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Geopolitical Risk, Brent Volatility, and Oil Import Flow Dynamics: Evidence from Indonesia

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Abstract
Geopolitical risk can affect oil-importing economies through heightened market uncertainty and subsequent procurement adjustment. This study examines a focused transmission pathway from geopolitical risk (GPR) to monthly Brent conditional volatility and then to Indonesia's oil and petroleum-product import volume. Monthly data from January 2014 to April 2026 are combined with daily Brent spot prices. Brent volatility is estimated using EGARCH(1,1), while the dynamic relationships are assessed using ARDL models with Newey-West HAC standard errors, bounds testing, long-run multipliers, and deterministic Dynamic ARDL simulations. The results show that GPR is positively and significantly associated with Brent conditional volatility, with a contemporaneous coefficient of 0.0284 (p = 0.001), a bounds F-statistic of 17.417, and a positive long-run multiplier of 0.0415. By contrast, the import-volume response is weaker and delayed: contemporaneous and first-lag volatility effects are insignificant, while the second lag is negative at approximately 24,030 tons per volatility point (p = 0.078), providing only marginal support. Under a +1 SD GPR shock, Brent volatility peaks at +1.81 points in month 3 and import volume reaches its largest decline in month 4 at approximately 68,239 tons below the reference path. The historical-extreme scenario increases these deviations to +4.33 points and about 163,220 tons. The findings indicate strong transmission to oil-market

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volatility but a more limited and lagged adjustment in Indonesia's import flows.

Key Words: geopolitical risk; Brent volatility; oil import flows; Indonesia; EGARCH; ARDL; dynamic ARDL; procurement

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INTRODUCTION

Geopolitical risk has become an important source of uncertainty in global energy markets because geopolitical tensions can alter expectations regarding oil production, transport routes, sanctions, inventories, and future supply conditions. The Geopolitical Risk Index (GPR) developed by Caldara and Iacoviello (2022) provides a systematic measure of such uncertainty. Previous studies show that geopolitical disturbances contain information for crude-oil returns and volatility and can influence oil markets through changes in expected supply, risk premia, inventories, and market behaviour (Liu et al., 2019; Demirer et al., 2019; Qian et al., 2022; Jiao et al., 2023; Pan et al., 2023; Mignon & Saadaoui, 2024).

For oil-importing economies, however, exposure to geopolitical uncertainty does not end with movements in global market prices or volatility. Oil must ultimately be procured through physical contracts, cargo schedules, logistics networks, and external suppliers. Consequently, changes in global market uncertainty may be transmitted differently to financial-market variables and to physical import quantities. Market volatility can adjust rapidly as expectations change, whereas procurement volumes may respond more slowly because contractual commitments, refinery requirements, domestic consumption needs, and logistics constrain immediate adjustment.

Indonesia provides a relevant setting for examining this distinction because part of its oil and petroleum-product requirements is supplied through international markets. In this study, monthly import volume is treated specifically as a procurement-flow variable rather than as a measure of national inventories or operational reserves. A stable import flow during a period of elevated market volatility may reflect continuing contractual and domestic supply requirements, while a decline in imports does not by itself imply a decline in physical stocks because domestic production, inventory changes, and distribution conditions also matter.

Against this background, the paper addresses two related questions. First, to what extent is geopolitical risk associated with changes in monthly Brent conditional volatility? Second, is higher Brent conditional volatility followed by an adjustment in Indonesia's oil and petroleum-product import volume, and how quickly does such an adjustment emerge? By separating the global market response from the subsequent physical procurement response, the analysis focuses on the timing and strength of transmission rather than assuming that geopolitical risk mechanically determines import quantities.

Literature Review and Theoretical Framework

The first strand of literature establishes the relationship between geopolitical risk and oil-market uncertainty. Caldara and Iacoviello (2022) show that geopolitical risk has measurable macro-financial consequences, while oil-market studies find that geopolitical disturbances affect returns and volatility through changing expectations, perceived supply risks, and risk premia (Liu et al., 2019; Demirer et

al., 2019; Qian et al., 2022). Jiao et al. (2023) further identify demand, supply, inventory, and speculative-behaviour channels through which geopolitical risk can be transmitted to crude-oil markets. Pan et al. (2023) show that geopolitical uncertainty has different volatility effects across oil-importing and oil-exporting countries. Together, these studies provide a strong basis for expecting geopolitical risk to be reflected rapidly in oil-market volatility.

The second strand concerns how uncertainty is translated into physical procurement decisions. The principal behavioural foundation used in this study is real-options theory. Under real-options logic, higher uncertainty can delay, resize, or otherwise alter decisions when adjustment is costly or partly irreversible (Dixit & Pindyck, 1994). Applied to petroleum procurement, this implies that import quantities need not respond instantaneously to market volatility because contracts, cargo scheduling, refinery requirements, logistics, and domestic demand can limit short-run flexibility. A supply-chain perspective complements this mechanism by recognising that geopolitical events may affect exporter availability, transport routes, sourcing options, and bilateral trading relationships (Zhang et al., 2024). Thus, the same geopolitical shock can generate a rapid response in market volatility but a slower and more constrained response in physical import flows.

Recent empirical studies reinforce the importance of this distinction. Zhang et al. (2024) find that the effect of geopolitical risk on energy imports in China varies over time and differs across energy products. Huang et al. (2025), comparing China and India, likewise show that the relationship between geopolitical risk and oil imports is horizon- and country-dependent, with adverse short- or medium-run responses potentially followed by later reversals as procurement plans and sourcing patterns adjust. These findings suggest that import responses to geopolitical uncertainty should not be assumed to be immediate or uniform across importing economies.

Hypothesis Development

The first hypothesis follows from the oil-market uncertainty mechanism. Geopolitical tensions alter expectations about future production, transport disruption, sanctions, and supply availability. Such changes in expectations and perceived supply risk can increase risk premia and widen the dispersion of market expectations, producing higher conditional volatility in benchmark oil prices. Consistent with the evidence of Liu et al. (2019), Demirer et al. (2019), Qian et al. (2022), Jiao et al. (2023), and Pan et al. (2023), the study therefore expects geopolitical risk to be positively associated with Brent conditional volatility.

H1. Higher geopolitical risk is positively associated with Brent conditional volatility.

The second hypothesis follows from real-options logic and procurement adjustment under uncertainty. Higher oil-market volatility increases uncertainty surrounding procurement conditions and may alter the timing or scale of purchases. However, because physical procurement is constrained by contracts, cargo schedules, logistics, refinery requirements, and domestic demand, the quantity response is expected to be slower than the market-volatility response. The study therefore expects higher

Brent volatility to be followed by a reduction in Indonesia's oil and petroleum-product import volume rather than an immediate one-for-one adjustment.

H2. Higher Brent conditional volatility is negatively associated with Indonesia's oil and petroleum-product import volume.

Research Gap, Contribution, and Objective

Existing research provides substantial evidence that geopolitical risk affects crude-oil prices, returns, and volatility (Liu et al., 2019; Demirer et al., 2019; Qian et al., 2022; Jiao et al., 2023; Pan et al., 2023; Mignon & Saadaoui, 2024). A separate and more recent literature also shows that geopolitical risk can influence energy-import behaviour, although the direction and timing of the response differ across countries and horizons (Zhang et al., 2024; Huang et al., 2025). These two strands establish, respectively, the global oil-market response to geopolitical uncertainty and the possibility of adjustment in energy-import quantities.

What remains less clearly established is the connection between these two stages. The literature reviewed above does not directly establish whether geopolitical risk first materialises as higher conditional volatility in the global Brent market and whether that volatility is subsequently followed by a measurable adjustment in the monthly petroleum-import flows of an oil-importing economy such as Indonesia. Existing studies also provide limited evidence on the relative timing of these two responses: the rapid adjustment of market uncertainty and the potentially slower adjustment of physical procurement quantities.

This paper addresses that gap through a focused sequential design. First, it estimates the dynamic relationship between GPR and monthly Brent conditional volatility. Second, it evaluates whether Brent volatility is followed by changes in Indonesia's monthly oil and petroleum-product import volume. The Dynamic ARDL simulations then illustrate the timing and magnitude of the estimated transmission under controlled geopolitical-risk scenarios.

Accordingly, the paper makes three contributions. First, it connects the well-established GPR–oil-volatility relationship with subsequent petroleum-import-flow adjustment in Indonesia rather than stopping at the global market response. Second, it distinguishes a rapidly adjusting market-uncertainty variable from a more constrained physical procurement-flow variable, allowing the strength and timing of the two stages to be assessed separately. Third, it constructs monthly conditional Brent volatility from daily prices using EGARCH(1,1), aligns that measure with monthly import data in ARDL-HAC models, and translates the estimated relationships into deterministic Dynamic ARDL stress-response paths.

The headline findings reinforce the relevance of this distinction. GPR is strongly associated with higher Brent conditional volatility, including a positive long-run relationship, whereas the import-volume response is weaker and delayed: contemporaneous and first-lag effects are insignificant, while a negative association appears only at the second lag and at the 10% significance level. In the Dynamic

ARDL scenarios, Brent volatility reaches its largest deviation in month 3, while the largest negative import-flow deviation occurs in month 4.

Geopolitical Risk (GPR)	→	Brent Conditional Volatility	→	Oil Import Flow Dynamics
Global risk signal	H1	Market uncertainty EGARCH-derived volatility; ARDL(2,1)	H2	Procurement-flow response ARDL(5,2)

Figure 1. Sequential Analytical Framework and Hypotheses

Source: Authors' conceptualization based on the two hypothesized dynamic relationships.

METHOD

Data and Study Design

The empirical sample covers January 2014-April 2026 and contains 148 monthly observations. Daily Brent spot prices are additionally used to construct the volatility measure. Monthly GPR data are obtained from Caldara and Iacoviello (2022); daily Europe Brent Spot Price FOB data are obtained from the U.S. Energy Information Administration (EIA, 2026); and Indonesia's aggregate monthly oil and petroleum-product import volume is obtained from Badan Pusat Statistik (BPS, 2026). The combination of daily global oil-price information and monthly Indonesian import data allows the paper to examine the transmission from geopolitical risk to market volatility and subsequently to domestic procurement flows.

Table 1. Variables, Frequency, Sources, and Analytical Roles

Variable	Frequency	Unit	Primary Source	Role in This Paper
GPR	Monthly	Index points	Caldara & Iacoviello	Global geopolitical-risk driver
Brent price	Daily	USD/barrel	U.S. EIA	Input to log returns and EGARCH
Brent conditional volatility	Daily → monthly	Points	Derived from Brent	Global market-uncertainty variable
Oil import volume	Monthly	Tons	BPS	Domestic procurement-flow variable

Source: Authors, based on the study dataset.

Constructing Monthly Conditional Brent Volatility

Daily Brent price changes are expressed as logarithmic returns. EGARCH(1,1) is then estimated on the daily return series to capture volatility persistence and asymmetric responses to news (Nelson, 1991). GPR is not inserted into the variance equation; the construction of the volatility variable is deliberately separated from the subsequent ARDL relationship between GPR and volatility.

$$r_d = 100\ln\left(\frac{P_d}{P_{d-1}}\right) \quad (1)$$

In Equation (1), r_d denotes the daily logarithmic Brent return expressed in percent, P_d is the Brent spot price on trading day d, P_(d-1) is the price on the preceding trading day, ln denotes the natural logarithm, and the factor 100 expresses the return in percentage terms.

$$r_d = \mu + \varepsilon_d \quad (2)$$

Equation (2) does not define a different r_d; it specifies the conditional mean process for the same return series constructed in Equation (1). Here, μ is the constant mean return and ε_d is the return innovation (residual) on day d.

$$\ln(\sigma_d^2) = \omega + \beta \ln(\sigma_{d-1}^2) + \alpha \left(|z_{d-1}| - \sqrt{\frac{2}{\pi}} \right) + \gamma z_{d-1} \quad (3)$$

In Equation (3), σ_d² denotes the conditional variance of Brent returns on day d; ω is the variance-equation constant; β measures volatility persistence through σ_(d-1)²; α captures the magnitude effect of the previous standardized innovation; γ measures the asymmetric response to positive and negative innovations; and z_(d-1) = ε_(d-1)/σ_(d-1) is the standardized innovation from the previous day. The term √(2/π) centers the absolute standardized innovation under the standard-normal formulation (Nelson, 1991). Equations (1)-(3) therefore form one sequence: Equation (1) constructs the observed return, Equation (2) yields the daily innovation, and Equation (3) uses the standardized innovation to estimate daily conditional variance.

The estimated daily conditional variances are aggregated within each calendar month and the square root of their sum is used as monthly conditional Brent volatility. This follows the logic of temporal aggregation of conditional variance (Drost & Nijman, 1993). The resulting series is model-based conditional volatility rather than realized volatility directly computed from observed squared returns.

$$\mathrm{VOL}_m = \sqrt{\sum_{d=1}^{N_m} \sigma_{m,d}^2} \quad (4)$$

In Equation (4), VOL_m is monthly conditional Brent volatility for month m; N_m is the number of available trading-day observations in month m; σ_(m,d)² is the EGARCH-estimated conditional variance for trading day d in month m; d indexes trading days within the month; and m indexes monthly periods.

ARDL-HAC Models and Long-Run Assessment

Augmented Dickey-Fuller (ADF) tests are evaluated at the 5% significance level to establish the integration order of the three core variables. Table 2 reports the p-values at level and first difference. GPR and monthly conditional Brent volatility are stationary at level and are therefore I(0), whereas oil import volume becomes stationary after first differencing and is I(1). No core variable is I(2), satisfying the integration-order requirement for ARDL bounds testing (Pesaran et al., 2001). Candidate lag structures are then evaluated through an exhaustive search with a maximum of six lags for the dependent and independent variables. AIC is the

primary selection criterion, while BIC and HQIC are retained as specification-sensitivity comparators. Coefficient inference uses Newey-West HAC standard errors with one lag (Newey & West, 1987).

Table 2. Augmented Dickey-Fuller Unit-Root Test Results for Core Variables

Variable	ADF p-value (Level)	ADF p-value (First Difference)	Integration Order
GPR	0.006109	<0.001	I(0)
Brent conditional volatility	<0.001	<0.001	I(0)
Oil import volume	0.238374	<0.001	I(1)

Source: Authors' calculations based on the study data. The 5% level is used for the stationarity decision; p-values below 0.001 are reported as <0.001.

The first model estimates the dynamic association between GPR and monthly conditional Brent volatility. The second model estimates the dynamic association between Brent volatility and Indonesia's import volume. The equations form a sequential analytical pathway but are estimated separately and are not interpreted as a simultaneous structural causal system.

$$\mathrm{VOL}_t = \alpha_0 + \sum_{i=1}^{p} \alpha_i \, \mathrm{VOL}_{t-i} + \sum_{j=0}^{q} \beta_j \, \mathrm{GPR}_{t-j} + \varepsilon_t \quad (5)$$

$$\mathrm{VI}_t = \alpha_0 + \sum_{i=1}^{p} \alpha_i \, \mathrm{VI}_{t-i} + \sum_{j=0}^{q} \beta_j \, \mathrm{VOL}_{t-j} + \varepsilon_t \quad (6)$$

AIC (Akaike, 1974) selects ARDL(2,1) for the GPR-volatility relationship and ARDL(5,2) for the volatility-import relationship. For the second relationship, BIC and HQIC prefer specifications that exclude Brent volatility, which is retained as an explicit robustness caution. Long-run level relationships are assessed through the Pesaran-Shin-Smith bounds test, and a long-run multiplier is interpreted as confirmed only when the bounds evidence is sufficiently conclusive.

Hypothesis testing follows the two model relationships directly. H1 is evaluated from the sign and statistical significance of the GPR coefficients in the Brent-volatility model, together with the bounds test and long-run multiplier. H2 is evaluated from the volatility coefficients in the import-volume model. Statistical significance at the 5% level is treated as primary evidence, while significance at the 10% level is reported as marginal support rather than strong confirmation.

Dynamic ARDL Stress-Scenario Design

Deterministic Dynamic ARDL simulations translate the selected ARDL point estimates into response paths under controlled geopolitical-risk scenarios (Jordan & Philips, 2018; Philips, 2018). The simulation begins immediately after the final observed month, April 2026. Accordingly, the GPR value observed in April 2026 (230.77 points) is retained as an observed-state reference path, not as a claim about a normal or long-run GPR level. For historical context, the full-sample mean is 112.75 points and the sample standard deviation is 40.23 points. The observed-state reference is therefore already elevated relative to the full-sample mean.

Two scenarios are evaluated. The standard incremental shock raises GPR by one sample standard deviation to approximately 271.00 points in months 1-3 and returns it to the observed-state reference from month 4 onward. The historical-extreme stress scenario raises GPR to 326.99 points, the maximum observed in the sample, which is 96.22 points or approximately 2.39 standard deviations above the April-2026 reference. Both scenarios use the same estimated coefficients, initial conditions, three-month shock duration, and twelve-month horizon. Innovations are set to zero, so the simulated differences are deterministic scenario implications rather than probability forecasts or new causal estimates.

$$\mathrm{DRF}_h = \hat{Y}_{t+h}^{\mathrm{shock}} - \hat{Y}_{t+h}^{\mathrm{base}} \quad (7)$$

Table 3. Dynamic ARDL Geopolitical-Risk Scenario Design

Scenario / Benchmark	GPR Level	Change from Apr-2026 Reference	Role
Full-sample historical mean	112.75	-118.02 points	Historical context only; not the simulation reference
April-2026 observed state	230.77	0	Reference path for the DARDL simulation
Standard incremental shock	≈271.00	+40.23 points = +1 SD	Primary stress scenario, months 1-3
Historical extreme	326.99	+96.22 points ≈ +2.39 SD	Sensitivity/stress scenario, months 1-3

Source: Authors' calculations based on the study data and DARDL scenario design.

RESULT AND DISCUSSION

Descriptive Profile

The 148-month sample captures substantial variation in geopolitical conditions, oil-market uncertainty, and import flows. GPR averages 112.75 points with a standard deviation of 40.23 and reaches 326.99 at its maximum. Monthly conditional Brent volatility averages 10.42 points, while aggregate import volume averages approximately 4.01 million tons. These ranges provide sufficient variation for the dynamic models and show why the April-2026 GPR reference of 230.77 should be interpreted as an observed high-risk state rather than a normal baseline.

Table 4. Descriptive Statistics for Core Variables (n = 148)

Variable	Mean	Median	Std. Dev.	Min	Max
GPR (points)	112.75	104.87	40.23	58.42	326.99
Brent conditional volatility (points)	10.42	9.76	4.38	3.82	32.47
Import volume (million tons)	4.01	4.03	0.66	2.23	6.03

Source: Authors' calculations based on the study dataset.

Hypothesis 1: Geopolitical Risk and Brent Volatility

H1 is supported. In ARDL(2,1), the contemporaneous GPR coefficient is 0.0284 with a HAC p-value of 0.001. A one-point increase in GPR is therefore associated with an increase of approximately 0.0284 points in monthly conditional Brent volatility in the same month, holding the dynamic terms in the model constant. The first GPR lag is negative (-0.0144) and marginal at 10% (p = 0.051), indicating partial adjustment after the contemporaneous response.

Table 5. ARDL-HAC and Long-Run Results: Geopolitical Risk to Brent Conditional Volatility

Variable	Coefficient	HAC SE	z-statistic	p-value
Constant	2.0042	1.246	1.609	0.110
VOL(t-1)	0.9570	0.083	11.575	<0.001***
VOL(t-2)	-0.2944	0.076	-3.873	<0.001***
GPR(t)	0.0284	0.008	3.401	0.001***
GPR(t-1)	-0.0144	0.007	-1.966	0.051*
Panel B. Bounds Test and Long-Run Evidence				
Measure	**Result**	**Interpretation**		
Bounds F-statistic	17.417	Above the 5% upper bound		
10% critical bounds	4.04-4.78	Pesaran-Shin-Smith, k = 1		
5% critical bounds	4.94-5.73	Pesaran-Shin-Smith, k = 1		
Cointegration status	Cointegrated	Long-run level relationship supported		
Long-run multiplier	+0.0415	Volatility points per one-point increase in GPR		

*Source: Authors' ARDL-HAC estimates and bounds-test results; * p < 0.10, ** p < 0.05, *** p < 0.01.*

The bounds test reinforces H1. The F-statistic is 17.417, well above the 5% upper bound of 5.73, and the long-run multiplier is +0.0415 volatility points per GPR point. Thus, H1 is supported by both the immediate coefficient and the long-run level relationship. This result is consistent with the broader literature showing that geopolitical tension raises uncertainty in oil markets (Liu et al., 2019; Demirer et al., 2019; Qian et al., 2022). Residual ARCH and non-normality remain model limitations, so coefficient inference is reported with HAC standard errors.

Hypothesis 2: Brent Volatility and Oil Import Flow Dynamics

H2 receives only marginal and delayed support. In ARDL(5,2), the contemporaneous volatility coefficient is positive but insignificant (+9,149 tons; p = 0.482), and the first lag is negative but also insignificant (-17,430 tons; p = 0.301). The second lag is negative at approximately -24,030 tons per volatility point and is marginally significant at the 10% level (p = 0.078). The evidence therefore does not support an immediate negative response, but it is consistent with a delayed reduction in import volume at the second lag.

Table 6. ARDL-HAC and Long-Run Results: Brent Conditional Volatility to Oil Import Volume

Variable	Coefficient	HAC SE	z-statistic	p-value
Constant	1,403,000	491,000	2.858	0.005***
VI(t-1)	0.1435	0.090	1.599	0.112
VI(t-2)	0.0501	0.099	0.507	0.613
VI(t-3)	0.2792	0.082	3.390	0.001***
VI(t-4)	0.0716	0.079	0.904	0.368
VI(t-5)	0.1928	0.078	2.469	0.015**
VOL(t)	9,149	13,000	0.704	0.482
VOL(t-1)	-17,430	16,800	-1.039	0.301
VOL(t-2)	-24,030	13,500	-1.776	0.078*
Panel B. Bounds Test and Long-Run Evidence				
Measure	**Result**	**Interpretation**		
Bounds F-statistic	5.302	Above the 10% upper bound but within the 5% bounds		
10% critical bounds	4.04-4.78	Pesaran-Shin-Smith, k = 1		
5% critical bounds	4.94-5.73	Pesaran-Shin-Smith, k = 1		
Cointegration status	10%: cointegrated; 5%: inconclusive	No confirmed 5% long-run relationship		
Long-run multiplier	-122,916 tons	Descriptive only because the 5% bounds result is inconclusive		

*Source: Authors' ARDL-HAC estimates and bounds-test results; * p < 0.10, ** p < 0.05, *** p < 0.01.*

The bounds test yields an F-statistic of 5.302. This exceeds the 10% upper bound of 4.78 but lies between the 5% lower and upper bounds (4.94-5.73), making the 5% result inconclusive. The algebraic long-run multiplier of -122,916 tons per volatility point is therefore retained only as descriptive information, not as a confirmed long-run equilibrium effect. The AIC specification also differs from BIC/HQIC alternatives that exclude Brent volatility, reinforcing the classification of H2 as marginally rather than strongly supported.

The weak immediate quantity response is nevertheless substantively informative. Import procurement cannot necessarily adjust freely within a month because cargo schedules, contracts, domestic consumption needs, logistics, and supply-continuity objectives create short-run rigidity. In this setting, global uncertainty may first change procurement conditions and planning decisions before appearing in observed quantity. The finding is therefore not treated as a failed relationship, but neither is it promoted to a strong causal result.

Table 7. Summary of Hypothesis Testing

Hypothesis	Key Empirical Evidence	Decision	Interpretation

H1: GPR → Brent conditional volatility	GPR(t) = +0.0284, p = 0.001; bounds F = 17.417; LRM = +0.0415	Supported	Positive contemporaneous and long-run relationship
H2: Brent volatility → import volume	VOL(t) and VOL(t-1) insignificant; VOL(t-2) = -24,030 tons, p = 0.078; 5% bounds result inconclusive	Marginally supported	Negative response appears only with a two-month lag and at 10% significance

Source: Authors' ARDL-HAC estimates and bounds-test results.

Dynamic Stress Scenarios: Standard versus Historical-Extreme Geopolitical Risk

The deterministic scenarios make the timing and scale of the estimated transmission easier to interpret. Under the standard +1 SD incremental shock, Brent conditional volatility rises quickly and reaches a maximum deviation of approximately +1.81 points in month 3. Under the historical-extreme scenario, the volatility deviation also peaks in month 3 but reaches approximately +4.33 points. The larger shock therefore magnifies the response without changing the timing of the volatility peak. In both scenarios, the volatility deviation meets the study's 5% recovery criterion around month 8.

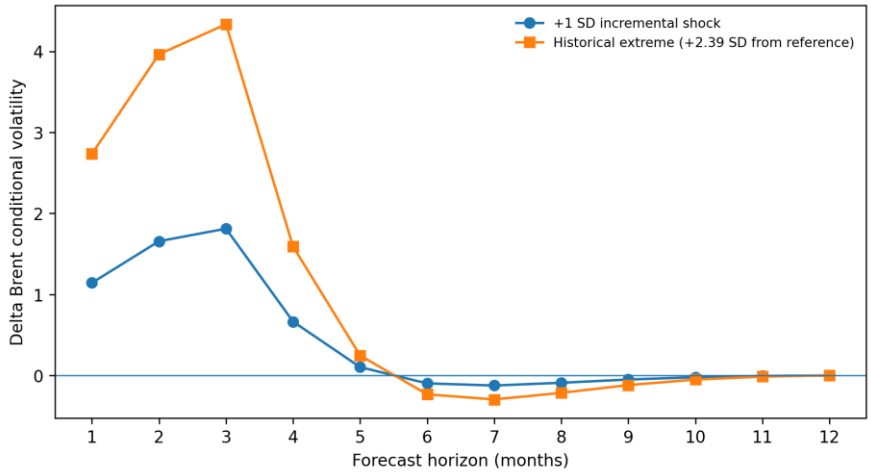


Figure 2. DARDL Brent-Volatility Response under Standard and Historical-Extreme GPR Stress

Source: Authors' DARDL calculations. The extreme path uses the historical maximum GPR of 326.99.

Import volume responds more slowly. Under the standard scenario, the deviation remains positive in month 1 (+10,461 tons), turns slightly negative in month 2, and reaches its largest decline in month 4 at approximately -68,239 tons. Under the historical-extreme scenario, the month-1 deviation is about +25,021 tons before turning negative, reaching approximately -94,993 tons in month 3 and -163,220 tons in month 4. Import volume remains below the reference path through month 12 in both scenarios, with an extreme-scenario month-12 deviation of approximately -52,846 tons. These are scenario implications based on point estimates and should be read in light of the marginal statistical support for the volatility-import relationship.

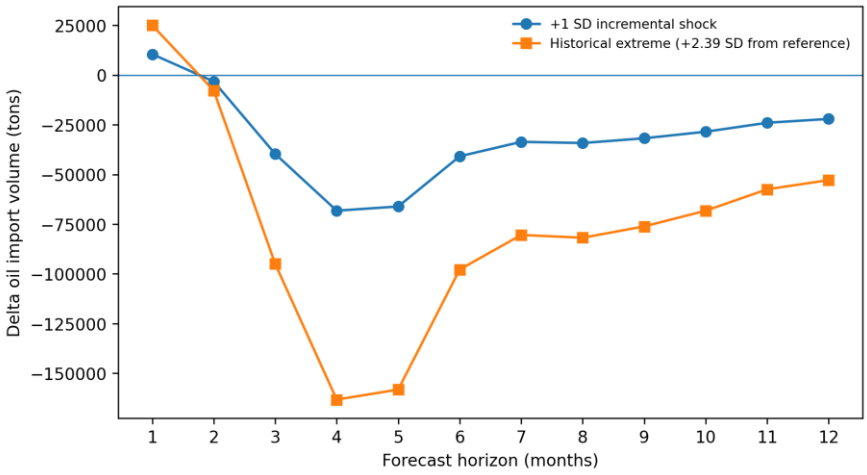


Figure 3. DARDL Oil-Import-Volume Response under Standard and Historical-Extreme GPR Stress

Source: Authors' DARDL calculations under the stated scenario definitions.

Table 8. Peak Response and Recovery across DARDL Stress Scenarios

Variable	Standard Peak	Extreme Peak	Peak Horizon	Standard Recovery	Extreme Recovery
Brent conditional volatility	+1.81 points	+4.33 points	Month 3	Around month 8	Around month 8
Oil import volume	-68,239 tons	≈ -163,220 tons	Month 4	Not within 12 months	Not within 12 months

Source: Authors' DARDL calculations.

Discussion and Practical Implications for Indonesia's Oil Import Management

Taken together, the results reveal an asymmetric transmission of geopolitical stress across global market uncertainty and Indonesia's physical import flows. The first-stage relationship is comparatively strong. Higher GPR is positively and significantly associated with monthly Brent conditional volatility, both contemporaneously and in the estimated long run. This result is consistent with studies showing that geopolitical risk contains information for oil-market volatility and that geopolitical disturbances affect expectations, risk premia, and perceived supply conditions (Liu et al., 2019; Demirer et al., 2019; Qian et al., 2022; Jiao et al., 2023; Pan et al., 2023). The finding therefore reinforces the interpretation of Brent volatility as a relatively responsive market indicator of geopolitical uncertainty.

The second-stage relationship is notably weaker. Indonesia's import volume does not respond significantly to Brent volatility in the contemporaneous period or at the first lag, while a negative association of approximately 24,030 tons per volatility point emerges only at the second lag and at the 10% significance level. This result is consistent with broader evidence that import responses to geopolitical uncertainty

can be dynamic and country-specific rather than immediate or uniformly negative. Zhang et al. (2024) document time-varying responses of energy imports in China, while Huang et al. (2025) show that the relationship between geopolitical risk and oil imports in China and India differs across horizons. The Indonesian evidence in this study extends that discussion by showing that a strong market-volatility response can coexist with a substantially weaker and delayed physical import-flow adjustment.

Real-options logic provides one plausible interpretation of this difference. Under uncertainty, procurement decisions may be delayed or adjusted gradually when actions are constrained by existing commitments or are costly to reverse (Dixit & Pindyck, 1994). In petroleum procurement, contracts, cargo schedules, refinery requirements, logistics, and domestic consumption needs can limit the ability to alter physical import quantities immediately. The results should therefore not be interpreted as showing that these specific mechanisms have been causally identified; rather, they are consistent with the observed short-run rigidity of import flows and provide plausible explanations for why market uncertainty is not translated one-for-one into monthly import quantities.

The Dynamic ARDL scenarios add a timing perspective to this interpretation. Under the +1 standard-deviation GPR scenario, Brent conditional volatility reaches its largest deviation of approximately +1.81 points in month 3, while import volume reaches its largest negative deviation of approximately 68,239 tons in month 4. Under the historical-extreme scenario, the respective deviations increase to approximately +4.33 points and 163,220 tons while preserving the same sequence of peaks. Because the simulations are deterministic and derived from estimated point coefficients, they should be interpreted as stress-response scenarios rather than probability forecasts or structural causal effects.

For policy and corporate risk management, the distinction between market response and procurement response is important. Brent volatility may provide useful early information for reviewing procurement exposure before changes become visible in monthly import quantities. A sharp increase in geopolitical risk and oil-market volatility can therefore justify closer monitoring of cargo schedules, contract flexibility, sourcing alternatives, and logistics conditions. At the same time, the marginal statistical support for the volatility–import relationship means that volatility should not be used as a mechanical predictor of import volumes. Procurement decisions should continue to be assessed together with contractual commitments, domestic demand requirements, logistics, and other operational information.

The main empirical contribution is therefore not a claim that geopolitical risk directly determines Indonesia's import quantity. Rather, the study identifies a strong first-stage transmission from geopolitical risk to global oil-market volatility, followed by a weaker and delayed second-stage adjustment in observed import flows. This distinction helps reconcile a rapidly adjusting global market signal with the greater short-run rigidity of physical petroleum procurement.

Limitations

Several limitations condition the interpretation. First, the volatility-import relationship is marginal at 10%, inconclusive in the 5% bounds test, and sensitive to the information criterion because BIC and HQIC prefer specifications that omit volatility. Second, import volume is a procurement-flow variable rather than a direct measure of physical inventories or cargo-level contractual decisions. Third, residual ARCH and non-normality remain in the GPR-volatility model, although HAC standard errors are used for coefficient inference. Fourth, DARDL results are deterministic counterfactual scenarios derived from point estimates and do not provide probability bands or structural causal identification. Finally, the analysis is specific to Indonesia, so cross-country generalization should be made cautiously.

CONCLUSIONS

This study demonstrates a sequential and asymmetric transmission from geopolitical risk to global oil-market volatility and, subsequently, to Indonesia's oil and petroleum-product import volume. First, geopolitical risk is positively and significantly associated with monthly conditional Brent volatility, with a contemporaneous coefficient of 0.0284 and a positive long-run multiplier of 0.0415. This finding confirms that geopolitical disturbances are rapidly transmitted into higher and more persistent uncertainty in the global oil market.

Second, the response of Indonesia's import volume to Brent volatility is weaker and delayed. No significant adjustment occurs contemporaneously or at the first lag, while a negative association of approximately 24,030 tons per volatility point emerges at the second lag. The DARDL scenarios reinforce this temporal pattern, with Brent volatility peaking before the subsequent decline in Indonesia's import volume.

Overall, the findings support a focused interpretation: geopolitical risk is transmitted strongly to oil-market volatility, whereas Indonesia's import-flow response is delayed, smaller, and statistically less conclusive. For policy and corporate risk management, this distinction matters because market-volatility indicators can be monitored as early warning signals while procurement decisions continue to account for contracts, cargo schedules, logistics, and domestic demand requirements.

REFERENCES

Akaike, H. (1974). A new look at the statistical model identification. IEEE Transactions on Automatic Control, 19(6), 716-723. https://doi.org/10.1109/TAC.1974.1100705

Badan Pusat Statistik. (2026). Data nilai dan volume impor minyak dan produk minyak Indonesia, 2014-2026. Badan Pusat Statistik.

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

Demirer, R., Gupta, R., Ji, Q., & Tiwari, A. K. (2019). Geopolitical risks and the predictability of regional oil returns and volatility. OPEC Energy Review, 43(3), 342-361.

Dixit, A. K., & Pindyck, R. S. (1994). Investment under uncertainty. Princeton University Press.

Drost, F. C., & Nijman, T. E. (1993). Temporal aggregation of GARCH processes. Econometrica, 61(4), 909-927.

Huang, F.-W., Su, C.-W., Yang, S., Qin, M., & Zhang, W. (2025). How do economic policy uncertainty and geopolitical risk affect oil imports? Evidence from China and India. Energy Strategy Reviews, 59, 101695. https://doi.org/10.1016/j.esr.2025.101695

Jiao, J. W., Yin, J. P., Xu, P. F., Zhang, J., & Liu, Y. (2023). Transmission mechanisms of geopolitical risks to the crude oil market: A pioneering two-stage geopolitical risk analysis approach. Energy, 283, 128449. https://doi.org/10.1016/j.energy.2023.128449

Jordan, S., & Philips, A. Q. (2018). Cointegration testing and dynamic simulations of autoregressive distributed lag models. The Stata Journal, 18(4), 902-923.

Liu, J., Ma, F., Tang, Y., & Zhang, Y. (2019). Geopolitical risk and oil volatility: A new insight. Energy Economics, 84, 104548.

Mignon, V., & Saadaoui, J. (2024). How do political tensions and geopolitical risks impact oil prices? Energy Economics, 129, 107219.

Nelson, D. B. (1991). Conditional heteroskedasticity in asset returns: A new approach. Econometrica, 59(2), 347-370.

Newey, W. K., & West, K. D. (1987). A simple, positive semi-definite, heteroskedasticity and autocorrelation consistent covariance matrix. Econometrica, 55(3), 703-708.

Pan, Z., Huang, X., Liu, L., & Huang, J. (2023). Geopolitical uncertainty and crude oil volatility: Evidence from oil-importing and oil-exporting countries. Finance Research Letters, 52, 103565. https://doi.org/10.1016/j.frl.2022.103565

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.

Philips, A. Q. (2018). Have your cake and eat it too? Cointegration and dynamic inference from autoregressive distributed lag models. American Journal of Political Science, 62(1), 230-244. https://doi.org/10.1111/ajps.12318

Qian, L., Zeng, Q., & Li, T. (2022). Geopolitical risk and oil price volatility: Evidence from Markov-switching model. International Review of Economics & Finance, 81, 29-38.

U.S. Energy Information Administration. (2026). Europe Brent spot price FOB, 2014-2026. U.S. Energy Information Administration.

Zhang, X., Meng, X., & Su, C.-W. (2024). The security of energy import: Do economic policy uncertainty and geopolitical risk really matter? Economic Analysis and Policy, 82, 377–388. https://doi.org/10.1016/j.eap.2024.03.014