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Impact of financial and energy market uncertainties on ASEAN-5 markets

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Abstract

This study investigates the interdependence between global uncertainty indices and ASEAN-5 equity markets. Utilizing the CBOE Volatility Index (VIX) and the CBOE Oil Volatility Index (OVX) as proxies for global financial market and oil market uncertainty, respectively, we examine their connectedness with five major Southeast Asian stock markets (Malaysia, Indonesia, Singapore, Thailand, and the Philippines). A time-varying copula framework is employed to model non-linear dependencies and extreme tail co-movements, and we complement this with risk metrics (Value-at-Risk and CoVaR) to quantify downside risk spillovers. Our findings reveal that ASEAN-5 markets are highly susceptible to spikes in global volatility, especially during crisis periods. Singapore and Thailand show notably greater sensitivity to oil-market volatility shocks, while Malaysia and the Philippines react more strongly to global financial uncertainty. We also uncover asymmetric tail dependence: negative shocks to global volatility indices exert a more pronounced contagion effect on ASEAN-5 markets than positive shocks of equivalent magnitude. The ΔCoVaR analysis further highlights that systemic risk in ASEAN-5 is amplified under heightened global uncertainty, underscoring the need for vigilant monitoring of uncertainty transmission. These results significantly impact policymakers and investors in designing tailored risk management strategies to mitigate regional contagion.

Keywords ASEAN-5 · Global uncertainty · Interdependence · Systemic risk · Contagion

JEL classification C58 · F36 · F65 · G01 · G15

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1 Introduction

Recent crises have underscored the highly interconnected nature of global financial and commodity markets. The 2008 global financial crisis, the COVID-19 pandemic, and the Russia-Ukraine war are all examples of localized shocks that rapidly spilled over to the worldwide financial system. This phenomenon—often called systemic risk—highlights the importance of monitoring how uncertainty in one market can transmit to others to safeguard financial stability (Billio et al., 2012). This study examines how global financial and oil market uncertainty affects the equity markets of the ASEAN-5 economies (Malaysia, Indonesia, Singapore, Thailand, and the Philippines).

Our analysis focuses on two key measures of global uncertainty: the CBOE Volatility Index (VIX) and the CBOE Oil Volatility Index (OVX). The VIX, often dubbed the "fear index," reflects investors' expectations of volatility in U.S. equity markets and is a barometer of global risk aversion. The OVX analogously measures implied volatility in crude oil prices, capturing uncertainty in energy markets. We select these indices because they represent two crucial and distinct external risk factors for ASEAN-5: general financial market turbulence and commodity (oil) market turbulence.[1] By examining both VIX and OVX, we can distinguish the effects of broad financial stress from those of oil-specific shocks on ASEAN-5 stock returns (Acharya et al., 2012, 2017; Billio et al., 2012; Girardi & Tolga Ergün, 2013; Karimalis & Nomikos, 2018). This approach ensures a clear interpretation of how global equity market fear and oil price volatility—each highly relevant given ASEAN-5's economic linkages—transmit to the region, without diluting the analysis with additional overlapping uncertainty indices.

The ASEAN-5 countries have heterogeneous exposure to oil market fluctuations, which makes the OVX an especially pertinent risk indicator for the region. Malaysia and Indonesia are net oil exporters whose government revenues and trade balances benefit from stable or higher oil prices. In contrast, Singapore, Thailand, and the Philippines are net oil importers that rely on affordable oil for energy. Their trade balances and inflation rates are adversely affected by oil price spikes. This divergence means that a surge in oil-price volatility can have uneven impacts: it can simultaneously hurt oil-importing economies (through higher costs) while affecting oil exporters via revenue variability. By including OVX alongside VIX, we capture these nuanced transmission channels of uncertainty – financial and energy – that are particularly relevant for ASEAN-5 market stability.

Extensive prior research has documented connectedness and spillovers among uncertainty indicators and financial markets, predominantly focusing on advanced economies (Bams et al., 2017; Diebold and Yilmaz, 2014; Duncan and Kabundi, 2013; Dungey et al., 2017). For instance, Diebold and Yilmaz (2014) develop measures of volatility spillovers among major stock markets, and Chen et al. (2019) examine how oil price uncertainty influences stock returns in developed markets. These studies generally find that financial and geopolitical uncertainties can signifi-

[1] We consider these two indices because of the availability of daily information. There are other measures of uncertainty which are mostly in a monthly basis based on the text analysis.

cantly impact developed-market assets. In comparison, far fewer studies have investigated emerging-market contexts (Abuzayed and Al-Fayoumi, 2021; Alamgir and Amin, 2021; Batten et al., 2015; Shah and Dar, 2021; Shahzad et al., 2017). Notable exceptions include analyses of Gulf and South Asian markets: for example, Abuzayed and Al-Fayoumi (2021) report that the systemic risk connectedness between oil prices and GCC stock markets increased markedly after the COVID-19 outbreak, and Shahzad et al. (2017) explore spillovers in Asian emerging markets. Overall, the literature suggests emerging economies are increasingly intertwined with global volatility yet remain underrepresented in empirical studies (Farid et al., 2022; Mohammed et al., 2023). The ASEAN-5 markets, in particular, have received limited attention in terms of how they interact with global uncertainty indices, despite the region's growing integration with world markets and its unique mix of exporter/importer characteristics.

Preliminary analysis confirms that ASEAN-5 equity returns exhibit volatility clustering (persistent high volatility following market shocks) and heavy-tailed co-movements. Accordingly, our modeling framework combines ARMA–EGARCH models to capture this volatility persistence with a dynamic Student-t copula to capture tail dependence in extreme market conditions. This approach ensures that both the time-series volatility dynamics and the non-linear extreme dependence between ASEAN-5 markets and global uncertainty indices are appropriately modeled.

Our contribution to this literature is two-fold. First, we adopt a dynamic copula-based approach to model the dependence structure between ASEAN-5 equity returns and the VIX and OVX indices. This method allows us to capture non-linear and tail-dependent connectedness – including asymmetric responses in extreme market conditions – that traditional correlation or spillover models might misrepresent. In other words, we can detect if, for example, an extreme jump in the VIX leads to disproportionately large co-movements (contagion) in ASEAN-5 markets, beyond what a linear model would predict. Second, we extend the systemic risk analysis to a new context by focusing on the ASEAN-5. By examining these emerging markets in relation to global uncertainty benchmarks, we shed light on the vulnerabilities and resilience of ASEAN-5 economies under external stress, thereby filling an important gap in the systemic risk literature.

Our empirical results show that ASEAN-5 equity markets exhibit pronounced susceptibility to global volatility shocks, with notable heterogeneity across countries. We find an asymmetric dependence structure: negative shocks in global uncertainty (surges in the VIX or OVX) have a more severe impact on ASEAN-5 returns than positive shocks of the same magnitude. Periods of extreme global volatility – for example, during the COVID-19 crisis – correspond to significantly higher co-movements and risk spillovers to the region. Moreover, the type of uncertainty matters: Singapore and Thailand are particularly sensitive to oil-market volatility, whereas Malaysia and the Philippines respond more strongly to global financial market volatility. Our CoVaR analysis reveals that when global risk is high, the downside risks of ASEAN-5 markets increase sharply, suggesting that traditional diversification benefits diminish in such turbulent times. These findings underscore the complex nature of uncertainty transmission in emerging markets and highlight the importance of accounting for tail-risk asymmetries when formulating risk management strategies.

Our study carries practical implications for policymakers and investors. For regulators and central banks in ASEAN, the results emphasize the need for enhanced systemic risk monitoring that incorporates global indicators like the VIX and OVX. Early warning signals from these indices could help authorities implement preemptive measures (e.g. macroprudential policies or regional financial safety nets) to mitigate contagion. In addition, the differences we document across countries suggest that policy responses should be tailored: a volatility spike in oil markets might warrant a stronger response in oil-importing countries (e.g. Singapore or Thailand), while a surge in global financial uncertainty might be more relevant for markets like Malaysia or the Philippines. For international investors, our findings highlight opportunities to improve portfolio allocation and hedging strategies. Recognizing which ASEAN-5 markets are more vulnerable to which type of global shock allows investors to diversify more effectively – for instance, hedging oil price risk in portfolios concentrated in Singapore, or hedging equity market risk for portfolios in Malaysia. Overall, by delineating the distinct channels of uncertainty transmission, this study helps inform the design of risk management frameworks that are sensitive to the nature of the shock and the specific market involved.

The remainder of the paper is organized as follows. Section 2 reviews relevant literature on financial and oil-market uncertainty spillovers and systemic risk. Section 3 outlines the methodology, including the marginal distribution model and the copula-based systemic risk framework. Section 4 describes the data and presents summary statistics. Section 5 discusses the empirical results. Section 6 concludes with policy and investment implications and suggests future research directions.

2 Related literature review

Research on cross-market connectedness and systemic risk has grown substantially in recent years. Early studies on volatility spillovers largely focused on developed markets. For example, Alter and Beyer (2014) examine spillover effects among sovereign credit default swaps in Europe, and Broadstock and Filis (2014) and Reboredo and Ugolini (2018) analyze how oil price fluctuations and geopolitical tensions affect major stock indices. These studies consistently find that financial and geopolitical uncertainties can have a significant impact on developed-market assets, evidencing a high degree of interconnectedness among advanced economies' financial systems. In addition, a variety of methodologies have been employed to capture these linkages – from vector autoregressions and frequency-domain analyses (e.g., wavelet coherence; Vacha and Barunik (2012) to network-based spillover indexes (Diebold & Yilmaz, 2012, 2014) – all suggesting that during turbulent periods, correlations across markets strengthen and risks can transmit quickly.

In contrast, emerging and developing markets have received comparatively less attention, though interest is growing. Batten et al. (2015) and Shah and Dar (2021) document return and volatility transmission across equity, bond, and commodity markets in emerging economies, finding evidence of substantial spillovers, especially during global stress episodes. Focusing on oil-producing regions, Abuzayed and Al-Fayoumi (2021) evaluate the connectedness between oil prices and GCC stock markets before and after the outbreak of COVID-19. They report that systemic risk linkages increased significantly in the post-COVID period, implying that the shock amplified the vulnerability of those markets to oil uncertainty. Similarly, Alamgir and Amin (2021) find a positive and asymmetric influence of global oil price changes on stock indices in South Asia - stocks tend to react more strongly to oil price increases than to decreases. Shah and Dar (2021) further show that cross-market spillovers (between financial and commodity markets) become more intense during periods of financial and economic turmoil. These findings suggest that emerging markets, including those in Asia, are not immune to global shocks; in fact, their growing integration may expose them to volatility emanating from major markets or commodities.

A separate strand of the literature has focused on measuring systemic risk and tail connections directly. Acharya et al. (2017) introduce the concept of "systemic expected shortfall", which estimates each financial institution's contribution to system-wide risk under stressed conditions. Their approach highlights the importance of capturing fat tails and correlations during crises when assessing systemic stability. In a related vein, Adrian and Brunnermeier (2016) propose the Conditional Value-at-Risk (CoVaR) framework to quantify how the distress of one institution or market can increase the tail risk of another. Girardi and Tolga Ergün (2013) apply the CoVaR methodology to U.S. financial firms and find that it effectively identifies interlinkages and potential sources of contagion beyond what standard VaR captures. Focusing on emerging-market assets, Al-Yahyaee et al. (2020) examine the tail dependence between Sukuk (Islamic bonds), Sharia-compliant equities, and GCC stock markets, reporting evidence of both symmetric and asymmetric tail connectedness. This indicates that extreme negative shocks may propagate differently (and often more powerfully) than extreme positive shocks – a feature also noted by Karimalis and Nomikos (2018) in their study of systemic risk in commodity and equity markets.

In summary, the literature shows a comprehensive understanding of uncertainty spillovers in developed markets and growing evidence that similar interconnectedness exists in emerging markets, especially during global stress events. However, studies explicitly examining the joint impact of global financial volatility and commodity-market volatility on emerging equity markets are still limited. The ASEAN-5 economies represent an important case in point. Given their increasing financial integration and diverse exposure to commodity markets, a closer analysis of how global uncertainty factors (like the VIX and OVX) transmit to ASEAN-5 markets can provide valuable insights. Our study contributes to this ongoing discussion by using a copula-based systemic risk approach to capture the nuanced dependency structure and tail-risk transmission between global uncertainty indices and ASEAN-5 financial markets.

3 Methodology

Traditional static correlation measures can be misleading when studying financial markets, as they fail to capture the dynamics and non-linear dependencies that often intensify during turbulent periods. To overcome this limitation, we employ a two-step methodology. First, we model each market's returns individually (marginal distributions) to account for autocorrelation and heteroskedasticity. Second, we use a Dynamic Conditional Correlation (DCC) Student-t copula to model the time-varying dependence structure between the ASEAN-5 equity returns and the uncertainty indices. This copula-based approach allows us to capture tail dependence (the co-movement during extreme events) and asymmetric responses to shocks. We then integrate this with the CoVaR framework to assess systemic risk contributions.

3.1 Marginal distribution model

We model the conditional mean and volatility of returns using an ARMA(1,0)-EGARCH(1,1) framework to account for asymmetric volatility responses (leverage effects). For a return series r_t :

$$r_t = \phi_0 + \phi_1 r_{t-1} + \theta_1 \epsilon_{t-1} + \epsilon_t, \qquad \epsilon_t = \sigma_t z_t$$

Where, φ_0 is the constant, φ_1 represents the AR coefficient, θ_1 represents the MA coefficient. The logarithmic EGARCH variance equation is specified as:

$$\ln\left(\sigma_t^2\right) = \omega + \alpha\left(\frac{|\epsilon_{t-1}|}{\sigma_t - 1}\right) + \gamma\frac{\epsilon_{t-1}}{\sigma_{t-1}} + \beta\ln\left(\sigma_{t-1}^2\right)$$

where, γ captures the leverage effect of asymmetric shocks, $\alpha\ and\ \beta$ represents the ARCH and GARCH components of the framework, respectively.

3.2 Time-varying copula model

We use a DCC- Student-t copula to capture the extreme non-linear tail dependence among the underlying assets, which typically characterizes financial, and commodity returns. According to (Sklar, 1959), we can define the joint distribution function for a copula as:

$$F_{XY}(x, y) = C(u, v) \tag{1}$$

where $u = F_X(x)$ and $v = F_Y(y)$ represents univariate functions and $F_{XY}(x, y)$ corresponds to the joint distribution function. We may define the Student-t copula as:

$$\begin{aligned} C_{d,\rho}(u_1, \ldots, u_n) &= t_{d,\rho}\left(t_d^{-1}(u_1), \ldots, t_d^{-1}(u_n)\right) \\ &= \int_{-\infty}^{t_d^{-1}(u_1)}, \ldots, \int_{-\infty}^{t_d^{-1}(u_n)} \frac{\left(\frac{d+n}{2}\right)|\rho|^{-\frac{1}{2}}}{\left(\frac{d}{2}\right)(\pi v)^{\frac{n}{2}}} \\ &\left(1 + \frac{1}{d} z^T \rho^{-1} z\right)^{\frac{d+n}{2}} dz_1, \ldots, dz_n, \end{aligned} \tag{2}$$

where t_d^{-1} is the inverse univariate of t distribution with d representing the symmetric tail dependence and $t_{d,\rho}$ corresponds to multivariate t distribution.

3.3 Value-at-risk (VaR), CoVar, and ΔCoVaR

To evaluate the downside risk and uncertainty spillovers between ASEAN-5 economies and uncertainty indices, we follow (Adrian & Brunnermeier, 2016). Specifically, we estimate the VaR, CoVaR, and $\Delta\, CoVaR$ among the assets to attain a comprehensive overview of the systemic risk contribution of uncertainty indices to the ASEAN-5. Let $\{X_{1,t},\ X_{2,t}\}\ : t = 1,\ 2,\ \ldots\ ,\ T$, be the logarithmic returns of underlying assets $1\ and\ 2$, respectively, then the $VaR^{1}_{\alpha\ ,t}$ is estimated as the α -th quantile returns' distribution:

$$\Pr\left(X_{1,t} \leq\ VaR^{1}_{\alpha\ ,t}\right) = \alpha\,\%. \tag{9}$$

The CoVaR is the VaR of ASEAN-5 conditional on the extreme downward movements in uncertainty indices and can be expressed as:

$$\Pr\left(X_{1,t} \leq\ CoVaR^{1|2}_{\alpha\ ,\beta\ ,t}|X_{2,t} \leq\ VaR^{2}_{\beta\ ,t}\right) = \alpha\,\%, \tag{10}$$

where $\Pr\left(X_{2,t} \leq\ VaR^{2}_{\beta\ ,t}\right) = \beta\,\%$ for a β -th quantile of $X_{2,t}$.

In addition, we also estimate the ΔCoVaR $(\Delta\ CoVaR)$ to assess the systemic risk contribution as follows:

$$\Delta\ CoVaR^{1|2}_{\alpha\ ,\beta\ ,t} = \left(CoVaR^{1|2}_{\alpha\ ,\beta\ ,t} -\ CoVaR^{1|2}_{\alpha\ ,50,t}\right), \tag{11}$$

where $CoVaR^{1|2}_{\alpha\ ,50,t}$ satisfies $\Pr\left(X_{1,t} \leq\ CoVaR^{1|2}_{\alpha\ ,50,t}|X_{2,t} \leq\ VaR^{2}_{50,t}\right) = \alpha\,\%$, for the 50%-th quantile (or median) of the return distribution $X_{2,t}$.

The copula framework's application to ASEAN-5 markets provides crucial methodological advantages in capturing time-varying dependencies during periods of market stress. Our DCC-Student-t specification, following (Uddin et al., 2022), addresses the limitations of conventional correlation measures by explicitly modeling the heavy-tailed distributions and asymmetric responses characteristic of emerging market returns. This approach proves particularly valuable for quantifying systemic risk transmission during periods of elevated global uncertainty. Furthermore, the framework's time-varying nature enables detection of shifting market dependencies that static models might overlook. By incorporating both VIX and OVX indices, we capture how global financial and energy market uncertainties distinctly influence ASEAN-5 market dynamics. This dual-uncertainty approach provides deeper insights into regional market vulnerabilities than single-index frameworks previously employed in the literature.

4 Data and descriptive statistics

We analyze daily data from May 11, 2007 to January 30, 2023 for the five ASEAN-5 stock market indices and the two global uncertainty indices (VIX and OVX). The sample period spans multiple significant events – including the 2008–09 financial crisis, the 2010s commodity price swings, and the 2020 COVID-19 shock – providing a rich context to study volatility transmission. All financial series (stock index levels and the VIX and OVX) are converted to daily log-returns. The data were obtained from Thomson Reuters DataStream; our sample size is determined by the availability of all series.

The choice of VIX and OVX as our global uncertainty proxies is motivated by their broad coverage and relevance. The VIX is a widely tracked measure of expected stock market volatility and is often used as a proxy for global investor fear or risk aversion. The OVX similarly reflects the market's expectation of volatility in crude oil prices. Focusing on these indices allows us to capture two principal dimensions of global uncertainty – financial market turmoil and energy market uncertainty – which are particularly pertinent for ASEAN-5 economies. Importantly, by limiting the analysis to these two measures, we avoid overlap that might occur with additional indices (for example, an Economic Policy Uncertainty index that could be correlated with VIX, or a gold volatility index that might overlap with OVX's information). This parsimonious approach isolates the impact of each type of uncertainty on ASEAN-5 markets in a clear-cut manner.

Table 1 provides summary statistics for all return series. The average annualized returns of the ASEAN-5 equity indices over the sample are modest, ranging from slightly negative (e.g., −0.435% for Malaysia) to slightly positive (e.g., 6.450% for Indonesia). In contrast, the VIX and OVX tend to decline on average over time (2.399% and 2.472, respectively), reflecting the fact that these indices often spike during crises and then revert downwards. All series exhibit substantial volatility: the ASEAN-5 markets have annualized standard deviations between 12.3% (Malaysia) and 24.5% (Indonesia), whereas the VIX is much more volatile (over 120% annualized since it is itself a volatility measure. Returns are non-normal across the board – they show negative skewness (long left tails) for all series except VIX and OVX, and high kurtosis (leptokurtic distributions with fat tails) for every series. The Jarque–Bera test strongly rejects normality for each return series.

Table 1 Descriptive statistics

	Mean (%)	SD (%)	Skew	Kurt	JB STAT	Q (20)	Q^2 (20)	ARCH(20)
Malaysia	-0.435	0.123	-0.673	16.050	0.000***	49.2***	704.9***	321.9***
Indonesia	6.450	0.245	-0.171	10.749	0.000***	64.8***	2007.2***	616.1***
Singapore	-2.089	0.182	-0.182	10.177	0.000***	77.6***	5487.3***	1179.6***
Thailand	4.127	0.214	-0.679	14.532	0.000***	68.0***	3029.2***	909.7***
Philippines	3.469	0.216	-0.807	13.320	0.000***	42.7***	1254.2***	596.9***
CBOE VIX	2.399	1.218	1.017	9.042	0.000***	78.7***	297.5***	197.0***
CBOE OVX	2.472	0.902	1.636	31.036	0.000***	63.2***	513.4***	402.0***

Notes: The table provides descriptive statistics for the underlying assets

All return series exhibit significant non-normality: returns are negatively skewed (long left tails) and leptokurtic (fat-tailed), as shown by highly significant Jarque–Bera tests. The Ljung–Box test on squared returns and Engle's ARCH test confirms volatility clustering in every market (significant autocorrelation in volatility), underlining the need for GARCH-type models. Figure 1 further illustrates this: during major turmoil episodes (e.g., 2008–09 and March 2020), the VIX spiked above 80 and OVX above 150 while ASEAN-5 equities plunged, and volatility remained elevated for an extended period. Such patterns foreshadow our later results, indicating that ASEAN-5 markets respond strongly to global volatility shocks, especially during extreme events.

5 Empirical analysis

5.1 Marginal model Estimation results (ARMA-EGARCH)

We first discuss the results of the marginal distribution models (ARMA(1,0)-EGARCH(1,1)) for each return series, which are summarized in Table 2. These results offer valuable insights into the individual behavior of each market and index before considering their interactions. In the mean equations, the autoregressive term (AR(1)) is positive and statistically significant for Malaysia (around 0.04), indicating a mild momentum or serial correlation in Malaysian daily returns. In contrast, the AR(1) terms for the other ASEAN markets are small in magnitude and not significant (except a weak significance for the Philippines at the 10% level), suggesting that, for most of these markets, yesterday's return has little predictive power for today's return. Interestingly, the AR(1) coefficients for the VIX and OVX returns are negative and significant (–0.073 and -0.041, respectively). This implies a slight mean-reversion in the volatility indices: after a jump in VIX or OVX, there tends to be a pull-back the next day, consistent with the behavior of volatility indices that mean-revert after extreme spikes.

In the variance equations, the EGARCH(1,1) model yields several important observations. The constant terms in the EGARCH equations are negative and significant for all five ASEAN markets and both VIX and OVX, which helps to set a long-run volatility level. The persistence of volatility is reflected in the ARCH (α) and GARCH (β) parameters. Across all markets, we find β (the persistence parameter) to be very high and significant (often on the order of 0.98 for equities, and ranging around 0.90–0.97 for VIX/OVX), indicating that slow dissipation of volatility shocks – in other words, volatility is highly persistent. The ARCH term α is also significant for most series, capturing the immediate impact of daily shocks on volatility. Taken together, these α and β estimates imply that volatility in both ASEAN-5 stocks and the volatility indices is clustered and long-lasting: a surge in volatility due to a market event will influence the conditional variance for many subsequent days.

The leverage effect parameter in the EGARCH model (which allows asymmetry) is found to be significant for the equity markets. Specifically, for Malaysia, Indonesia, Singapore, Thailand, and the Philippines, the EGARCH estimates indicate that negative return shocks increase volatility more than positive shocks of the same size. This

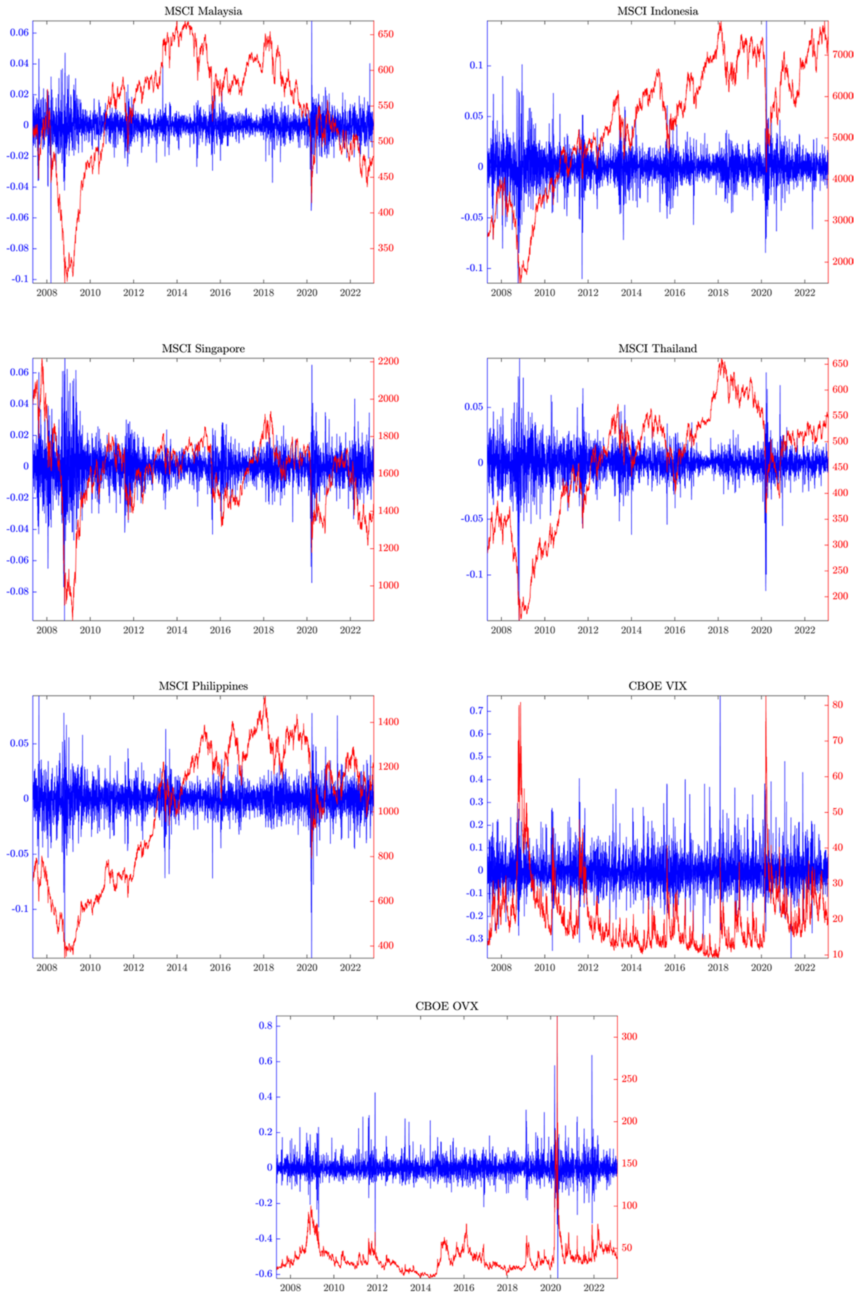

Fig. 1 Development of time and return series

Table 2 Marginal distribution model

	Malaysia	Indonesia	Singapore	Thailand	Philippines	CBOE VIX	CBOE OVX
Constant	0.000	0.000	0.000	0.000	0.000	-0.002***	-0.003***
	(0.443)	(0.350)	(0.183)	(0.653)	(0.267)	(0.001)	(0.000)
AR(1)	0.042***	-0.013	0.013	0.013	0.026*	-0.0734**	-0.041***
	(0.005)	(0.392)	(0.434)	(0.410)	(0.089)	(0.015)	(0.005)
Constant	-0.127***	-0.150***	-0.097***	-0.102***	-0.275***	-0.295***	-0.273***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
GARCH(1)	0.987***	0.983***	0.990***	0.989***	0.969***	0.947***	0.955***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
ARCH(1)	0.151***	0.156***	0.130***	0.163***	0.164***	0.070***	0.157***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Leverage(1)	-0.060***	-0.078***	-0.075***	-0.059***	-0.074***	0.214***	0.081***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
DoF	5.800***	5.012***	9.204***	5.649***	5.841***	4.659***	3.644***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
LogL	14638.02	11878.79	13251.87	12629.32	12208.23	5177.204	6786.65
AIC	-29,262	-23743.6	-26489.7	-25244.6	-24402.5	-10340.4	-13559.3
BIC	-29,218	-23699.5	-26445.6	-25200.6	-24358.4	-10296.3	-13515.2
Skewness	-0.28124	-0.38513	-0.24706	-0.14294	-0.28721	1.174957	2.448309
Kurtosis	5.823407	6.07311	4.369098	5.234021	5.732165	6.883581	26.13889
Q(23)	25.76931	12.17433	26.67953	25.86615	25.3427	19.04898	4.680912
ARCH (23)	26.05441	12.4799	26.43061	30.86238	25.88736	18.39667	4.651298

Notes: The table presents the marginal distribution model for each of the underlying series

is a common feature in equity markets: bad news or price drops tend to make investors more jittery, thus increasing future volatility. By contrast, for the VIX (which is not a typical asset but an index of volatility itself), we observe an opposite asymmetry – volatility rises more following a positive shock to VIX. This essentially means that when the VIX experiences a sudden jump (often corresponding to a market scare), its variability subsequently remains high (volatility-of-volatility increases), whereas a negative shock to VIX (volatility falling) tends to stabilize things. The OVX shows a weaker asymmetry, but generally, its volatility responds more to upside movements (increases in oil volatility) than to decreases.

Lastly, the distribution of residuals from these models is heavy-tailed. The degrees-of-freedom estimates for the Student-t distribution are in the range of 6 to 10 for the ASEAN returns, and around 4–5 for VIX and OVX (lower DoF means heavier tails). This confirms that even after accounting for GARCH effects, extreme returns are more likely than a normal distribution would predict – particularly for the VIX/OVX. The model diagnostics (log-likelihood, AIC, and the Ljung-Box Q-statistics on residuals) all suggest that the ARMA-EGARCH fits are adequate and the standardized residuals are close to white noise, collectively underscore a well-fitted model, affirming the reliability of the presented results.

5.2 DCC-Student-t copula

We now turn to the time-varying dependency results obtained from the DCC-Student-t copula, which are reported in Table 3. Panel A of Table 3 corresponds to the dependence between each ASEAN-5 market and the VIX (global financial uncertainty), while Panel B corresponds to each ASEAN-5 market and the OVX (oil market uncertainty). For each pair, we have an estimate of the long-run correlation (ρ), the tail dependence (through the degrees-of-freedom of the t copula), and the DCC parameters (α and β) that govern the short-run dynamics of correlation.

From Panel A (ASEAN-5 with VIX), the time-varying copula results reveal clear heterogeneity in dependence on global uncertainties. For the VIX (global financial uncertainty), all ASEAN-5 markets show positive dependence, but to varying degrees: Malaysia and the Philippines have the highest average correlations with VIX (0.11), whereas Indonesia and Thailand have the lowest (0.05), with Singapore in between (0.09). This implies that Malaysian and Philippine equities are the most sensitive to spikes in global equity volatility, while Indonesian and Thai markets are relatively less so (Singapore being moderate). Moreover, the tail dependence with VIX differs markedly. Malaysia's t-copula degrees of freedom (DoF around 33) is the lowest, indicating a high chance of joint extreme movements with VIX surges. Indonesia and Singapore have intermediate DoF (43 and 51), and Thailand's DoF is

Table 3 DCC-Student-t copula estimates

		Malaysia	Indonesia	Singapore	Thailand	Philippines
Panel A: CBOE VIX	ρ	0.110***	0.051***	0.092***	0.053***	0.111***
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
	DoF	33.068***	43.320***	50.785***	87.402***	149.553***
		(0.000)	(0.000)	(0.000)	(0.696)	(0.000)
	α	0.000***	0.000***	0.000***	0.000***	0.000***
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
	β	0.696***	0.577***	0.568***	0.552***	0.628***
		(0.000)	(0.000)	(0.000)	(0.115)	(0.001)
	Log(L)	25.978	6.428	17.737	5.911	24.860
	AIC	-45.957	-6.855	-29.473	-5.823	-43.721
		Malaysia	Indonesia	Singapore	Thailand	Philippines
Panel B: CBOE OVX	ρ	-0.103***	-0.103***	-0.168***	-0.140***	-0.062***
		(0.000)	(0.001)	(0.001)	(0.000)	(0.000)
	DoF	94.278***	58.619***	199.964***	51.057***	196.569***
		(23.039)	(50.839)	(4.178)	(11.488)	-
	α	0.000	0.021	0.012	0.006	0.004
		(0.039)	(0.011)	(0.006)	(0.064)	-
	β	0.426***	0.780***	0.936***	0.976**	0.001
		(8.304)	(0.113)	(0.029)	(0.464)	-
	Log(L)	21.720	24.316	60.661	42.254	7.902
	AIC	-37.440	-42.631	-115.323	-78.507	-9.803

Notes: The table reports DCC-Student-t copula estimates between ASEAN-5 markets and uncertainty indices for the period May 11, 2007 to January 30, 2023. ρ represents the correlation coefficient, DoF denotes degrees of freedom for tail dependence, while α and β capture immediate impact and persistence respectively. Standard errors in parentheses. Statistical significance: *** 1%, ** 5%, * 10%

higher (87), suggesting increasingly thinner tail linkages. The Philippines stands out with a very high DoF (150), effectively indicating negligible tail dependence with VIX. In practical terms, while all markets tend to drop when the VIX spikes, extreme VIX-induced crashes are far more likely for Malaysia (and to a lesser extent Indonesia), but much less so for Thailand or the Philippines.

Turning to the dynamic correlation parameters for the VIX connections, we observe that the DCC GARCH parameter β is quite high for all pairs (ranging from about 0.55 to 0.70 and highly significant). This indicates that shocks to the correlation (when, say, an ASEAN market and VIX suddenly become more correlated due to a global event) tend to be very persistent. In practical terms, if a crisis causes the correlation between an ASEAN market and the VIX to jump, that elevated correlation will likely persist for a while before slowly dissipating. The ARCH parameter α for the correlation (not shown in the excerpt but implied by β and log-likelihood values) is also significant but relatively small (usually in the 0.1 to 0.2 range), meaning that the immediate impact of a shock on correlation is noticeable, but the bulk of the correlation dynamics is governed by the high persistence.

The dependence structure of OVX (oil market volatility) is notably different. All five markets exhibit a negative correlation with OVX (since oil volatility shocks generally coincide with equity downturns). Singapore's and Thailand's equity returns have the strongest inverse correlations with OVX (approximately −0.17 and −0.14, respectively), indicating that they are most adversely affected by oil volatility spikes. Malaysia and Indonesia show more moderate correlations (–0.10), and the Philippines is least sensitive (–0.06). In terms of tail dependence with OVX, Singapore and the Philippines have extremely high DoF estimates (around 200), implying virtually no tail co-movement even severe oil volatility events do not often coincide with equally extreme stock moves in those two markets. By contrast, Indonesia and Thailand have much lower DoF (59 and 51), denoting strong tail dependence: when OVX reaches its most extreme levels, these two markets have a high probability of simultaneous extreme downturns. Malaysia's DoF (94) is intermediate, suggesting a moderate tail linkage with OVX. In summary, these results demonstrate that each ASEAN-5 market responds differently to global shocks: e.g., Malaysia and the Philippines are more susceptible to financial-market turmoil (VIX), whereas Singapore and Thailand are more vulnerable to oil-market volatility (OVX), with Indonesia exhibiting a balanced exposure. This underscores the importance of a non-linear, tail-sensitive approach in capturing such heterogeneous dependence patterns.

The dynamic correlation parameters for the OVX pairs reveal an interesting contrast to the VIX case. The persistence β of correlation with OVX is more varied: for Thailand, β is around 0.98, indicating that any change in its correlation with OVX is extremely persistent (almost a unit root, meaning correlations can shift to a new level for long periods). For Malaysia, Singapore, and Indonesia, β is also significantly high, showing substantial persistence. However, for the Philippines, the estimated β is very low (close to 0.0). This suggests that the Philippines' correlation with OVX is highly reactive but not persistent – it might spike up or down in the short term when an oil volatility event occurs, but then it mean-reverts quickly. Combined with a relatively low α (immediate effect) for some pairs, this indicates heterogeneous correlation dynamics: some ASEAN-OVX relationships adjust quickly and briefly, while others adjust slowly and enduringly. This could be due to differences in how each market processes oil-related information (e.g., speculative trading in some markets versus fundamental-driven moves in others).

In summary, the copula results highlight clear differences in how ASEAN-5 markets relate to the two types of global uncertainties. All ASEAN-5 markets have a positive dependence with global equity volatility (VIX), but the strength and extreme vulnerability differ – Malaysia and the Philippines are more strongly linked (especially in extreme cases for Malaysia), whereas Indonesia and Thailand are less so. In contrast, their dependence with oil volatility (OVX) is negative, consistent with oil uncertainty being a risk factor, yet here Singapore and Thailand emerge as more sensitive, and Indonesia and Malaysia somewhat less. These findings suggest that policy measures or portfolio allocations cannot treat ASEAN-5 as a monolithic block; instead, one must consider which global shock is of concern. For example, a global financial shock may pose the greatest risk to Malaysia's and the Philippines' markets, while an oil supply shock might be most problematic for Singapore and Thailand. It also shows that co-movements are state-dependent – they can strengthen in crises (tail dependence) – emphasizing why a dynamic, non-linear modeling approach is warranted. In the next subsection, we translate these dependence patterns into concrete risk measures (VaR and CoVaR) to quantify the potential losses and spillovers under these scenarios.

5.3 VAR, CoVar, and ΔCoVaR

Having characterized the dependence structure, we now examine how global uncertainties translate into quantifiable risk levels for the ASEAN-5 markets. Table 4 reports the 1% VaR for each market individually, while Tables 5 and 6 present the CoVaR and ΔCoVaR results for each market associated with extreme VIX and OVX scenarios, respectively.

From the VaR (Table 4), we observe that at the 99% confidence level (i.e., 1% risk of exceedance), the daily VaR for the ASEAN-5 stock indices ranges from roughly −1.2% to -2.3% of their values. This means that on 1% of days (about 2–3 trading days per year), we expect losses of at least those magnitudes. Among the five, Indonesia has the most extreme VaR at −2.293%, reflecting its higher volatility – an investor in the Jakarta market could lose 2.293% or more in a single day 1% of the time. Thailand and the Philippines also show relatively high VaR (around −1.97% and −2.03%, respectively), while Singapore's VaR is a bit lower (–1.675%). Malaysia has the smallest 99% VaR at −1.169%, indicating the least extreme downside among

Table 4 Value-at-risk

	Malaysia	Indonesia	Singapore	Thailand	Philippines	VIX	OVX
Mean	-1.169	-2.293	-1.675	-1.971	-2.031	-9.733	-6.801
Median	-1.057	-2.020	-1.461	-1.703	-1.891	-9.008	-6.254
Max	-0.483	-0.962	-0.525	-0.589	-0.982	-4.756	-3.835
Min	-4.770	-9.314	-8.584	-9.810	-8.231	-38.209	-38.741
Std	0.510	0.986	0.868	1.010	0.698	3.036	2.418

Notes: The table presents the Value-at-Risk (VaR) estimates for all the underlying assets in our sample

Table 5 CoVaR and ΔCoVaR between VIX and ASEAN-5

		Malaysia	Indonesia	Singapore	Thailand	Philippines
Panel A: Conditional Value-at-risk	Mean	-10.608	-10.099	-9.525	-9.322	-10.990
	Median	-10.615	-10.185	-9.656	-9.489	-10.972
	Max	-10.396	-7.893	-5.272	-4.431	-10.853
	Min	-10.649	-10.517	-10.233	-10.184	-11.802
	Std	0.030	0.310	0.535	0.630	0.091
		Malaysia	Indonesia	Singapore	Thailand	Philippines
Panel B: Delta Conditional Value-at-risk	Mean	0.069	0.717	1.037	1.219	-0.265
	Median	0.062	0.631	0.905	1.052	-0.247
	Max	0.281	2.923	5.289	6.109	-0.127
	Min	0.029	0.298	0.329	0.357	-1.077
	Std	0.030	0.310	0.535	0.630	0.091

Notes: The table presents the Conditional Value-at-Risk (CoVaR) and ΔCoVaR $(\Delta\ CoVaR)$ estimates between VIX and the ASEAN-5 countries in our sample

Table 6 CoVaR and ΔCoVaR between OVX and ASEAN-5 countries

		Malaysia	Indonesia	Singapore	Thailand	Philippines
Panel A: Conditional Value-at-risk	Mean	-6.440	-6.478	-5.515	-6.271	-6.685
	Median	-6.517	-6.574	-5.706	-6.397	-6.721
	Max	-3.951	-4.018	0.638	-2.586	-5.098
	Min	-6.914	-6.945	-6.539	-6.921	-6.954
	Std	0.353	0.346	0.773	0.475	0.179
		Malaysia	Indonesia	Singapore	Thailand	Philippines
Panel B: Delta Conditional Value-at-risk	Mean	0.809	0.799	1.500	0.919	0.518
	Median	0.732	0.703	1.309	0.793	0.482
	Max	3.298	3.259	7.653	4.604	2.105
	Min	0.335	0.333	0.475	0.269	0.249
	Std	0.353	0.346	0.773	0.475	0.179

Notes: The table presents the Conditional Value-at-Risk (CoVaR) and ΔCoVaR $(\Delta\ CoVaR)$ estimates between VIX and the ASEAN-5 countries in our sample

the group, consistent with its lower return volatility. In comparison, the volatility indices themselves have much larger VaR values in absolute terms: about −9.733% for VIX and −6.801% for OVX. These large numbers are not surprising – VIX and OVX are not asset prices but measures of variance, which can swing dramatically (for example, the VIX can drop by 10 points in a day from a high level, which corresponds to a large percentage drop). The takeaway is that on a standalone basis, an ASEAN-5 equity market can lose around 1–2% on a rare bad day, whereas the VIX (if viewed as a tradable instrument) can lose much more in percentage terms on a calm day after a volatility spike.

With respect to CoVaR (Table 5, Panel A), We evaluate if the VIX is itself at an extreme high (90th percentile of its distribution, corresponding to a period of market turmoil) and how badly might the ASEAN-5 markets fare? Based on our estimates, when conditioned on a stress event in the VIX, each ASEAN-5 market's 99% CoVaR is dramatically more negative than its unconditional VaR. Specifically, the mean CoVaR values (reported in Table 5) are around −9% to -11%. For example, Malaysia's CoVaR with VIX is approximately −10.608%, meaning that if global equity volatility is at crisis levels, Malaysia's stock index could plausibly drop over 10% in that tail scenario. Similarly, Indonesia's CoVaR is about −10.099%, Singapore's is -9.525%, and Thailand's is **-9.322%. The Philippines shows the most extreme CoVaR at -10.990%, suggesting it could lose nearly 11% of its value in a worst-case day when the VIX is extremely high. These conditional risk measures illustrate how much more severe losses can be conditional on a global volatility shock. In fact, comparing to the earlier VaR figures, the CoVaR values are roughly 5–6 times larger in magnitude. This underscores a crucial point: an extreme global fear event (high VIX) can inflict far greater damage on these markets than what their normal volatility alone would imply. It also indicates strong spillover – the difference between CoVaR and VaR can be interpreted as the portion of risk due to the VIX being in distress.

From the ΔCoVaR which is the difference between the CoVaR and the normal VaR for each market. We find that for four of the ASEAN-5 markets (Malaysia, Indonesia, Singapore, Thailand), ΔCoVaR is substantially positive, on the order of 8–9% points (since their VaR was around −1 to −2% and CoVaR around −10%). This indicates that a move of the VIX from its median to its 99th percentile increases the tail loss of those markets by about 8–9%. For instance, Thailand's median-state VaR is around −1.97%, but its VIX-stressed CoVaR is −9.32%, so ΔCoVaR around 7.35% points. The Philippines, however, exhibits a slightly different behavior: its ΔCoVaR with VIX is negative (approximately −0.265%). This somewhat counterintuitive result implies that the Philippines' 99% VaR is already around −11% in absolute terms (when considering its own volatility and other factors), and having the VIX in distress does not make that worst-case much worse – in fact, the conditional quantile comes out a tad less negative than its worst-case unconditional quantile. This could be due to the Philippines' high baseline volatility or tail risk from domestic factors that dominate its 1% quantile regardless of VIX's state. Essentially, for the Philippines, its worst-case daily loss might occur in scenarios not perfectly aligned with global volatility extremes (perhaps domestic crises). For the other four markets, the positive ΔCoVaR underscores their vulnerability to global shocks: when the VIX is high, their risk of extreme loss rises significantly.

Overall, the systemic risk contribution of VIX to each ASEAN market is clearly non-trivial. To put it differently, an investor or regulator who only looks at each market's VaR would severely underestimate potential losses on a day of global market panic. The CoVaR framework shows that conditional losses are far greater when the system (global market) is under stress, highlighting the interconnected nature of risk.

With respect to CoVaR of OVX (Table 6, Panel A), we condition on an extreme event in the oil market volatility (OVX). We report that the ASEAN-5 markets also experience heightened tail risk in this scenario, though generally the impact is a bit less dramatic than with VIX. The mean CoVaR values (99% level) for ASEAN-5 conditional on OVX being at its 99th percentile range from roughly −5.5% to -6.7%. Singapore's CoVaR is about −5.515%, Thailand's is -6.271%, Malaysia's is -6.440%, Indonesia's is -6.478%, and the Philippines again has the largest loss at -6.685%. These numbers indicate substantial losses in an extreme oil volatility scenario, but they are only about half (or even less) of the magnitudes we observe in the VIX scenario. This suggests that a pure oil volatility shock, while significant, may be somewhat less systemic for the region than a broad financial volatility shock. One reason could be that oil price volatility, by itself, has both winners and losers among ASEAN-5 (importers hurt, exporters sometimes benefit from volatility if prices jump), whereas a global financial shock tends to uniformly hurt all markets by tightening financial conditions. Nonetheless, a −5% to −6% one-day loss is very large, so the risk is still quite serious. Among the markets, the ordering here shows the Philippines and Indonesia near the top (most negative CoVaRs around −6.5% or worse), implying they are most vulnerable to an oil volatility spike, whereas Singapore appears somewhat less affected (–5.5%). This might initially seem counterintuitive given Singapore's strong negative correlation with OVX noted earlier. However, it could be that Singapore's own volatility is lower, so even under stress its 1% tail does not extend as far in percentage terms as those of inherently more volatile markets like the Philippines or Indonesia.

Similarly, for the ΔCoVaR of OVX, the estimates are positive for all five markets, meaning an increase in oil volatility from normal to extreme adds to the tail risk of each market. The increments are on the order of 4–5% points. For example, Malaysia's unconditional 99% VaR was around −1.17%, and its OVX-stressed CoVaR is −6.44%, so ΔCoVaR estimate is around 5.27%. We observe that Singapore has the highest ΔCoVaR with OVX (around +5.5% or more, given its VaR of around −1.68% vs. CoVaR −5.52%), indicating that an oil volatility shock has a relatively large marginal impact on Singapore's risk. Thailand, Malaysia, and Indonesia have ΔCoVaRs in a similar ballpark (roughly +4.5% to +5.5%). The Philippines has the smallest ΔCoVaR (around +4.0% or slightly less), consistent with the observation that its tail risk is already high due to internal factors and it is slightly less directly tied to oil fluctuations. It is worth noting that even the smallest ΔCoVaR here (+4%) is not negligible – it implies that an extreme oil market disruption could increase an already large tail loss by an additional 4% points of index value.

Comparing VIX vs. OVX impacts, it is evident that global financial uncertainty (VIX) poses a greater systemic risk to ASEAN-5 markets than oil market uncertainty (OVX), in terms of both absolute CoVaR values and ΔCoVaR. For instance, Malaysia's CoVaR went from about −10.6% (with VIX stress) to −6.4% (with OVX stress), and similar drops are seen for others. This roughly mirrors intuition – a financial crisis (captured by VIX) can freeze funding, trigger capital flight, and affect all sectors, whereas oil volatility, while significant, primarily and directly affects energy-related sectors and inflation. However, OVX's impact is not trivial either, especially for certain markets like Singapore and Thailand that heavily import energy. Policymakers should thus be wary of both types of shocks, i.e., global financial panic remains the larger threat to systemic stability, but energy market turbulence can also erode market capitalization and investor confidence, particularly if it occurs in tandem with other shocks.

To provide a visual sense of these risk dynamics, Figs. 2 and 3 plot the time-varying VaR, CoVaR, and ΔCoVaR for each ASEAN-5 market associated with VIX and OVX, respectively. These figures show how risk metrics evolve, highlighting specific periods where risks spiked. For example, during the 2008–2009 crisis and again in March 2020 (COVID-19 outbreak), the CoVaR and ΔCoVaR for all markets jumped markedly, indicating that systemic risk was heightened at those times.

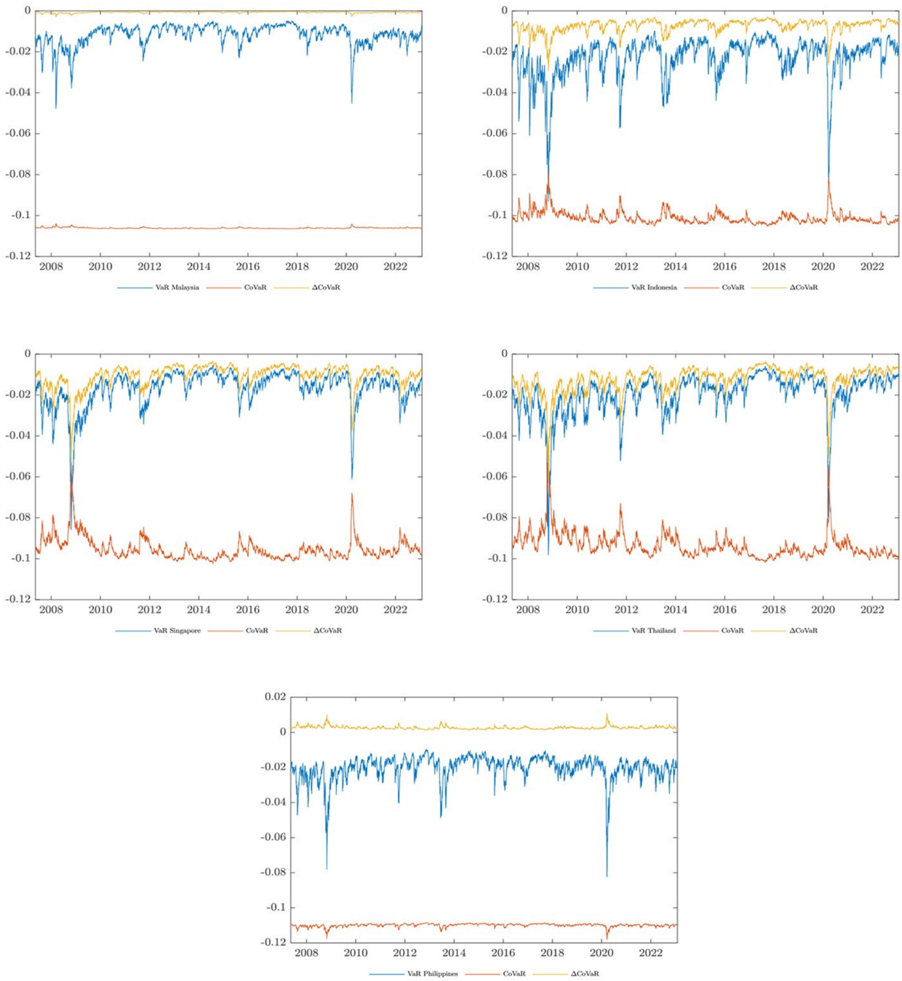

Fig. 2 Development of VaR, CoVaR, and ΔCoVaR between VIX and ASEAN-5

In early 2020, as the COVID-19 pandemic led to a global market crash, the VIX CoVaR of ASEAN markets moved to its most extreme levels, signifying that given the heightened VIX estimates, the conditional losses for ASEAN-5 were exceptionally large. Similarly, OVX spiked in spring 2020 due to the simultaneous oil price crash, which is reflected in higher OVX CoVaR values for ASEAN-5 around that period. These visuals reinforce our earlier quantitative findings, i.e., periods of global stress correspond to disproportionate increases in ASEAN-5's risk, underlining the importance of monitoring these external indices. The plots also suggest that at certain times, one type of uncertainty dominated (e.g., the oil market turmoil in 2014–2015 affected OVX-related risk, whereas the Eurozone debt crisis of 2011 affected VIX-related risk).

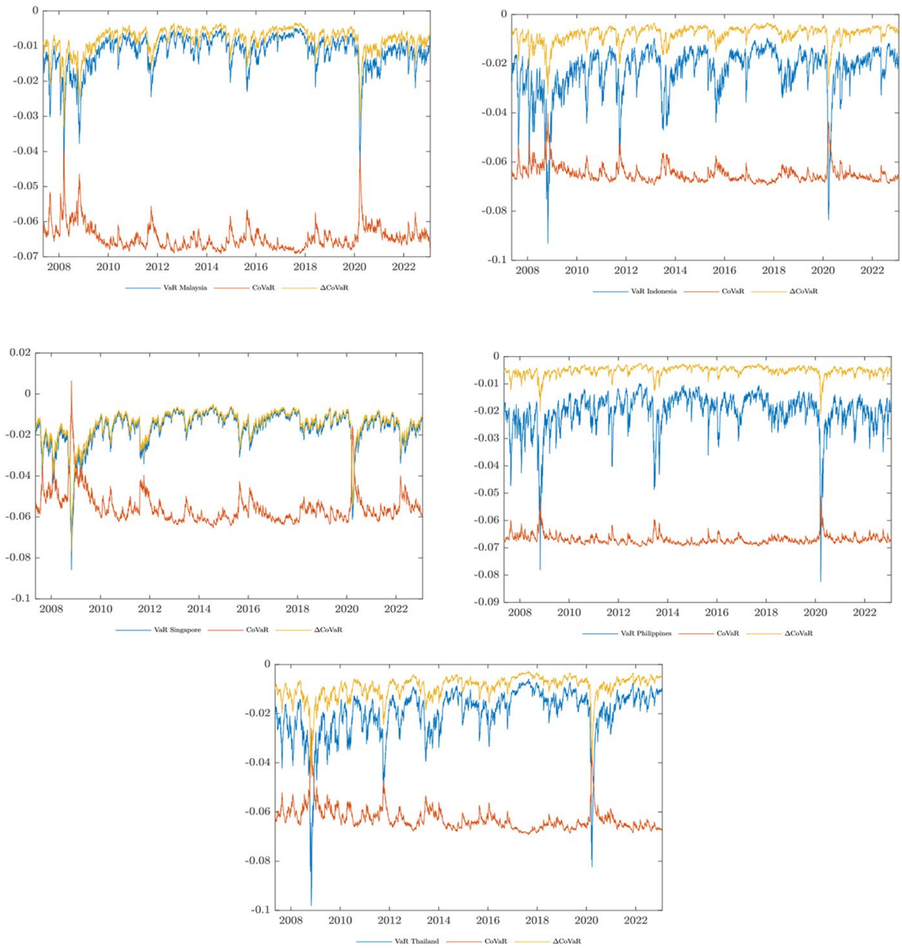

Fig. 3 Development of VaR, CoVaR, and ΔCoVaR between OVX and ASEAN-5

6 Conclusion

This study evaluate the systemic risk connectedness between ASEAN-5 financial markets and global volatility benchmarks. By employing a copula-based dependence model and CoVaR risk analytics, we captured asymmetric and non-linear interdependencies that traditional approaches might miss. Our approach provides a nuanced understanding of how shocks in global financial uncertainty (as proxied by the VIX) and oil market uncertainty (OVX) transmit to emerging equity markets in Southeast Asia.

We find that ASEAN-5 economies are highly sensitive to global financial and oil-market turmoil. In particular, these markets exhibit latent vulnerabilities that manifest strongly during periods of intensified worldwide uncertainty (such as the 2008 crisis or the COVID-19 pandemic in 2020). Overall, our results enhance the monitoring of systemic risk for ASEAN-5 in the context of global volatility swings. As financial integration deepens and capital flows freely, the channels of uncertainty transmission become a critical area for policymakers to monitor in order to safeguard regional stability. Notably, our analysis highlights the presence of asymmetric tail connectedness: negative shocks (surges) in the VIX or OVX exert a greater contagion impact on ASEAN-5 markets than positive shocks of similar size. This asymmetry means that downturns can be more contagious than upturns are beneficial, a pattern important for risk management.

Our findings carry specific implications for market participants and policymakers. For investors and portfolio managers, the documented patterns suggest that diversification strategies should be adjusted according to the source of uncertainty. For instance, a portfolio heavily invested in Singapore and Thailand might require extra hedging against oil price volatility, since those markets showed pronounced sensitivity to OVX shocks. Conversely, exposure to Malaysia and the Philippines comes with higher vulnerability to global financial volatility (VIX spikes). Investors can leverage this information by rotating exposures or using derivatives to hedge when, say, an oil supply shock is anticipated (protecting Singaporean and Thai equities) or when global recession risks rise (protecting Malaysian and Philippine equities). In essence, recognizing that not all ASEAN markets respond uniformly to a given type of shock allows for more effective risk mitigation – a form of informed diversification where one hedges the specific risk each market is most subject to.

For policymakers, our results underscore the importance of both regional coordination and country-specific measures in financial oversight. The significant ΔCoVaR values across multiple markets indicate that stress in one market (or external index) can quickly propagate region-wide. This makes a case for enhanced regional cooperation – for example, ASEAN + 3 financial safety nets or swap lines could be bolstered to provide liquidity support in the event of a contagion from a global shock. Joint surveillance mechanisms could be improved to monitor cross-border capital flows, as large swings in the VIX often coincide with sudden portfolio flow reversals in emerging markets. At the same time, one-size-fits-all policies may not be optimal given the heterogeneous risk profiles of the ASEAN-5. Our analysis suggests that tailored regulatory frameworks are needed for each country. For example, Singapore, being highly sensitive to oil volatility, might prioritize building buffers against commodity price shocks (through strategic reserves or supply diversification) and ensure banks are stress-tested for oil market turmoil. Malaysia and Indonesia, as oil producers, should manage the twin risks of oil revenue volatility and financial volatility – possibly by saving windfall gains in sovereign wealth funds that can be drawn down in volatile periods. Meanwhile, the Philippines and Thailand should strengthen macroprudential measures that address global financial cycle risks, as their markets could be swept by global risk-on/risk-off waves. Policymakers could also consider contingency plans that are activated when the VIX or OVX exceed certain thresholds, such as temporary capital flow management, to stabilize markets if needed.

From a regulatory standpoint, the evidence of asymmetric spillovers (worse outcomes from negative shocks) means that stress testing and scenario analysis should incorporate the non-linear effects of global shocks. Regulators in ASEAN-5 could adopt scenarios where the VIX jumps to, say, the 95th percentile (as it did in 2008 and 2020) and examine the projected impacts on domestic financial institutions and markets. Our CoVaR estimates provide a template for the scale of losses to expect in such scenarios, which could inform the sizing of capital buffers or emergency facilities.

In terms of broader significance, this work demonstrates how combining modern dependence modeling (copulas) with systemic risk metrics (CoVaR) can bridge the gap between theoretical rigor and practical applicability (Acharya et al., 2017; Girardi & Tolga Ergün, 2013) for emerging markets. We have shown that it is feasible to apply these advanced techniques to developing economies and derive actionable insights. The methodology captures the reality that in calm times, correlations are low, and markets seem independent, but in crisis times, correlations spike and losses come hand-in-hand – which is precisely when it matters most.

For the future studies, there are several avenues for further research. One extension could be to incorporate other forms of uncertainty or risk, such as economic policy uncertainty indices or geopolitical risk indices, to see if they offer additional explanatory power for ASEAN-5 market dynamics beyond VIX and OVX. Another avenue is to explore higher-frequency data (if available) to capture intraday connectedness, which might be important for market microstructure and for implementing real-time risk management tools. Additionally, future studies could apply our framework to a broader set of emerging markets (beyond ASEAN) to assess whether the findings generalize or if certain regions exhibit different patterns of vulnerability. This would enrich the understanding of global financial linkages and help emerging economies benchmark their risk profiles against peers.

In conclusion, our empirical findings highlight the necessity for ASEAN-5 countries to adopt market-specific and shock-specific approaches to systemic risk management. By recognizing the distinct ways in which global financial vs. oil-market uncertainties affect each economy, policymakers and investors can better navigate periods of turmoil. As the world becomes more interconnected, such nuanced perspectives will be vital in preserving financial stability and guiding investment decisions in emerging markets.

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Data availability The data that support the findings of this study are available from Thomson Reuters DataStream. Restrictions apply to the availability of these data, which were used under license for this study. Data are available from the correspond author with the permission of Thomson Reuters DataStream.

Declarations

Conflict of interest The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this thesis.

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