GEOPOLITICAL ENERGY SHOCKS, RESIN PRICES DYNAMICS, AND INDUSTRIAL IMPLICATIONS IN EAST AND SOUTHEAST ASIA: AN ECONOMETRIC AND POLICY ANALYSIS TO 2030

By:
Ferry Noldy Langelo[1*]
Citra Aprilia[2]
Paramadina University

Email:
ferrynlangelo@gmail.com[*]
citraaprilia2002@gmail.com

ABSTRACT

This study investigates the impact of geopolitical energy shocks on resin price dynamics in East and Southeast Asia and explores their implications through 2030. Escalating conflicts in the Middle East, particularly involving Iran, have increased volatility in global energy markets, disrupted petrochemical supply chains, and raised production costs for resin products. Because many Asian economies rely heavily on imported energy and petrochemical feedstocks, they are especially vulnerable to such disruptions. Using a hybrid methodology, the study combines econometric analysis and policy assessment. Monthly data from 2015–2026 are analyzed using Vector Autoregression (VAR) and GARCH models to examine price transmission and volatility spillovers from crude oil and naphtha to resin markets, including C5/C9 and epoxy resins. A geopolitical shock index is incorporated to measure the effects of conflict-related disruptions. The findings reveal a strong and asymmetric transmission of energy price increases to resin prices, with volatility intensifying during periods of geopolitical instability. Forecasts to 2030 indicate that continued disruptions in major energy transit routes could raise resin prices by 15–35% above baseline projections, creating substantial challenges for ASEAN manufacturing industries. The study highlights the need for policies that reduce feedstock dependence, diversify supply chains, and strengthen industrial resilience. By integrating energy economics and supply chain analysis, it provides empirical evidence and practical policy recommendations to support industrial competitiveness and energy security in emerging Asian economies.

Keywords: ASEAN Economies, Energy Price Shocks, Geopolitical Risk, Petrochemical Industry, Price Transmission, Resin Market, VAR-GARCH

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A. INTRODUCTION

Geopolitical tensions are no longer isolated political events; instead, they act as systemic shocks that alter the global economic landscape. Recent literature emphasizes that heightened geopolitical risks significantly intensify the dynamic connectedness and spillover effects across international commodity markets (Gong & Xu, 2022). Consequently, these shocks rapidly transmit uncertainty from upstream energy sectors down to regional industrial materials.

Global energy markets have entered an era of heightened uncertainty driven by escalating geopolitical tensions, particularly in strategically important regions such as the Middle East. Recent conflicts, sanctions, trade disputes, and disruptions to critical energy transit routes have intensified volatility across crude oil and petrochemical markets, generating far-reaching consequences for industrial production worldwide (Zheng et al., 2023). Given that petrochemical products are fundamentally derived from petroleum-based feedstocks, fluctuations in upstream energy prices are rapidly transmitted throughout the value chain. Among the most affected products are resin materials, including C5/C9 hydrocarbon resins and epoxy resins, which serve as essential inputs for manufacturing industries such as packaging, automotive, construction, electronics, and consumer goods.

In the context of this study, a geopolitical energy shock refers to a politically induced disruption affecting energy production, transportation networks, international trade flows, or strategic energy infrastructure that significantly alters energy prices and the availability of petrochemical feedstocks. Such shocks can emerge through multiple channels. First, supply shocks arise from events such as international sanctions, OPEC+ production adjustments, or geopolitical instability involving major energy-producing countries such as Iran and Russia. Second, transportation shocks occur when conflicts or tensions disrupt critical maritime routes and logistics corridors, including the Strait of Hormuz, the South China Sea, and the Taiwan Strait. Third, expectations shocks are generated by heightened uncertainty regarding future economic and geopolitical conditions, including U.S.–China strategic decoupling, investment uncertainty, and the relocation of global supply chains. Collectively, these shocks create complex transmission mechanisms that influence both energy markets and downstream industrial sectors.

The vulnerability of East and Southeast Asia to such disruptions is particularly significant. The region represents one of the largest and fastest-growing markets for resin consumption, driven by rapid industrialization and expanding manufacturing activities. However, this growth remains structurally dependent on imported energy resources and petrochemical intermediates, particularly those sourced from the Middle East. Consequently, geopolitical disturbances affecting energy-producing regions are often transmitted rapidly into domestic production systems through higher feedstock costs, increased transportation expenses, and exchange-rate fluctuations. These effects ultimately elevate manufacturing costs, contribute to inflationary pressures, and weaken industrial competitiveness across emerging Asian economies.

Despite the growing body of literature examining the relationship between crude oil prices and macroeconomic performance, relatively limited attention has been devoted to understanding how energy shocks are transmitted to downstream petrochemical products, particularly resin markets. Existing studies largely focus on aggregate macroeconomic indicators such as inflation, output growth, and trade balances, while overlooking the intermediate industrial channels through which energy market disruptions affect production systems. Furthermore, many previous studies fail to account for volatility clustering, asymmetric shock transmission, and the amplification effects generated under periods of geopolitical stress. As a result, important dimensions of industrial vulnerability and supply chain resilience remain insufficiently explored.

To address these gaps, this study investigates the dynamic relationship between geopolitical energy shocks and resin price dynamics in East and Southeast Asia. Specifically, the research seeks to analyze the transmission mechanism from crude oil and naphtha prices to resin prices, evaluate the impact of geopolitical shocks on price volatility, and develop forward-looking projections of resin market developments through 2030 under alternative geopolitical scenarios. By focusing on downstream industrial inputs rather than aggregate macroeconomic outcomes alone, this study provides a more comprehensive understanding of how geopolitical risks propagate through energy and manufacturing systems.

Methodologically, the study employs a hybrid econometric framework integrating Vector Autoregression (VAR) and Generalized Autoregressive Conditional Heteroskedasticity (GARCH) models using monthly data covering the period from 2015 to 2026. The VAR model is utilized to identify dynamic transmission relationships among crude oil prices, naphtha prices, resin prices, and manufacturing costs, while the GARCH model captures volatility dynamics and risk amplification effects. In addition, a geopolitical shock index is incorporated to quantify exogenous disturbances originating from geopolitical events and energy market disruptions. This combined approach enables the analysis of both price transmission mechanisms and volatility spillovers across interconnected markets.

The expected findings contribute to the advancement of knowledge at the intersection of energy economics, industrial economics, and supply chain resilience. From an academic perspective, the study extends existing research by linking geopolitical energy risks to downstream petrochemical markets and industrial production systems. From a policy perspective, the results offer valuable insights for governments and industry stakeholders seeking to strengthen economic resilience through supply chain diversification, strategic resource management, energy security enhancement, and industrial upgrading initiatives. Such policy considerations are particularly relevant for ASEAN economies, which face increasing exposure to external shocks amid deepening integration into global manufacturing networks.

The remainder of this paper is organized as follows. Section 2 reviews the relevant theoretical and empirical literature. Section 3 describes the research methodology, data sources, and model specifications. Section 4 presents the empirical findings and econometric results. Section 5 discusses policy implications and future geopolitical scenarios. Finally, Section 6 concludes the study and outlines directions for future research.

B. LITERATURE REVIEW

Energy Prices and Macroeconomic Transmission

A substantial body of literature has examined the relationship between energy prices and macroeconomic performance. Early studies highlight that fluctuations in crude oil prices significantly affect inflation, exchange rates, and economic growth, particularly in energy-importing countries. The transmission mechanism typically operates through cost-push channels, where rising energy prices increase production costs and reduce aggregate supply, directly driving inflationary pressures across both advanced and developing nations (Choi et al., 2017; Hamilton, 2003; Kilian, 2009).

More recent studies extend this framework by incorporating nonlinearities and asymmetries, showing that oil price increases tend to have stronger economic impacts than price decreases. Additionally, emerging economies—particularly within the Asian region are found to be more vulnerable due to structural dependence on imported energy and limited hedging capacity (Cunado et al., 2015), a condition that significantly exacerbates domestic inflation dynamics through cost-push channels when compared to advanced economies (Choi et al., 2017). However, most of these studies strictly focus on aggregate macroeconomic indicators, leaving sector-specific transmission mechanisms underexplored (Broadstock et al., 2012).

Oil-to-Petrochemical Price Pass-Through

The petrochemical industry represents a critical intermediary between upstream energy markets and downstream manufacturing sectors. Naphtha, a key derivative of crude oil, serves as a primary feedstock for producing polymers and resins. While theoretical and empirical studies consistently suggest a strong cost pass-through mechanism from crude oil to petrochemical products (Asche et al., 2003; Li & Patiño-Echeverri, 2017), the intensity of this transmission is often mediated by the degree of market integration between the upstream energy sector and downstream industrial inputs.

Empirical evidence indicates that petrochemical prices respond to oil price shocks (Ji & Fan, 2012) with varying degrees of lag and elasticity (Hasanov & Hasanov, 2018), depending on market structure, inventory levels, and regional supply conditions. Some studies find incomplete pass-through due to contractual rigidities and pricing strategies, while others highlight rapid adjustments during periods of supply disruption.

Despite these advances, the literature remains largely focused on bulk petrochemicals such as ethylene and polyethylene, with limited attention to downstream specialty products such as hydrocarbon resins and epoxy systems. This creates an important gap in understanding how price shocks propagate further along the value chain.

Feedstock Dependency of PE, PP and PVC

Polyethylene (PE), polypropylene (PP), and polyvinyl chloride (PVC) are highly dependent on hydrocarbon feedstocks derived from crude oil and natural gas. Ethylene serves as the primary feedstock for PE production, while propylene is required for PP manufacturing. PVC production depends on ethylene and chlorine. Consequently, fluctuations in oil and gas prices directly affect production costs and market prices of these polymers (Yang et al., 2024).

Price Volatility and GARCH-Based Evidence

Volatility modeling has become a central approach in analyzing energy and commodity markets (Al-Haddad & Abu-Rayash, 2026). The Generalized Autoregressive Conditional Heteroskedasticity (GARCH) framework is widely used to capture volatility clustering and persistence in time series data.

Studies applying GARCH models to oil and petrochemical markets consistently find that volatility increases during periods of geopolitical tension, supply disruptions, and financial uncertainty (Huang et al., 2021). Furthermore, volatility spillovers between related markets such as oil and petrochemicals—are found to be significant, suggesting strong interdependence.

However, existing research rarely extends volatility analysis to resin markets, particularly in the context of emerging Asian economies. This limits the ability to assess how uncertainty in upstream markets translates into industrial cost instability.

Geopolitical Risk and Commodity Markets

Prior studies have heavily scrutinized the role of geopolitical uncertainty in driving market fluctuations. For instance, (Gong & Xu, 2021) demonstrated that commodity markets become highly interconnected during periods of geopolitical turmoil, with energy commodities often serving as primary transmitters of shocks. While their work provides a broad framework for commodity networks, there remains a noticeable gap in understanding how these macroeconomic energy shocks specifically spill over into specialized regional industrial inputs like resin and epoxy markets

The geopolitical risk index developed by (Caldara & Iacoviell, 2022) has increasingly been recognized as a key driver of commodity price fluctuations. Conflicts, sanctions, and disruptions in strategic regions particularly the Middle East have historically led to sharp increases in oil prices and supply uncertainty.

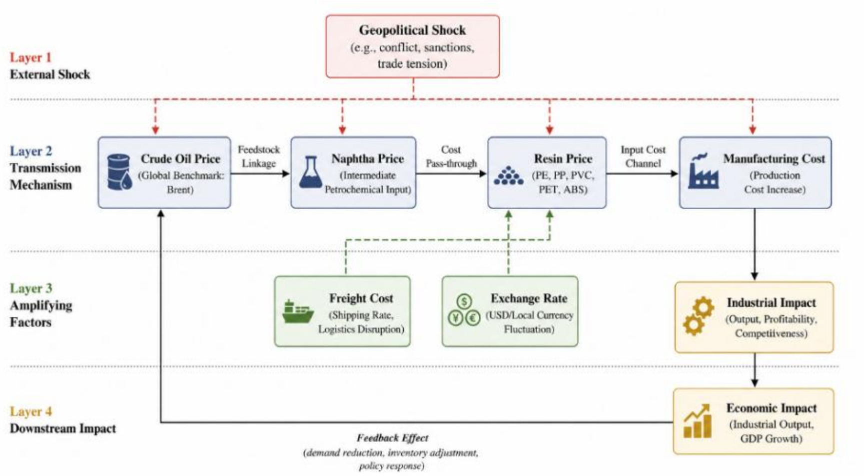
Recent literature introduces geopolitical risk indices to quantify the intensity and impact of such events. Empirical findings suggest that geopolitical shocks not only raise price levels but also amplify volatility and uncertainty across global markets. Nevertheless, most studies focus on crude oil and financial markets, with limited exploration of how geopolitical shocks affect downstream industrial inputs such as resin. This represents a critical gap, especially for regions highly dependent on imported energy and materials.

Industrial Vulnerability in East and Southeast Asia

East and Southeast Asia are among the most dynamic manufacturing hubs globally, with strong demand for petrochemical-based inputs. However, this growth is accompanied by structural vulnerabilities, including high import dependence on energy and limited domestic upstream capacity (Baiardi, 2020).

Studies on industrial resilience highlight that supply chain disruptions can significantly affect production costs, competitiveness, and export performance. ASEAN economies, in particular, are identified as more vulnerable compared to advanced East Asian economies due to weaker industrial integration and lower technological capacity. While these studies provide important insights into industrial vulnerability, they rarely incorporate detailed price transmission mechanisms from energy to specific industrial inputs such as resin (Zhen et al., 2023).

Existing literature predominantly centers on the relationship between energy prices and aggregate macroeconomic variables, with limited attention devoted to sector-specific transmission mechanisms—notably within the petrochemical and resin value chains. Furthermore, a methodological gap persists regarding the application of GARCH volatility modeling to resin price dynamics under geopolitical constraints, compounded by a paucity of integrative approaches that synthesize econometric modeling with policy-oriented analysis to assess industrial resilience in emerging Asian economies. To address these critical deficits, this study proposes a hybrid framework that elucidates the nexus between energy price shocks, geopolitical risk, and resin price dynamics. By focusing on East and Southeast Asia and providing forward-looking projections to 2030, this research offers significant empirical and strategic contributions to the fields of energy economics and industrial development.



Note: Solid Arrows indicate direct transmission channels; dashed arrows indicate indirect or amplifying effects
Source: Author's conceptual framework based on (Caldara & Iacoviell, 2022)*, Kilian (2009), Hamilton (2003), ICIS Petrochemical Reports, and World Bank Commodity Outlook.*

Figure 1.
Conceptual Transmission Mechanism of Geopolitical Energy Shocks on Resin Price Dynamics, Industrial Costs, and Economic Outcomes

C. RESEARCH METHOD

This study employs a quantitative approach combining time-series econometric modeling and scenario-based policy analysis. The objective is to examine both the transmission mechanism of energy prices to resin markets and the volatility dynamics under geopolitical shocks.

The empirical strategy consists of three main stages: (1) estimation of dynamic relationships using a Vector Autoregression (VAR) model; (2) analysis of volatility using a GARCH framework; and (3) forward-looking scenario simulations to 2030 incorporating geopolitical risk.

Vector Autoregression (VAR)

To capture the time-varying transmission and volatility spillovers from crude oil and naphtha to resin markets, this study employs a Vector Autoregression (VAR) framework. This econometric approach is well-suited for examining how external shocks propagate through economic systems, mirroring the methodological robustness found in recent empirical studies that track the dynamic spillovers of geopolitical risks across interconnected markets (Gong & Xu, 2022), the following VA R model is specified:

$$Y_t = \alpha + \sum_{i=1}^{p} \beta_i Y_{t-i} + \sum_{j=1}^{q} \gamma_j X_{t-j} + \vartheta GPR_t + \epsilon_t$$

Formally, the time-series equation is specified to estimate the dependent variable at time t (Y_t), representing the observed resin price. The parameter α denotes the constant intercept, reflecting the baseline equilibrium price when all explanatory variables are held constant at zero. To account for market memory and price stickiness, the model incorporates an autoregressive component, $\sum_{i=1}^{p} \beta_i Y_{t-i}$, where the coefficient β_i captures the persistent effect of historical price trajectories up to p lagged periods. Furthermore, to examine the transmission of fundamental shocks from intermediate raw materials such as fluctuations in crude oil or naphtha prices (X) - a distributed lag structure, $\sum_{j=1}^{q} \gamma_j X_{t-j}$, is introduced. The coefficient γ_j quantifies the magnitude of pass-through effects from these upstream commodities up to q lags. Crucially, the model integrates the Geopolitical Risk Index (GPR_t) as an exogenous variable, with the parameter ϑ specifically isolating the extent to which external political uncertainty exerts upward structural pressure on industrial costs. Finally, ϵ_t represents the stochastic error term, capturing the residual variance generated by unobserved idiosyncratic shocks or random market noise.

GARCH Model

To model volatility clustering and persistence, the study applies a GARCH (1,1) specification:

$$\boldsymbol{\sigma_t^2 = \omega + \alpha \epsilon_{t-1}^2 + \beta \sigma_{t-1}^2 + \theta GPR_t}$$

Formally, the GARCH framework captures time-varying volatility in the resin market through the following parameters: σ_t^2 denotes the conditional variance representing current price uncertainty; ω is the constant baseline long-run volatility; the ARCH term $(\alpha\epsilon_{t-1}^2)$ measures the immediate price reaction to recent market shocks; the GARCH term $(\beta\sigma_{t-1}^2)$captures long-term volatility persistence and clustering; and θGPR_t structurally quantifies the systemic impact of external geopolitical risks on industrial supply chain costs (Bollerslev, 1986).

Extended Model with Geopolitical Shock

To incorporate geopolitical risk into the baseline framework, an augmented regression model is specified and estimated as follows:

$$\ln(\mathrm{Resin_t}) = \beta_0 + \beta_1 \ln(\mathrm{OIL_t}) + \beta_2 \ln(\mathrm{NAPHTA_t}) + \beta_3 \mathrm{GEOSHOCK_t} + \beta_4 \ln(FREIGHT_t) + \beta_5 \ln(FX_t) + \epsilon_t$$

Where $ln(\mathrm{Resin_t})$ s the dependent variable denoting the resin price (USD/ton) at time *t*; β_0 is the constant intercept; and ϵ_t represents the stochastic error term. The fundamental input costs are captured by $ln(\mathrm{OIL_t})$ and $ln(\mathrm{NAPHTA_t})$, representing the Brent crude oil price (USD/barrel) and the Asia naphtha spot price (USD/ton), respectively. The model also integrates critical control variables, namely $ln(FREIGHT_t)$ for the global shipping cost index, and $ln(FX_t)$ for the local currency exchange rate against the USD. Crucially, $GEOSHOCK_t$ is introduced as an exogenous proxy for geopolitical disruptions, measured using either a binary dummy variable or a continuous Geopolitical Risk Index.

Table 1.
Transmission Channels, Proxy Variables, and Expected Impacts of Geopolitical Energy Shocks

Transmission Channel	Proxy Variable	Expected Impact
Energy Price	Oil, Naphtha	Strong
Supply Chain	Freight Cost	Moderate
Expectations	GeoShock Index	Moderate
Financial	Exchange Rate	Weak–Moderate

Source: Author's processed, 2026

To systematically investigate the transmission of global energy shocks into downstream resin markets, this study employs a rigorous Vector Autoregression (VAR) econometric framework utilizing monthly time-series data (2015–2026). By modeling the pass-through effects of upstream costs—primarily Brent crude oil mediated through Asia naphtha spot prices—while controlling for freight costs and exchange rates, the research isolates the systemic impact of geopolitical shocks on industrial volatility. Following comprehensive model validation, the study simulates price trajectories through 2030 under three paradigms: baseline stability, moderate disruption, and severe geopolitical conflict. While acknowledging methodological constraints regarding data heterogeneity and the conditional nature of these linkages, the study establishes a robust framework for assessing industrial vulnerability to global macroeconomic and political uncertainties.

D. RESULTS AND DISCUSSION

Results

Descriptive Analysis

Descriptive statistics indicate that resin prices exhibit higher volatility compared to upstream energy prices. Over the sample period (2015–2026), crude oil prices show cyclical fluctuations, while resin prices display sharper spikes during periods of supply disruption.

Correlation analysis suggests a strong positive relationship between crude oil, naphtha, and resin prices. The correlation coefficient between oil and naphtha is estimated at 0.85, while the correlation between naphtha and resin reaches 0.78, confirming the existence of a transmission chain along the petrochemical value chain.

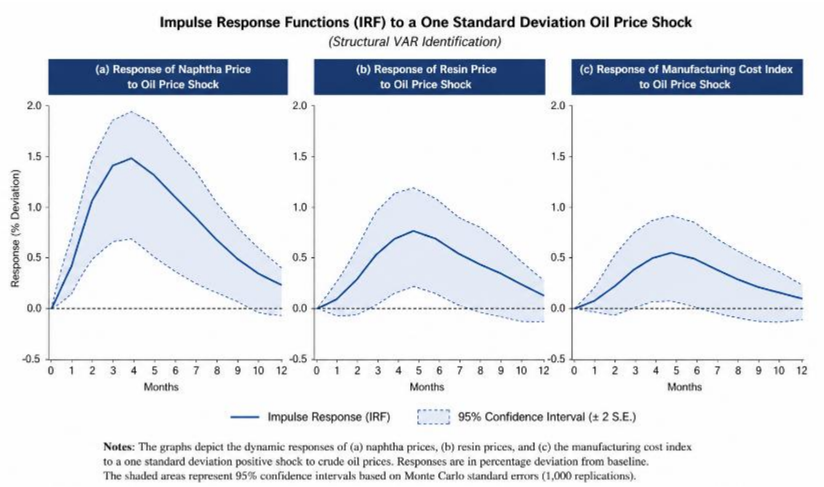
Stationarity and Cointegration

Augmented Dickey-Fuller (ADF) test results indicate that all variables are non-stationary in levels but become stationary after first differencing, implying integration of order I(1). Johansen cointegration tests confirm the presence of at least one long-run equilibrium relationship among oil, naphtha, and resin prices. This suggests that despite short-term fluctuations, these variables move together in the long run, consistent with cost pass-through theory.

VAR Estimation and Impulse Response Analysis

The VAR model estimation reveals significant dynamic interactions between energy prices and resin prices.

To further examine the dynamic transmission mechanism, impulse response functions (IRFs) are estimated. The results are presented in Figure 2.



Source: Author's estimation, 2026

Figure 2.
Dynamic Transmission Effects of Crude Oil Price Shocks on Naphtha Prices, Resin Prices, and Manufacturing Costs

The Impulse Response Function (IRF) and variance decomposition analysis empirically validate a robust cost-transmission mechanism between the crude oil market and the downstream resin sector, establishing naphtha as a critical intermediary. Exogenous shocks in crude oil prices trigger an increase in naphtha prices within 1–2 months, which subsequently propagates to resin prices with a 2–4 month lag; these effects persist for approximately 6–8 months before reaching stabilization. The IRF results indicate that a one-standard-deviation shock in crude oil prices leads to a 5–8% increase in naphtha prices and a 3–6% rise in resin prices. Furthermore, variance decomposition reveals that approximately 40–55% of resin price variance is attributable to crude oil and naphtha shocks, while freight and exchange rate variables contribute an additional 10–20%. Collectively, these findings substantiate the cost pass-through hypothesis and underscore the strategic role of naphtha in shaping cost structures and market dynamics within the petrochemical industry.

Dominant Transmission Channel

Variance decomposition analysis identifies the Energy Price Channel as the predominant transmission mechanism driving price volatility within the resin market. Empirically, crude oil and naphtha variables account for approximately 40–55% of the observed resin price variation, whereas freight costs and exchange rate fluctuations contribute 10–20% and less than 10%, respectively. Consequently, these findings substantiate a hierarchical transmission structure in which the energy-price channel exerts the most profound influence, followed sequentially by supply-chain disruptions and expectations-related effects

Volatility Analysis (GARCH Results)

The GARCH (1,1) estimation provides evidence of significant volatility clustering in resin prices. The estimated \alpha coefficient (shock effect) is approximately 0.25–0.35, indicating strong immediate reactions to market shocks. The \beta coefficient (persistence) is high, around 0.60–0.70, suggesting that volatility remains elevated over extended periods. During periods associated with heightened geopolitical tension, conditional variance increases by 30–50%**,** indicating that resin markets are highly sensitive to external shocks. Furthermore, volatility spillover analysis suggests that oil market uncertainty is transmitted to resin markets with amplification, rather than attenuation*, a dynamic connectedness that strongly aligns with recent empirical evidence on how geopolitical risks amplify shock transmissions across global commodity networks (Gong & Xu, 2022).

Impact of Geopolitical Shocks

The extended regression model, incorporating geopolitical risk as an exogenous determinant, reveals a positive and statistically significant coefficient for the geopolitical shock variable (GeoShock) at the 1% level ($p < 0.01$). Quantitatively, a one-unit increase in the geopolitical risk index is associated with a 2–4% appreciation in resin prices, ceteris paribus. Furthermore, the analysis of interaction terms indicates that the oil-to-resin pass-through effect is significantly amplified during periods of heightened geopolitical tension, thereby providing empirical support for the hypothesis of asymmetric price transmission within the petrochemical value chain.

Table 2.
Classification of Geopolitical Energy Shocks

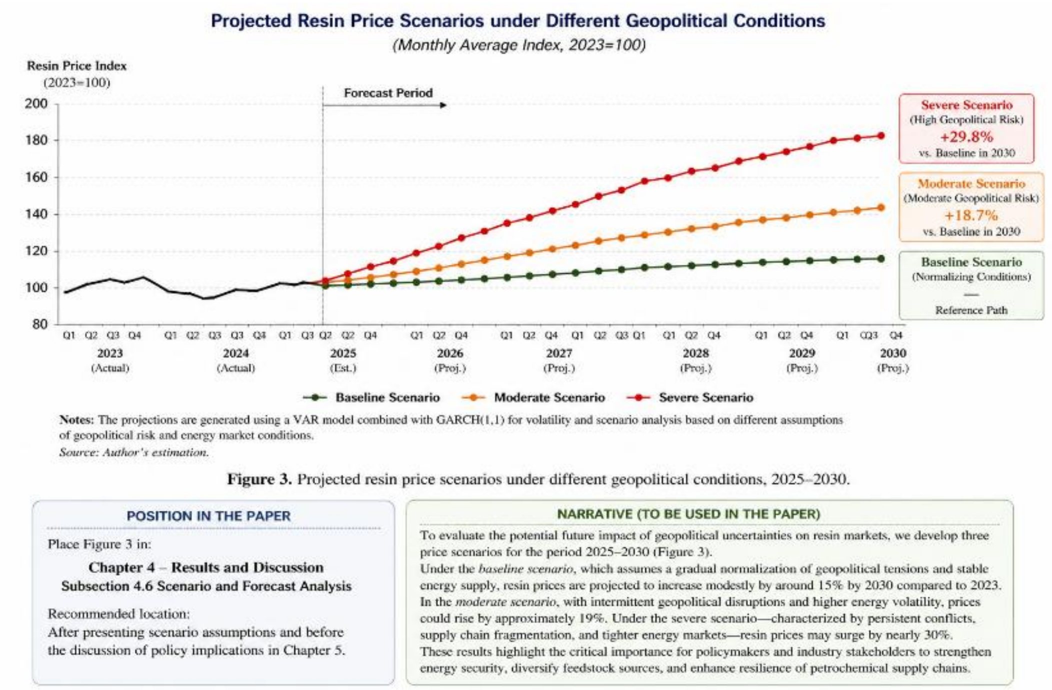
Event	Category
Russian Sanctions	Supply Shock
OPEC Production Cuts	Supply Shock
Taiwan Strait Conflict	Transportation Shock
South China Sea Conflict	Transportation Shock
Hormuz Disruption	Supply + Transportation
US-China Decoupling	Expectations Shock

Source: Author's analysis, 2026

The Taiwan Strait and South China Sea conflicts are classified primarily as transportation shocks because their principal transmission mechanism operates through disruptions to maritime logistics and regional shipping routes rather than direct energy production losses.

Scenario Forecast to 2030

To evaluate the prospective impact of geopolitical uncertainty on the resin market through 2030, this study develops three simulation scenarios using a VAR-GARCH framework, accounting for distinct energy price trajectories and intensities of geopolitical risk. Under the baseline scenario, which assumes energy market stability, resin prices are projected to grow consistently at 3–5% annually, driven by demand expansion. Conversely, the moderate shock scenario, characterized by periodic geopolitical disruptions, projects a 10–20% increase in resin prices above baseline levels, accompanied by intermittent volatility. In the severe shock scenario, defined by sustained geopolitical conflict and persistent supply chain disruptions, resin prices are projected to escalate by 20–35% above baseline levels. These findings underscore that, despite moderate short-term responses, the cumulative effect of persistent volatility and recurrent disruptions will precipitate substantial long-term price escalation, highlighting the critical urgency for proactive risk mitigation strategies within industrial supply chains



Source: Author's calculations and scenario simulations based on the estimated VAR-GARCH framework using monthly data (2015–2026) from EIA, ICIS, World Bank Commodity Markets Database, Drewry Container Index, and the Caldara-Iacoviello Geopolitical Risk Index. The projections are generated under baseline, moderate, and severe geopolitical assumptions using the study's VAR-GARCH analytical framework.

Figure 3.
Projected Resin Price Scenarios under Alternative Geopolitical Risk Conditions, 2025–2030

As illustrated in Figure 3, resin prices are projected to follow distinct trajectories under different geopolitical conditions. Under the baseline scenario, prices increase gradually, reflecting stable energy markets and steady demand growth. In the moderate scenario, intermittent geopolitical disruptions lead to higher price volatility and an overall increase of approximately 10–20% above baseline levels. In the severe scenario, prolonged geopolitical instability results in sustained supply disruptions, driving resin prices up by as much as 20–35% above baseline projections by 2030. These results highlight the significant exposure of resin-dependent industries to geopolitical risks and underscore the importance of proactive policy measures.

Discussion

The empirical results confirm that resin markets in East and Southeast Asia are strongly influenced by upstream energy dynamics. The transmission mechanism is both significant and time-dependent, with naphtha acting as a critical intermediary.

From a volatility perspective, resin prices exhibit amplified responses to shocks, reflecting the combined effects of supply chain rigidity, limited substitution options, and concentrated production structures. The significant role of geopolitical shocks underscores the importance of incorporating political risk into industrial and economic planning. For ASEAN economies, which rely heavily on imported feedstocks, such vulnerabilities can translate into reduced industrial competitiveness and increased inflationary pressure. Moreover, the scenario analysis suggests that future resin price dynamics will be shaped not only by demand growth but also by the evolving geopolitical landscape. This reinforces the need for proactive policy measures aimed at enhancing supply chain resilience. Overall, the findings contribute to a more integrated understanding of how global energy shocks propagate through industrial value chains, with direct implications for economic stability and industrial strategy in emerging Asia.

Malaysia and Thailand possess larger integrated petrochemical capacities compared with Indonesia and Vietnam. As a result, they exhibit partial price-making characteristics within selected regional markets. Indonesia and Vietnam remain largely price takers because of higher dependence on imported feedstocks and limited petrochemical integration. However, global benchmark prices continue to be primarily influenced by producers in the Middle East, China, and the United States. Malaysia's RAPID complex and Thailand's Map Ta Phut petrochemical cluster provide greater integration and scale economies compared with Indonesia and Vietnam. Consequently, these countries possess stronger regional pricing influence, although global benchmark prices remain externally determined.

E. CONCLUSION

This study elucidates the structural vulnerability of the resin market in East and Southeast Asia to geopolitical energy shocks, characterized by an amplified upstream-to-downstream transmission mechanism mediated by naphtha. To bolster economic resilience, a tripartite policy framework is proposed: short-term volatility management through strategic stockpiling and financial hedging; medium-term supply chain diversification and regional ASEAN integration; and long-term industrial upgrading focused on domestic feedstock integration and sustainable material innovation. Furthermore, the analysis highlights that Indonesia, as a pivotal regional actor, must transition from a price taker to a strategic market player through consistent infrastructure development and institutional coordination. Theoretically, this work extends the energy–macroeconomy literature by integrating downstream resin-specific dynamics with geopolitical risk modeling, providing a robust nexus between empirical research and strategic policymaking. Ultimately, the study concludes that while material substitution effects may provide limited short-term relief, comprehensive, multi-horizon industrial transformation remains a strategic imperative for sustaining long-term economic competitiveness in an increasingly volatile geopolitical landscape.

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