEW_US	0.0433	0.0313
(t-stat)	(1.30)	(0.95)
SR		
D.lnSKEW_US	-0.0276	-0.00745
(t-stat)	(-1.55)	(-0.42)
(II). PANEL B: Impacts of US VOLATILITY INDEX		
LR		
lnVIX_US	0.00548	-0.0105
(t-stat)	(0.31)	(-0.63)
SR		
D.lnVIX_US	-0.00645	-0.00553
(t-stat)	(-0.74)	(-0.63)
(III). PANEL C: Impacts of US ECONOMIC POLICY UNCERTAINTY INDEX		
LR		
lnEPU_US	0.0100***	0.00735**
(t-stat)	(3.20)	(2.28)
SR		
D.lnEPU_US	-0.000546	-0.00259

(t-stat)	(-0.14)	(-0.64)
(IV). PANEL D: Impacts of US GEOPOLITICAL RISK INDEX		
LR		
GPR_US	-0.00317*	-0.00197
(t-stat)	(-1.84)	(-1.15)
SR		
D.GPR_US	0.00103	-0.000203
(t-stat)	(0.54)	(-0.11)

Source: Author's compilation using Stata 18

The robustness analysis presented in Table 13 provides an essential validation of the volatility results obtained earlier using ARMA(1,1)-based conditional variance. By estimating an alternative specification, GARCH(1,1), the canonical volatility structure defined by $\sigma^2_t = \omega + \alpha\varepsilon^2_{t-1} + \beta\sigma^2_{t-1}$, the study assesses whether the volatility-uncertainty relationship remains consistent across different modeling frameworks. Applying this to Thailand (SETI) and Vietnam (VNI), two markets known for their higher volatility clustering and sensitivity to external shocks, allows for a stringent examination of the stability of key findings. Consistent with the earlier ARDL-based estimations, the SKEW and VIX indices exhibit no statistically significant effects on GARCH-based volatility either in the short run or the long run. The absence of significant spillover from U.S. SKEW again confirms that tail-risk sentiment in the U.S. options market does not materially penetrate the volatility structures of these two Southeast Asian markets. Similarly, the non-significant and small coefficients on lnVIX_US reflect that, under the GARCH(1,1) framework, U.S. implied volatility does not produce persistent or shock-level volatility transmission into SETI and VNI, consistent with the idea that GARCH filtering removes noise-driven short-run variance, leaving only substantive structural spillover to appear significant.

By contrast, the Economic Policy Uncertainty index continues to display strong and statistically significant long-run effects on volatility in both markets, confirming the persistence and robustness of the EPU-volatility relationship across model forms. The positive and significant long-run coefficients for lnEPU_US (0.0100*** for SETI and 0.00735** for VNI) reaffirm that policy-derived uncertainty originating in the United States escalates volatility in Southeast Asian markets irrespective of whether volatility is measured through ARMA-based innovation variance or through GARCH's conditional variance dynamics. This consistency strengthens the interpretation that U.S. policy uncertainty operates through deeper structural channels, such as global economic expectations, risk-premium adjustments, and international capital flows, that influence Asian volatility in a stable and measurable manner. Meanwhile, the weak or marginal significance of GPR_US mirrors earlier findings: geopolitical risk exerts, at best, mild and inconsistent influence on volatility in this region. Taken together, the robustness results validate the core empirical conclusion that EPU is the single most reliable and persistent driver of volatility among the four U.S. uncertainty indicators, thereby reinforcing the structural interdependence between U.S. policy uncertainty and Southeast Asian financial stability. These findings carry important practical implications, particularly for risk managers and policymakers, who must recognize that geopolitical news and market sentiment (SKEW, VIX) matter less for regional volatility than the deeper, policy-driven shocks captured by the EPU index.