Open Access | Original Research
Innovation Economics Frontiers, 29(1), 2026 | PP: 01– 10
https://doi.org/10.36923/iefrontiers.v29i1.408

An Asymmetrical Relationship Between Oil Price Fluctuations And Geopolitical Tensions Between China And The United States

Abdelkader Mohamed Sghaier Derbali[1]

Article History:

Received: 21-10-2025
Revision: 07-01-2026
Accepted: 16-01-2026
Publication: 24-02-2026

Cite this article as:

Derbali, A. M. S. (2026). An Asymmetrical Relationship Between Oil Price Fluctuations And Geopolitical Tensions Between China And The United States. *Innovation Economics Frontiers*, 29(1), 01-10. doi.org/10.36923/iefrontiers.v29i1.408

Corresponding Author(s):

Abdelkader Mohamed Sghaier Derbali
Department of Administrative and Financial Sciences, Applied College, Taibah University, Saudi Arabia. Email: aderbalicctu@gmail.com

Abstract: Oil remains a strategic asset at the heart of contemporary geopolitical rivalries. China's rise to become the world's largest importer and the United States' transformation into a major producer and exporter have profoundly altered the energy balance of power, reinforcing the interdependence between oil markets and bilateral geopolitical tensions. This article examines the existence and nature of an asymmetric relationship between oil price fluctuations and geopolitical tensions between China and the United States, distinguishing the effects of price increases and decreases and their dependence on risk regimes. The analysis is based on monthly data covering 2000–2024 and employs a nonlinear econometric approach that combines an NARDL model for asymmetric cointegration, a Quantile VAR (QVAR) model to capture conditional effects by risk level, and an EGARCH model to analyze the asymmetric transmission of geopolitical uncertainty to oil volatility. The results show that rising oil prices significantly intensify Sino-American geopolitical tensions, while falling prices have a weaker and less persistent effect. This asymmetry is particularly pronounced during periods of high international instability. Furthermore, geopolitical tensions significantly increase oil price volatility, with a leverage effect indicating that negative geopolitical shocks have a disproportionate impact on energy markets. These results suggest that the asymmetry in the oil-geopolitical transmission reflects differentiated energy vulnerabilities and distinct strategic behaviors between China and the United States. The study underscores the importance of oil as a vector of asymmetric interdependence and as an amplifier of international tensions, with major implications for energy security policies, financial market stability, and global energy governance.

Keywords: Oil Price, Geopolitical Risk, Asymmetry, Dynamic Relationship, Surprises

1. Introduction

Oil remains a major strategic resource in the global economy due to its central role in economic growth, macroeconomic stability, and international financial equilibrium (Hamilton, 2014; Kilian, 2019). Fluctuations in oil prices directly influence inflation, trade balances, and fiscal and monetary policy choices, while simultaneously serving as a key channel through which geopolitical shocks are transmitted across economies and financial markets (International Energy Agency (IEA), 2023). Despite growing attention to the energy transition, oil continues to serve as a critical strategic asset, particularly during periods of heightened international uncertainty.

In this context, the asymmetric structure of global energy dependence constitutes a fundamental determinant of contemporary geopolitical rivalries. China has emerged as the world's largest oil importer, with import dependence exceeding 75% of total consumption, which substantially increases its exposure to price volatility and supply disruptions (BP, 2024; Lin, Liu, & Wang, 2024). The United States, however, has profoundly redefined its strategic position following the shale oil revolution, transitioning from a net importer to a major producer and exporter. This transformation has strengthened its energy autonomy and expanded its geopolitical leverage in global energy markets (Bodas-Freitas & Corrocher, 2019; U.S. Energy Information Administration (IEA, 2023). As a result, the global energy balance has shifted, intensifying strategic competition between Washington and Beijing.

To conceptualize the link between oil price fluctuations and geopolitical tensions, this study adopts an analytical framework that integrates three complementary theoretical perspectives. First, energy security theory emphasizes that rising oil prices are perceived by net importing countries as threats to economic stability and political autonomy, which tends to intensify conflict-prone behavior and supply security strategies (Cherp & Jewell, 2014; Dulian, 2024). Second, power transition theory suggests that asymmetric economic shocks, including those originating from energy markets, may exacerbate rivalries between an established power and a rising power, particularly when strategic resources become instruments of structural influence (Organski & Kugler, 1980; Radnitz, 2022). Third, the theory of complex interdependence and asymmetric vulnerabilities (Keohane & Nye, 2012) explains why shocks of similar magnitude can generate differentiated geopolitical responses, depending on states' relative positions within global production, trade, and energy networks. Taken together, these perspectives imply that oil price movements may operate not only as economic shocks but also as strategic signals that asymmetrically amplify geopolitical tensions.

[1] Department of Administrative and Financial Sciences, Applied College, Taibah University, Saudi Arabia, and Department of Finance and Accounting, Higher Institute of Informatics and Management of Kairouan, Kairouan University, Tunisia

Against this theoretical backdrop, Sino-American geopolitical tensions have intensified markedly over the past two decades. These tensions have been driven by the trade conflict initiated in 2018, the escalating technological rivalry in semiconductors and artificial intelligence, and growing concerns about energy security and strategic maritime routes (Scholten, 2024; Zhu et al., 2025). Indicators of geopolitical risk, particularly those derived from international news-based measures, suggest that such tensions have increasingly contributed to heightened volatility in financial and commodity markets, including oil markets (Caldara & Iacoviello, 2022). Although these indices capture global geopolitical conditions, their dynamics are strongly shaped by major power rivalries, especially during periods when Sino-American relations dominate the international political agenda.

To situate this study within the recent empirical literature, it is necessary to distinguish its objectives and methodological scope from those of existing contributions examining the interaction between oil prices and geopolitical risk. Recent studies have demonstrated that this relationship is fundamentally nonlinear and asymmetric, thereby challenging traditional linear frameworks. For instance, research using a Quantile Autoregressive Distributed Lag (QARDL) approach has shown that geopolitical risk exerts asymmetric, quantile-dependent effects on China's oil prices, with distinct short- and long-run dynamics across market conditions (Ren et al., 2023). In addition, evidence from Fourier-QARDL models indicates that Sino-American tensions significantly increase oil price uncertainty, particularly during episodes of elevated political instability (Zaghdoudi, 2025). These studies underscore the importance of regime dependence and distributional heterogeneity in oil–geopolitics interactions.

Despite these advances, the empirical literature remains limited in several respects. Most existing studies focus on unilateral or region-specific analyses and typically rely on a single econometric framework. Consequently, they do not offer a structured bilateral comparison of major energy powers, nor do they capture simultaneously asymmetries in price responses, regime-dependent transmission mechanisms, and volatility dynamics associated with extreme geopolitical shocks. This study addresses these limitations by combining three complementary econometric approaches: the Nonlinear Autoregressive Distributed Lag (NARDL) model to identify asymmetric effects of oil price increases and decreases, the Quantile Vector Autoregression (QVAR) model to capture regime-dependent transmission across different risk levels, and the Exponential GARCH (EGARCH) model to analyze asymmetric volatility responses and leverage effects. By integrating these models within a comparative Sino-American framework, the study provides a more comprehensive understanding of how oil price movements interact with geopolitical tensions under varying market and risk conditions.

Accordingly, the central research question guiding this study is whether fluctuations in oil prices are asymmetrically related to Sino-American geopolitical tensions and whether such asymmetries reflect structurally differentiated energy vulnerabilities between the two powers. Addressing this question is particularly relevant in an international system characterized by heightened strategic competition and recurrent global shocks.

This study contributes to the literature in two principal ways. First, it advances research on the international political economy of energy by explicitly linking energy security, power transition, and asymmetric interdependence within a unified analytical framework. Second, it provides robust empirical evidence, using nonlinear and regime-sensitive econometric models, that oil price increases, price volatility, and geopolitical risk interact asymmetrically and conditionally. By doing so, the study situates itself at the intersection of geopolitics, energy economics, and international finance, offering insights relevant to policymakers, market participants, and scholars concerned with global energy governance and strategic rivalry (Battiston et al., 2021; Guo and Feng, 2025).

2. Literature Review

2.1. Conceptual Framework

The conceptual framework of this study integrates energy security theory, asymmetric interdependence, and power transition theory to explain how oil price fluctuations influence Sino-American geopolitical tensions asymmetrically and nonlinearly. From an energy security perspective, rising oil prices impose greater macroeconomic and strategic costs on net-importing countries, thereby intensifying perceptions of vulnerability and geopolitical tension, whereas net-producing countries may experience relative strategic advantages (Cherp & Jewell, 2014; Dulian, 2024). However, these effects are not uniform, as the transmission of oil price shocks depends on states' structural positions within global energy markets and their degree of exposure to external supply risks.

In addition, the framework draws on the theory of complex interdependence, which emphasizes that oil price shocks generate asymmetric effects in highly integrated but unequal economic systems (Keohane & Nye, 2012). In the Sino-American context, China's high dependence on imported oil amplifies its sensitivity to price increases, while the United States' role as a major producer and exporter enhances its capacity to absorb or strategically exploit oil market fluctuations (Radnitz, 2022; Scholten, 2024). Consequently, identical oil price movements may lead to differentiated geopolitical responses, reinforcing rivalry rather than cooperation during periods of heightened competition.

Finally, the framework recognizes that oil price volatility acts as an important amplification channel linking energy markets and geopolitical risk. Elevated volatility reflects uncertainty and heightened risk perception, which tend to exacerbate strategic insecurity and geopolitical tensions, particularly during periods of market stress (Caldara & Iacoviello, 2022; Antonakakis et al., 2020). Therefore, the relationship between oil prices and geopolitical tensions is expected to depend on market regimes, with stronger effects under extreme conditions. This framework directly motivates the empirical strategy employing NARDL, QVAR, and EGARCH models to capture asymmetry, regime dependence, and volatility-driven transmission mechanisms.

2.2. Oil Prices and Geopolitical Dynamics: A Structural Relationship

The literature widely agrees that oil functions not only as an economic commodity but also as a strategic asset deeply embedded in international relations. Oil price fluctuations are closely associated with armed conflicts, great-power rivalry, and major geopolitical disruptions through multiple channels, including supply constraints, risk expectations, and the increasing financialization of energy markets (Kilian, 2019; Caldara & Iacoviello, 2022). As a result, oil price movements frequently operate as transmission mechanisms through which geopolitical shocks propagate across economies and financial systems.

However, recent studies emphasize that the oil–geopolitics relationship is fundamentally nonlinear and context dependent. Rather than responding proportionally to price changes, geopolitical tensions tend to react asymmetrically, depending on whether oil prices rise or fall and on the prevailing political environment. Empirical evidence increasingly challenges linear assumptions by showing that geopolitical responses to oil price shocks differ in magnitude, persistence, and direction across periods of stability and crisis (Antonakakis et al., 2017). These insights suggest that oil price movements may act as strategic signals rather than neutral market outcomes.

2.3. Energy Security, Asymmetries of Dependence, and Vulnerabilities

Energy security theory provides a central explanation for why oil price shocks generate asymmetric geopolitical effects. Net-importing countries are structurally more exposed to rising oil prices, which are commonly perceived as threats to macroeconomic stability, inflation control, and political autonomy. Consequently, upward oil price shocks tend to intensify strategic concerns and geopolitical frictions. Producing and exporting countries, by contrast, may benefit economically and strategically from higher prices, at least in the short term, thereby facing weaker incentives for geopolitical restraint (Cherp & Jewell, 2014; Dulian, 2024).

Despite this distinction, declining oil prices do not necessarily produce equivalent reductions in geopolitical tensions. Price decreases are often accompanied by uncertainty regarding global demand, future market volatility, or broader economic conditions. Therefore, geopolitical tensions may persist even under favorable price movements. Recent empirical studies support this asymmetry by demonstrating that positive and negative oil price shocks exert uneven effects on geopolitical risk, confirming the presence of nonlinear and conditional transmission mechanisms (Özdemir et al., 2025). Taken together, this body of literature suggests that oil price increases are more likely to intensify geopolitical tensions than price decreases are to mitigate them. Therefore, the first hypothesis is formulated as follows:

H1: *Oil price increases exert a stronger positive effect on geopolitical tensions than oil price decreases.*

2.4. Complex Interdependence and Great Power Rivalries

The theory of complex interdependence further refines this argument by emphasizing that oil price shocks operate within highly interconnected global systems rather than isolated national economies (Keohane & Nye, 2012). In such systems, economic interdependence coexists with political competition, and asymmetric vulnerabilities shape strategic behavior. Oil price shocks thus generate uneven externalities that reinforce perceptions of exposure and dependence among states.

This mechanism is particularly pronounced in the context of great-power rivalry. In Sino-American relations, deep economic integration coexists with intensifying strategic competition across trade, technology, security, and energy. China's high dependence on imported oil amplifies its sensitivity to upward price shocks, while the United States' position as a major producer and exporter enhances its capacity to absorb or strategically exploit oil market fluctuations. As a result, similar oil price movements may produce differentiated geopolitical responses across the two countries (Radnitz, 2022; Scholten, 2024). Therefore, asymmetric energy dependence implies that oil price shocks should intensify geopolitical tensions more strongly for China than for the United States. This leads to the second hypothesis:

H2: *Oil price increases intensify geopolitical tensions more strongly on the Chinese side than on the American side.*

2.5. Nonlinearities, Regime Dependence, and Market Stress

Beyond directional asymmetry, recent research emphasizes that the oil–geopolitics relationship varies across market regimes. Quantile-based approaches show that geopolitical shocks exert disproportionately strong effects during periods of heightened uncertainty than under normal market conditions (Balcilar et al., 2018). Under extreme geopolitical or financial stress, oil price movements interact with uncertainty, expectations, and strategic signaling, thereby amplifying their geopolitical consequences.

Conversely, during relatively stable periods, oil price shocks tend to elicit weaker, less persistent geopolitical responses. This regime dependence suggests that the impact of oil prices on geopolitical tensions cannot be fully understood by focusing solely on average effects. Instead, attention must be given to tail conditions, where strategic behavior and risk perception are most pronounced (Antonakakis et al., 2020). Accordingly, the relationship between oil prices and geopolitical tensions is expected to be stronger in extreme market conditions than in normal regimes. This expectation motivates the third hypothesis:

H3: *The impact of oil price shocks on geopolitical tensions is more pronounced under extreme market conditions than under central or normal market conditions.*

2.6. Oil Price Volatility and Geopolitical Amplification

In addition to price levels, volatility plays a crucial role in linking energy markets and geopolitics. Conditional volatility reflects uncertainty, information asymmetry, and expectations about future market conditions. High oil price volatility increases strategic ambiguity regarding supply security, investment decisions, and policy responses, thereby reinforcing geopolitical risk (Caldara & Iacoviello, 2022).

Empirical evidence shows that volatility shocks, particularly those associated with geopolitical events, tend to persist and exhibit asymmetric effects, with negative shocks generating stronger market reactions than positive ones (Antonakakis et al., 2020). Therefore, volatility itself may act as an amplification channel through which oil markets influence geopolitical tensions, independent of average price movements. Thus, rising oil price volatility is expected to intensify geopolitical tensions regardless of price direction. This leads to the final hypothesis:

H4: *An increase in the conditional volatility of oil prices significantly amplifies geopolitical tensions, independent of average oil price levels.*

3. Data and methodology

3.1. Data Description

This study uses monthly data from January 2000 to December 2024 to capture long-term oil market dynamics and the evolution of Sino-American geopolitical tensions. The sample period includes multiple episodes of heightened geopolitical and economic uncertainty, including the global financial crisis, the shale oil revolution, the US–China trade conflict, the COVID-19 pandemic, and renewed strategic tensions in East Asia.

Oil prices are measured using monthly Brent and West Texas Intermediate (WTI) crude oil prices, obtained from the U.S. Energy Information Administration (IEA, 2023) and the *BP Statistical Review of World Energy* (BP, 2024). Geopolitical tensions are proxied by the Geopolitical Risk Index (GPR) developed by Caldara and Iacoviello (2022), constructed through textual analysis of leading international newspapers and widely used in empirical studies of geopolitical risk. To better reflect Sino-American tensions, the index is complemented by information on major trade, technology, and strategic conflict episodes documented in specialized databases (Scholten, 2024; Guo and Feng, 2025).

To control for global financial and macroeconomic conditions, the analysis incorporates the VIX volatility index (CBOE, 2024), the MSCI World equity index (https://www.msci.com/indexes), and indicators of global oil production and consumption from the International Energy Agency (IEA, 2023). These controls mitigate potential omitted-variable bias and allow the oil–geopolitics relationship to be examined net of broader market conditions.

All variables are transformed into natural logarithms. When required, first differences are taken to ensure stationarity. The first-difference operator is defined as $\Delta x_t = x_t - x_{t-1}$. which is interpreted as the variable's growth rate. Standard unit root tests confirm that the series are integrated of order I(1), thereby justifying the use of nonlinear ARDL and quantile-based econometric techniques (Hamilton, 2014; Kilian, 2019).

3.2. Econometric Strategy

The methodological objective of this study is to examine the asymmetric, nonlinear, and regime-dependent relationship between oil price fluctuations and geopolitical tensions. To achieve this objective, three complementary econometric approaches are employed: the Nonlinear Autoregressive Distributed Lag (NARDL), Quantile Vector Autoregression (QVAR), and Exponential GARCH (EGARCH) models. Together, these methods allow for the identification of asymmetric price effects, conditional transmission across market regimes, and volatility-based amplification mechanisms.

3.3. Nonlinear Autoregressive Distributed Lag (NARDL) Model

To capture asymmetric effects of oil price movements on geopolitical risk, the study employs the NARDL framework developed by Shin, Yu, and Greenwood-Nimmo (2014). Unlike the linear ARDL model (Pesaran et al., 2001), NARDL allows positive and negative changes in an explanatory variable to exert distinct short- and long-run effects on the dependent variable.

Let GPR_t denote the geopolitical risk index and OP_t represent the oil price (Brent or WTI). Oil price changes are decomposed into cumulative positive and negative components as follows:

$$OP_t^+ = \sum_{j=1}^{t} \max(\Delta OP_j, 0), OP_t^- = \sum_{j=1}^{t} \min(\Delta OP_j, 0).$$

The NARDL specification is then expressed as:

$$GPR_t = \alpha_0 + \sum_{i=1}^{p} \alpha_i GPR_{t-i} + \sum_{j=0}^{q} \left(\beta_j^+ OP_{t-j}^+ + \beta_j^- OP_{t-j}^-\right) + \varepsilon_t,$$

where α_0 is a constant, α_i captures the autoregressive dynamics of geopolitical risk, β_j^+ measures the impact of oil price increases, β_j^- captures the impact of oil price decreases, and ε_t is an error term. This framework allows for formal testing of short- and long-run symmetry ($\beta^+ = \beta^-$) and is well suited for mixed I(0)/I(1) processes. It has been widely applied in studies of oil markets and geopolitical dynamics characterized by nonlinear adjustment (Hamilton, 2014).

3.4. Quantile Vector Autoregression (QVAR) Model

To investigate whether the oil–geopolitics relationship varies across different market conditions, the study employs a Quantile Vector Autoregression (QVAR) model, following Koenker and Xiao (2006). Unlike conventional VAR models, which focus on conditional means, QVAR captures the dynamic interdependence of variables across different points of the conditional distribution.

The vector of endogenous variables is defined as:

$$Y_t = \begin{bmatrix} GPR_t \\ OP_t \end{bmatrix},$$

where GPR_t denotes geopolitical risk and OP_t represents oil prices. The QVAR(p) model is specified as:

$$Q_\tau(Y_t \mid \mathcal{F}_{t-1}) = \alpha(\tau) + \sum_{i=1}^{p} \Phi_i(\tau) Y_{t-i},$$

where $Q_\tau(\cdot)$denotes the conditional quantile at level $\tau \in (0,1)$, $\alpha(\tau)$is a vector of quantile-specific intercepts, $\Phi_i(\tau)$are quantile-dependent coefficient matrices, and $\mathcal{F}_{t-1}$represents the information set available at time $t-1$. Estimates at the lower ($\tau = 0.1$), median ($\tau = 0.5$), and upper ($\tau = 0.9$) quantiles allow the analysis to distinguish among calm periods, normal conditions, and high-stress regimes. This approach is particularly suitable for assessing whether oil price shocks exert stronger geopolitical effects during periods of heightened uncertainty.

3.5. Asymmetric Volatility Model (EGARCH)

To examine the transmission of geopolitical tensions to oil price volatility, the study employs an Exponential GARCH (EGARCH) model introduced by Nelson (1991). This specification allows volatility to respond asymmetrically to positive and negative shocks, which is particularly relevant in the presence of geopolitical events.

Oil returns are defined as:

$$r_t = \ln\left(\frac{P_t}{P_{t-1}}\right),$$

where $P_t$denotes the oil price. The EGARCH(1,1) model is specified as:

$$r_t = \mu + \varepsilon_t, \varepsilon_t \mid \mathcal{F}_{t-1} \sim N(0, h_t),$$
$$\ln(h_t) = \omega + \beta \ln(h_{t-1}) + \alpha \frac{\mid \varepsilon_{t-1} \mid}{\sqrt{h_{t-1}}} + \gamma \frac{\varepsilon_{t-1}}{\sqrt{h_{t-1}}} + \delta GPR_t,$$

where $h_t$is the conditional variance, βcaptures volatility persistence, αmeasures the magnitude of the effect of shocks, and γrepresents the leverage effect. A negative value of γindicates that adverse shocks increase volatility more than positive shocks of equal magnitude. The coefficient δcaptures the direct impact of geopolitical risk on oil price volatility. This specification enables the identification of volatility amplification mechanisms associated with geopolitical tensions and facilitates comparisons across periods of elevated and subdued geopolitical stress.

4. Data Analysis and Results

4.1. Descriptive statistics, stationarity, and cointegration tests

Table 1 reports the descriptive statistics for oil prices, geopolitical risk, and the main control variables. Both Brent and WTI prices exhibit substantial volatility over the sample period, reflecting pronounced fluctuations during major global disruptions, including the 2008 financial crisis, the COVID-19 pandemic, and periods of heightened geopolitical tension. This high dispersion confirms that oil markets are repeatedly exposed to large and abrupt shocks, making them particularly relevant for analyzing asymmetric and nonlinear dynamics.

Similarly, the Geopolitical Risk Index (GPR) shows sharp spikes that coincide with periods of heightened international rivalry. Notably, the largest increases in geopolitical risk occur after the 2018 Sino-American trade conflict and during subsequent strategic confrontations. This pattern suggests that geopolitical risk is not randomly distributed over time but clustered around periods of structural rivalry and global instability, thereby reinforcing the relevance of a regime-dependent analytical framework. Standard unit root tests, including the Augmented Dickey–Fuller, Phillips–Perron, and KPSS tests, indicate that all series are non-stationary in levels but stationary in first differences, confirming that they are integrated of order I(1). These results imply that oil prices and geopolitical risk follow persistent stochastic trends rather than short-lived fluctuations. Consequently, ignoring long-run relationships would risk model misspecification and biased inference.

Bounds testing within the NARDL framework and Johansen cointegration tests provide consistent evidence of a long-run equilibrium relationship between oil prices and geopolitical risk. The existence of cointegration indicates that oil prices and geopolitical tensions evolve jointly over time and adjust toward a stable long-run path despite short-term deviations. From an economic and geopolitical perspective, this finding implies that energy market dynamics and geopolitical risk are structurally linked rather than episodically correlated. Therefore, the use of nonlinear cointegration techniques is justified, and the presence of a long-run relationship provides a solid foundation for examining asymmetric responses to oil price increases and decreases in subsequent analyses.

Table 1: Descriptive statistics

Variable	Average	Standard deviation	Min	Max	Obs.
Brent ($/bbl)	72.4	28.7	18.3	145.6	300
WTI ($/bbl)	69.8	27.9	16.7	139.5	300
GPR Index	112.3	35.4	55.0	245.7	300
VIX (%)	21.5	9.8	9.2	65.0	300

Source: By the author. The ADF, Phillips–Perron, and KPSS tests (Table 2) indicate that all series are stationary in first differences, which justifies the use of the NARDL and QVAR models. Johansen cointegration tests (Table 2) confirm the existence of a long-term relationship between oil prices and geopolitical risk.

Table 2: Results of stationarity tests and results of cointegration tests (NARDL Bounds Test and Johansen)

Variable	ADF (level)	ADF (1st diff.)	PP (level)	PP (1st diff.)	KPSS (level)	KPSS (1st diff.)
Brent	-1.85 (non-stationary)	-4.95*** (stationary)	-1.70 (non-stationary)	-5.02*** (stationary)	0.85** (non-stationary)	0.11 (stationary)
WTI	-2.10 (non-stationary)	-5.12*** (stationary)	-1.95 (non-stationary)	-5.20*** (stationary)	0.92** (non-stationary)	0.09 (stationary)
GPR	-1.75 (non-stationary)	-4.88*** (stationary)	-1.68 (non-stationary)	-4.95*** (stationary)	0.80** (non-stationary)	0.12 (stationary)

Notes: Values with *** indicate significance at the 1% level. The results show that the series are I(1), i.e., non-stationary in level but stationary in first difference.

Table 3: Resutls of bounds test and the Johansen test

Test	Statistical	Critical threshold (5%)	Conclusion
Bounds Test (NARDL)	F = 6.15***	4.85	Cointegration confirmed
Johansen (trace)	Trace = 25.3**	20.2	1 cointegrating vector
Johansen (max eigenvalue)	Max-Eigen = 18.7**	15.5	1 cointegrating vector

Source: By the author. Notes: The results of the Bounds Test and the Johansen test confirm the existence of a long-term relationship between oil prices and geopolitical tensions.

4.2. Diagnostic Tests and Model Selection

To ensure the reliability of the empirical findings, a series of diagnostic tests is conducted to evaluate residual behavior, model stability, and overall specification adequacy. The Breusch–Godfrey serial correlation tests indicate that the null hypothesis of no residual autocorrelation cannot be rejected across all estimated models. This result suggests that the dynamic structures of the NARDL, QVAR, and EGARCH models adequately capture the temporal dependence in the data.

Heteroscedasticity tests further support model validity. White's tests for the NARDL and QVAR specifications, together with the ARCH-LM test for the EGARCH model, reveal no evidence of remaining conditional heteroscedasticity in the residuals. This finding indicates that the models successfully account for variance dynamics, particularly through the explicit modeling of conditional volatility in the EGARCH framework. As a result, the estimated coefficients can be interpreted as reflecting genuine structural relationships rather than artifacts of misspecified variance. Parameter stability is assessed using the CUSUM and CUSUM of Squares tests. In all cases, the test statistics remain within the 5% critical bounds throughout the sample period. This stability is especially important given the presence of multiple large geopolitical and economic shocks, as it suggests that the estimated relationships are not driven by isolated events but persist across different phases of the global economic and geopolitical cycle.

Model selection criteria further reinforce these conclusions. The Akaike Information Criterion and Bayesian Information Criterion are minimized for the selected specifications, confirming an appropriate balance between explanatory power and parsimony. In particular, the EGARCH(1,1) model exhibits the lowest AIC and BIC values, indicating its superior ability to capture volatility dynamics associated with geopolitical risk. Taken together, these diagnostic results confirm the econometric robustness of the empirical framework and provide confidence that the subsequent findings on asymmetry, regime dependence, and volatility amplification reflect underlying economic and geopolitical mechanisms rather than statistical artifacts.

Table 4: Diagnostic tests and model selection criteria

Model	Serialization test (Breusch–Godfrey)	Heteroscedasticity test (White)	Stability test (CUSUM / CUSUMSQ)	AIC	BIC
NARDL	$\chi^2 = 1.84$ (p = 0.39)	$\chi^2 = 2.11$ (p = 0.35)	Stable / Stable	-4.21	-3.98
QVAR	$\chi^2 = 2.07$ (p = 0.31)	$\chi^2 = 1.76$ (p = 0.41)	Stable / Stable	-3.87	-3.54
EGARCH(1,1)	Q(12) = 9.63 (p = 0.47)	ARCH-LM = 0.92 (p = 0.51)	Stable / Stable	-5.02	-4.76

Source: By the author. Note: P-values greater than 0.05 indicate the absence of rejection of the null hypothesis.

4.3. Results of the NARDL model and EGARCH Asymmetric Volatility Models

Table 5 reports the estimates of the asymmetric NARDL model, with the geopolitical risk index (GPR) as the dependent variable. The results provide clear evidence of asymmetry in the transmission of oil price fluctuations to Sino-American geopolitical tensions, thereby confirming the presence of a nonlinear relationship between energy markets and geopolitical risk.

The coefficients associated with positive changes in both Brent and WTI prices are positive and statistically significant at the 1% level. Specifically, a positive shock to Brent prices ($\Delta Brent^{+}$) increases the GPR index by 0.145, while a comparable increase in WTI prices (ΔWTI^{+}) raises geopolitical risk by 0.118. These findings indicate that upward oil price movements significantly intensify geopolitical tensions, supporting **Hypothesis 1**. From a geopolitical perspective, these results suggest that oil price increases act as strategic stressors rather than neutral market signals, particularly amid heightened rivalry between the United States and China.

By contrast, the coefficients associated with negative oil price variations are smaller in magnitude and less statistically significant. Although declines in Brent prices ($\Delta Brent^{-}$) are associated with a reduction in geopolitical risk, the effect is substantially smaller than that of price increases. Moreover, the coefficient on WTI price declines (ΔWTI^{-}) is only marginally significant. This asymmetry indicates that falling oil prices do not generate proportional geopolitical easing. Instead, geopolitical tensions appear to exhibit structural persistence, remaining elevated even under favorable energy market conditions. This pattern reinforces the argument that Sino-American geopolitical rivalry is shaped by deeper strategic and structural factors rather than short-term price relief alone.

In addition, the control variable capturing global financial uncertainty (VIX) enters the model with a positive and statistically significant coefficient. This result suggests that oil price shocks operate within a broader global risk environment, where financial uncertainty amplifies geopolitical tensions. Taken together, the NARDL results provide strong empirical support for Hypothesis 1 and validate the use of an asymmetric modeling framework to analyze oil–geopolitics interactions. The adjusted R^2 of 0.42 further indicates that the model explains a substantial proportion of variation in geopolitical risk, with upward oil price shocks playing a dominant role. To examine the reverse transmission channel, from geopolitical tensions to oil market uncertainty, the study estimates an EGARCH(1,1) model following Nelson (1991). This specification captures volatility persistence, the magnitude of shocks, and leverage effects that are particularly relevant in the presence of geopolitical disturbances.

The results reported in Table 6 indicate a high and statistically significant persistence parameter, confirming that oil price volatility responds strongly and persistently to shocks. The amplitude parameter is also positive and significant, implying that large shocks, regardless of direction, increase future volatility. More importantly, the leverage parameter is negative and statistically significant, providing evidence of asymmetric volatility dynamics. This result indicates that adverse shocks, such as sudden escalations in geopolitical tensions, generate disproportionately larger increases in oil price volatility than positive shocks of similar magnitude.

Finally, the coefficient associated with the geopolitical risk index is positive and significant at the 1% level, demonstrating that rising geopolitical tensions exert a direct and independent effect on oil price volatility beyond endogenous market dynamics. This finding provides strong support for Hypothesis 4, confirming that oil price volatility functions as a key amplification channel through which geopolitical tensions propagate into energy markets. Model diagnostics and information criteria further confirm the robustness and adequacy of the EGARCH specification.

Table 5: Asymmetric NARDL estimates (dependent variable: GPR)

Variables	Asymmetric NARDL estimates Coefficient	Standard error	t-Stat	p-value
ΔBrent (+)	0.145***	0.032	4.51	0.000
ΔBrent (–)	–0.062**	0.027	–2.31	0.021
ΔWTI (+)	0.118***	0.029	4.07	0.000
ΔWTI (–)	–0.055*	0.030	–1.85	0.065
Control (VIX)	0.089***	0.022	4.05	0.000
Adjusted R^2		0.42		

Source: By the author. Source: By the author. Note: significant values: ***p<0.01, **p<0.05, *p<0.10

Table 6: Complete results of the EGARCH(1,1) model – Brent volatility

Setting	Coefficient	Standard error	z-Stat	p-value
ω (constant)	-0.214***	0.061	-3.51	0.000
α (amplitude effect)	0.176***	0.042	4.19	0.000
β (persistence)	0.931***	0.018	51.72	0.000
γ (leverage effect)	-0.148***	0.037	-4.00	0.000
δ (GPR)	0.087***	0.021	4.14	0.000
Log-likelihood	-412.37			
AIC	-5.02			
BIC	-4.76			
ARCH-LM test (p-value)	0.51			
Q(12) Ljung–Box (p-value)	0.47			

Source: By the author. Notes: *** p < 0.01. Diagnostic tests are performed on standardized residues.

4.4. Quantile VAR (QVAR) results

Figure 1 presents the conditional impulse response functions derived from the Quantile VAR model, illustrating the response of geopolitical risk to a Brent oil price shock across different quantiles of the conditional distribution. The median quantile ($\tau = 0.5$), represented by the blue curve, captures average market conditions, while the lower ($\tau = 0.1$) and upper ($\tau = 0.9$) quantiles correspond to low-risk and high-risk regimes, respectively.

The results reveal pronounced heterogeneity across market regimes. At the median, oil price shocks generate relatively moderate, short-lived responses in geopolitical risk. By contrast, in the extreme quantiles, particularly at the upper quantile associated with high geopolitical stress, oil price shocks lead to significantly stronger and more persistent increases in geopolitical risk. This pattern indicates that the oil–geopolitics relationship intensifies during periods of heightened uncertainty and instability. Importantly, the amplification observed in extreme quantiles confirms that oil price shocks exert disproportionate geopolitical effects under crisis conditions. This regime dependence supports Hypothesis 3, demonstrating that the impact of oil price fluctuations on geopolitical tensions is not uniform across the world's states. Instead, oil prices act as catalysts that exacerbate existing tensions during periods of elevated geopolitical risk, while exerting a weaker influence during relatively stable periods.

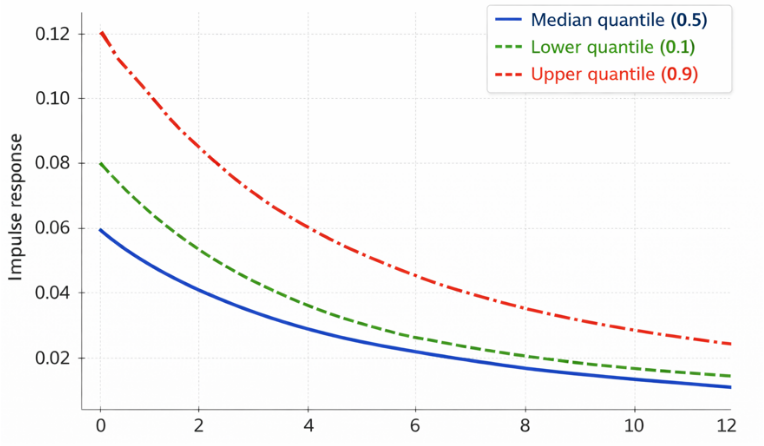


Figure 1: Conditional impulse responses (QVAR, Brent → GPR). Source: By the author.

5. Discussion

The empirical findings of this study provide robust evidence of an asymmetric and regime-dependent relationship between oil price fluctuations and Sino-American geopolitical tensions. Beyond statistical validation of the proposed hypotheses, these results deepen understanding of how energy markets interact with strategic rivalry under conditions of asymmetric dependence, uncertainty, and systemic stress. In particular, the findings suggest that oil prices operate not merely as economic variables but as strategic signals whose geopolitical consequences depend on both directionality and market regime.

5.1. Oil–Geopolitical Asymmetry and Strategic Behavior

The NARDL and QVAR results consistently show that increases in oil prices significantly amplify geopolitical risk, whereas decreases in oil prices have weaker and less persistent effects. This asymmetry aligns closely with energy security theory, which emphasizes that net-importing states experience upward price shocks as direct threats to economic stability and political autonomy, while benefiting only marginally from downward movements (Cherp & Jewell, 2014; Dulian, 2024).

In the Sino-American context, these findings extend prior empirical work by explicitly linking oil price asymmetry to structural energy dependence. China's heavy reliance on imported oil intensifies the strategic consequences of rising prices, thereby reinforcing incentives for assertive geopolitical behavior, including energy diplomacy, supply route diversification, and strategic stockpiling. By contrast, the United States' position as a major producer and exporter transforms oil price shocks upward into relative strategic advantages. This divergence supports the notion of asymmetric interdependence proposed by Keohane and Nye (2012), where interdependence does not eliminate rivalry but instead redistributes vulnerability and bargaining power. Compared with earlier studies that document asymmetric oil–geopolitics effects in single-country or regional settings (e.g., Özdemir et al., 2025), this study contributes a bilateral great-power perspective, showing that asymmetry reflects not only nonlinear market dynamics but also a structural imbalance in energy power between a rising and an established power.

5.2. Systemic Crises, Nonlinearities, and Geopolitical Escalation

The QVAR results further demonstrate that the oil–geopolitics relationship is highly sensitive to market regimes. Oil price shocks exert significantly stronger and more persistent effects on geopolitical risk in the distribution's extreme quantiles, corresponding to periods of heightened international instability. This finding corroborates earlier evidence that geopolitical and financial shocks generate disproportionate effects under conditions of elevated uncertainty (Balcilar et al., 2018; Antonakakis et al., 2020), while extending it to the specific case of Sino-American rivalry.

From a theoretical standpoint, these results are consistent with arguments emphasizing systemic complexity and strategic uncertainty. When institutional flexibility is constrained and rivalry intensifies, economic shocks are more likely to be interpreted through a geopolitical lens, thereby escalating tensions rather than being absorbed through market adjustment (Farrell & Newman, 2019). Episodes such as the US–China trade war, the COVID-19 pandemic, and tensions surrounding Taiwan illustrate how rising oil prices interact with broader strategic anxieties, increasing the opportunity costs of cooperation and encouraging confrontational responses.

Relative to studies employing linear or mean-based approaches, the present findings underscore that average effects substantially underestimate the geopolitical relevance of oil prices during crises. Energy markets thus function as nonlinear amplifiers of geopolitical escalation rather than neutral transmission channels.

5.3. Oil Volatility, Geopolitical Uncertainty, and Asymmetric Signaling

The EGARCH results reveal that geopolitical tensions exert a direct and significant impact on oil price volatility, with a pronounced leverage effect whereby adverse shocks generate disproportionately larger increases in volatility. This finding is consistent with the interpretation of geopolitical risk as an informational shock that affects expectations, risk premia, and market sentiment more strongly during periods of deterioration than during phases of easing (Caldara & Iacoviello, 2022).

Importantly, this study extends existing volatility-focused research by explicitly linking volatility amplification to Sino-American geopolitical dynamics. Prior studies document the sensitivity of oil markets to geopolitical risk in general (Antonakakis et al., 2020); however, the present analysis shows that volatility serves as a strategic amplification mechanism within a context of great-power rivalry. Negative geopolitical signals increase uncertainty simultaneously about supply security, future demand, and policy responses, thereby reinforcing persistent volatility even when price levels stabilize. This asymmetric signaling mechanism helps explain why reductions in geopolitical risk or favorable movements in oil prices fail to quickly restore market confidence. Consequently, oil volatility emerges as a central channel through which geopolitical uncertainty feeds back into energy markets, reinforcing oil's role as a globally systemic risk asset.

5.4. Comparative Perspective and Generalizability

An important question concerns the extent to which the observed asymmetries can be generalized beyond the Sino-American case. Existing research suggests that similar mechanisms operate in other geopolitical dyads, particularly in contexts where energy markets intersect with strategic competition and sanctions, such as US–Russia relations (Balcilar et al., 2018). However, the direction and magnitude of asymmetry depend critically on market structure and patterns of dependence. In the Russo-European case, for example, negative supply-side shocks often dominate, reflecting Europe's vulnerability to disruptions rather than price increases per se.

The Sino-American case differs in that oil markets are highly globalized, while strategic rivalry extends beyond energy into trade, technology, and security domains. As a result, oil price increases function more as strategic stress signals than as simple supply constraints. Extending the analysis to other energy commodities, such as natural gas or critical minerals, may reveal distinct asymmetry patterns linked to more regionalized markets and infrastructural rigidity. Taken together, these comparisons suggest that the oil–geopolitical asymmetry identified in this study is both structurally rooted in the central role of oil in the global energy system and contextually shaped by the specific characteristics of Sino-American rivalry.

6. Conclusions

This study investigates the asymmetric relationship between oil price fluctuations and Sino-American geopolitical tensions from 2000–2024. The empirical results show that increases in oil prices significantly intensify geopolitical tensions, whereas price declines have weaker, less persistent effects. This asymmetry reflects China's structural dependence on imported oil and the United States' relative strategic advantage as a major producer and exporter. In addition, geopolitical shocks are found to substantially amplify oil price volatility, particularly during periods of systemic stress such as trade conflicts and global crises, highlighting the bidirectional yet asymmetric interaction between energy markets and geopolitical rivalry.

The findings carry important strategic and policy implications. For China, persistent exposure to upward oil price shocks reinforces energy insecurity and strengthens incentives to diversify supply sources and accelerate the transition toward alternative energy systems. For the United States, higher oil prices may confer short-term economic and geopolitical advantages, but they also increase the risk of destabilizing globally integrated financial markets. At the international level, the results underscore the importance of energy coordination mechanisms and strategic dialogue to limit the spillover of bilateral tensions into oil and financial markets.

This study contributes to the literature by demonstrating that the oil–geopolitics nexus is fundamentally nonlinear and asymmetric, extending existing work in energy economics (Kilian, 2019), international finance, and international relations. At the same time, the analysis is subject to limitations related to the use of aggregate geopolitical risk measures and the exclusive focus on oil. Future research may extend this framework to other strategic energy resources and alternative geopolitical dyads to further assess the generalizability of the identified asymmetries.

Acknowledgement statement: The authors would like to thank the reviewers for their comments, which helped this manuscript reach completion.

Conflicts 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 paper.

Funding: This research did not receive a specific grant from any funding agency in the public, commercial, or non-profit sectors

Data availability statement: Data is available upon request. Please contact the corresponding author for any additional information on data access or usage.

Declaration of generative AI and AI-assisted technologies in the writing process: During the preparation of this work, the author(s) used ChatGPT for copy-editing. After using this tool/service, the author(s) reviewed and edited the content as needed and take(s) full responsibility for the content of the publication.

References

Antonakakis, N., Gupta, R., & Kollias, C. (2020). Geopolitical risks and the oil-stock nexus. *Finance Research Letters, 34*, 101206. https://doi.org/10.1016/j.frl.2017.07.017

Balcilar, M., Bonato, M., Demirer, R., & Gupta, R. (2018). Geopolitical risks and stock market dynamics of the BRICS. Economic Systems, 42(2), 295-306. https://doi.org/10.1016/j.ecosys.2017.05.008

Battiston, S., Mandel, A., Monasterolo, I., Schütze, F., & Visentin, G. (2021). Climate risks and financial stability. *Journal of Financial Stability, 54*, 100867. https://doi.org/10.1016/j.jfs.2021.100867

Caldara, D., & Iacoviello, M. (2022). Measuring geopolitical risk. *American Economic Review, 112*(4), 1194–1225. https://doi.org/10.1257/aer.20191823

CBOE. (2024). *CBOE volatility index (VIX) data*. Chicago Board Options Exchange.

Cherp, A., & Jewell, J. (2014). The concept of energy security: Beyond the four As. *Energy Policy, 75*, 415–421. https://doi.org/10.1016/j.enpol.2014.09.005

Zhu, Z., Hunjra, A. I., Alharbi, S. S., & Zhao, S. (2025). Global energy transition under geopolitical risks: An empirical investigation. *Energy Economics*, 145, 108495. https://doi.org/10.1016/j.eneco.2025.108495

Farrell, H., & Newman, A. L. (2019). Weaponized interdependence. *International Security, 44*(1), 42–79. https://doi.org/10.1162/isec_a_00351

Hamilton, J. (2014). Oil prices are an indicator of global economic conditions. Econbrowser Blog entry, 14.

IEA. (2023). *World Energy Outlook 2023*. International Energy Agency. https://www.iea.org/reports/world-energy-outlook-2023

Keohane, R. O., & Nye Jr, J. S. (1973*). Power and interdependence*. Survival, 15(4), 158-165. https://doi.org/10.1080/00396337308441409

Kilian, L. (2019). Measuring global real economic activity: Do recent critiques hold up to scrutiny?. *Economics Letters*, *178*, 106-110. https://doi.org/10.1016/j.econlet.2019.03.001

Koenker, R., & Xiao, Z. (2006). Quantile autoregressione. *Journal of the American Statistical Association, 101*(475), 980–990. https://doi.org/10.1198/016214506000000672

Bodas-Freitas, I.M., & Corrocher, N. (2019). The use of external support and the benefits of the adoption of resource efficiency practices: An empirical analysis of European SMEs. Energy Policy, 132, 75-82. https://doi.org/10.1016/j.enpol.2019.05.019

Radnitz, S. (2022). Solidarity through Cynicism? The Influence of Russian Conspiracy Narratives Abroad. *International Studies Quarterly, 66*(2), sqac012. https://doi.org/10.1093/isq/sqac012

Lin, B., & Song, Y. (2024). Coal price shocks and economic growth: A province-level study of China. *Energy Policy*, *193*, 114297. https://doi.org/10.1016/j.enpol.2024.114297

Nelson, D. B. (1991). Conditional heteroskedasticity in asset returns: A new approach. *Econometrica: Journal of the Econometric Society*, 347-370. https://doi.org/10.2307/2938260

Pesaran, M. H., Shin, Y., & Smith, R. J. (2001). Bounds testing approaches to the analysis of level relationships. *Journal of Applied Econometrics, 16*(3), 289–326. https://doi.org/10.1002/jae.616

Ren, X., An, Y., & Jin, C. (2023). The asymmetric effect of geopolitical risk on China's crude oil prices: New evidence from a QARDL approach. *Finance Research Letters, 53*, 103637. https://doi.org/10.1016/j.frl.2023.103637

Guo, C., & Feng, Y. (2025). Asymmetric risk spillover between energy markets and uncertainties of economic policy, infectious disease, and geopolitical risk. *Romanian Journal of Economic Forecasting, 28(1)*, 63-80.

Shin, Y., Yu, B., & Greenwood-Nimmo, M. (2014). Modeling asymmetric cointegration and dynamic multipliers in a nonlinear ARDL framework. In R. C. Sickles & W. C. Horrace (Eds.), *Festschrift in honor of Peter Schmidt* (pp. 281–314). Springer. https://doi.org/10.1007/978-1-4899-8008-3_9

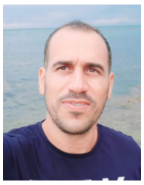
Dulian, M. (2024). Security of energy supply. *European Parliamentary Research Service*. 1-9. https://www.europarl.europa.eu/RegData/etudes/BRIE/2024/762410/EPRS_BRI(2024)762410_EN.pdf

Scholten, D. (2024). The Power of Energy: The Geopolitics of the Energy Transition. *E-International Relations, 1-6*. https://www.e-ir.info/2024/06/17/the-power-of-energy-the-geopolitics-of-the-energy-transition/

Zaghdoudi, T. (2025). US-China tension, geopolitical risks, and oil price uncertainty: Evidence from the Fourier-QARDL approach. *Energy Research Letters, 7*(Early View). https://doi.org/10.46557/001c.144072

Özdemir, L., Vurur, N. S., Ozen, E., Świecka, B., & Grima, S. (2025). Volatility Modeling of the Impact of Geopolitical Risk on Commodity Markets. Economies, 13(4), 88. https://doi.org/10.3390/economies13040088

About the Author (s):



Abdelkader Mohamed Sghaier Derbali is an Assistant Professor in Finance at the Department of Finance and Accounting, Higher Institute of Informatics and Management of Kairouan, Kairouan University, Kairouan, Tunisia, and at the Department of Administrative and Financial Sciences, Applied College, Taibah University, Saudi Arabia. His research interests include Risk Management, Systemic risk, International finance, Capital markets and institutions, Banking and market microstructure, and Islamic Finance. He is an active Editorial Board Member and has published articles in various journals.