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TÁC ĐỘNG CỦA ĐA DẠNG NĂNG LƯỢNG LÊN CÁC DOANH NGHIỆP DẦU KHÍ: VAI TRÒ ĐIỀU TIẾT CỦA RỦI RO ĐỊA CHÍNH TRỊ

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Trong kỷ nguyên chuyển đổi năng lượng, thành tựu công nghệ và đặc biệt là bất ổn toàn cầu, vấn đề an ninh năng lượng đã trở nên cấp thiết hơn bao giờ hết. Hệ quả là vị thế của các doanh nghiệp dầu khí trong bối cảnh đó cũng trở thành cuộc tranh luận giữa các nhà nghiên cứu. Để nghiên cứu vai trò điều tiết của rủi ro địa chính tị trong mối quan hệ giữa đa dạng năng lượng và các doanh nghiệp dầu khí, nghiên cứu của chúng tôi phân tích dữ liệu bảng của 312 doanh nghiệp dầu khí tại 8 nền kinh tế dầu khí lớn trong giai đoạn từ 2008 đến 2024. Kết quả cho thấy đa dạng năng lượng ảnh hưởng tiêu cực tới các doanh nghiệp dầu khí do sự vươn lên của các nguồn năng lượng khác. Hơn cả vậy, ở mức rủi ro địa chính trị cao, việc tập trung năng lượng có thể trở thành một mối đe doạn với các doanh nghiệp này do sự bất ổn của chuỗi cung ứng toàn cầu cũng như nền kinh tế. Dựa trên những kết quả này, nghiên cứu đề xuất các hàm ý chính sách cho cả các quốc gia và doanh nghiệp.

Từ khóa: đa dạng năng lượng, rủi ro địa chính trị, dầu khí

THE IMPACT OF ENERGY DIVERSIFICATION ON OIL&GAS FIRM PERFORMANCE: THE MODERATING ROLE OF GEOPOLITICAL RISK

Abstract

In the era of energy transition, technological advancement and especially global uncertainties, the issue of energy security has become urgent than ever. As a result, the position of oil & gas firms under this circumstances also remains a debate among researchers. To investigate the moderating role of geopolitical risk in the relationship between energy diversification and oil & gas firm performance, our study analyzes the panel data of 312 oil & gas firms in 8 major oil economies during the period from 2008 to 2024. The results show that energy diversification worsen the performance of oil & gas firms due to the rise of other power sources. Moreover, at the high level of geopolitical risk, the energy concentration would return become a threat to these firms owing to the uncertainty in the global supply chain as well as the economy's stability. Based on these results the study proposes the policy implications for both nations and firms.

Key words: energy diversification, gepolitical risk, oil&gas

1. Introduction

In contemporary macroeconomic theory, geopolitical risk (GPR) has emerged as a systemic variable that is inseparable from the stability of global financial and energy flows (Caldara & Iacoviello, 2022). Since the early 2020s, the global political landscape has experienced significant disruptions, most notably the Russia-Ukraine conflict in 2022 (European Central Bank, 2024). These developments have not only generated temporary uncertainty but have also produced structural shocks that reshape investor expectations and elevate systemic risk to unprecedented levels (Caldara & Iacoviello, 2022). As political disturbances increasingly translate into widespread economic crises, geopolitical risk is no longer a distant external factor but has become a central concern in the risk management strategies of both national economies and multinational corporations (Aastveit et al., 2017).

Amid these macroeconomic disturbances, the oil and gas industry and traditional energy firms are widely recognized as the most vulnerable sectors due to risk transmission mechanisms and structural market vulnerabilities (Liu et al., 2025). A clear manifestation of this sensitivity is the sharp escalation of crude oil prices, with benchmark indicators such as Brent and West Texas Intermediate (WTI) frequently exceeding USD 100 per barrel and even reaching USD 115-120 per barrel following military developments in Eastern Europe and the Middle East (Ittimani, 2026; DiSavino, 2026). For oil and gas companies, such volatility creates asymmetric effects on operational performance. While higher oil prices may boost short-term revenues, the surge in operational costs and market uncertainty exerts downward pressure on profitability and stock valuation, particularly in major oil-exporting economies (Basher et al., 2016). Consequently, key financial performance indicators such as return on assets (ROA) and return on equity (ROE) have become increasingly unstable under the influence of international sanctions and trade restrictions (Westerman et al., 2020; European Central Bank, 2024).

In response to these challenges, energy diversification has become increasingly critical, serving as a strategic "shield" to distribute risks and enhance resilience against external shocks through a multi-dimensional analytical framework (Stirling, 2010). Energy diversification, typically measured by reductions in energy supply concentration indices such as the Energy Diversification Index (EDI), enables economies and firms to reduce dependence on fossil fuel sources that are highly vulnerable to geopolitical disruptions (Gozgor & Paramati, 2022; Stirling, 2010). Transitioning toward a more balanced energy portfolio-including renewable energy and natural gas-therefore not only contributes to environmental sustainability but also plays a crucial role in maintaining competitiveness and financial stability in an increasingly uncertain business environment (Akrofi, 2021; Gozgor & Paramati, 2022).

Against this background, investigating the impact of energy diversification on the performance of oil and gas firms in major oil economies has become particularly important. Although previous studies have examined the relationship between diversification strategies and economic performance, the moderating role of geopolitical risk remains an important gap in the existing literature (Gozgor & Paramati, 2022; Westerman et al., 2020). This study therefore seeks to clarify how the degree of energy concentration interacts with geopolitical shocks in shaping firm performance. The findings are expected to provide bases for policymakers in designing policies.

2. Theoretical framework and Literature review

2.1. Theoretical framework

2.1.1. Overview of energy diversification

Energy diversification refers to the strategic process by which nations or economies reduce reliance on a limited set of energy sources, particularly fossil fuels such as oil and natural gas, in favour of a broader mix that includes renewables, nuclear, hydro, and other alternatives. This shift enhances energy security, stabilises prices, and supports sustainability objectives amid global transitions. In major oil economies, where oil and gas have

traditionally dominated primary energy consumption, diversification addresses vulnerabilities to supply disruptions and environmental pressures (Gozgor & Paramati, 2022).

Measurement of energy diversification typically relies on concentration indices. The most common approach is the Energy Diversification Index (EDI), derived from the Herfindahl-Hirschman Index (HHI). Gozgor et al. (2024) define the EDI as:

$$EDI_{i,t} = \sum_{k=1}^{K} \left(\frac{E_{i,t,k}}{\sum_{k=1}^{K} E_{i,t,k}} \right)^2$$

Where $E_{i,t,k}$ represents primary energy consumption from source k (coal, natural gas, oil, nuclear, hydro, renewables) in country i at time t, and K is the number of sources. The index ranges from near 0 (perfect diversification) to 1 (complete concentration). Higher EDI values indicate lower diversification and greater dependence on traditional sources like oil and gas (Gozgor & Paramati, 2022; Gozgor et al., 2024).

Empirical studies confirm that higher energy diversification (lower EDI) exerts a negative short-term impact on firm performance metrics such as return on assets (ROA), return on equity (ROE), and Tobin's Q, particularly in oil- and gas-intensive sectors. Diversification dilutes demand for fossil fuels and intensifies competition from alternatives, reducing profitability for conventional oil and gas firms unless offset by strong corporate social responsibility practices (Gozgor et al., 2024). In the context of the eight major oil economies examined here (2008-2024), elevated EDI signals sustained domestic dependence on oil and gas, preserving revenue stability for industry players while exposing them to transition risks.

2.1.2. Overview of geopolitical risk

Geopolitical risk (GPR) captures uncertainties stemming from wars, terrorist acts, and inter-state tensions that disrupt normal international relations and economic activity. (Caldara and Iacoviello, 2022). It is especially pronounced in energy markets, where conflicts in producer regions directly affect supply chains, price volatility, and investment decisions. Mei et al. (2020) define GPR as "the risk associated with wars, acts of terrorism, and tensions between states that affect the normal and peaceful course of international relations," encompassing both materialisation of events and escalation risks.

The standard measurement is the news-based GPR index, constructed through automated textual analysis of articles in major international newspapers, following methodologies akin to economic policy uncertainty indices (Caldara and Iacoviello, 2022). The index quantifies daily or monthly fluctuations and distinguishes between threat-related (GPT) and act-related (GPA) components. Higher GPR readings correlate strongly with elevated oil price volatility and supply-side shocks, with the GPA sub-index proving particularly influential for longer-term forecasting in energy commodities (Mei et al., 2020).

In major oil economies, GPR manifests through sanctions, trade barriers, and regional instability, directly impairing oil and gas firm cash flows and strategic planning.

2.1.3. Foundational theory and theory that link energy diversification, geopolitical risk and oil&gas firm performance

Resource Dependence Theory (RDT) posits that organisational survival and performance depend on managing external resource dependencies (Stern, Pfeffer and Salancik, 1979). Oil and gas firms in high-EDI (low-diversification) environments benefit from national reliance on fossil fuels, securing stable demand and revenues. However, GPR introduces power imbalances and external constraints, compelling firms to reconfigure dependencies through diversification, regionalisation, or decoupling to restore autonomy. Bednarski et al. (2025) apply RDT to geopolitical tensions in strategic industries, demonstrating that elevated GPR moderates dependence effects: low GPR reinforces positive outcomes from concentration (high EDI), while high GPR turns dependence into vulnerability, prompting supply-chain redesign and eroding performance. In oil economies, this explains the sign reversal observed in the EDI-performance relationship under varying GPR levels.

Contingency Theory asserts that the relationship between independent and dependent variables is contingent on contextual factors (Lawrence and Lorsch, 1968). Here, the impact of energy diversification (EDI) on oil and gas firm performance (ROA/ROE) is moderated by GPR. Nguyen (2026) examines oil and gas firms across fragmented geopolitical environments, revealing that under low GPR, high EDI (concentration) enhances financial performance through insulated demand. At high GPR-amplified by sanctions, wars, and policy uncertainty-the same concentration triggers supply disruptions, price ceilings, and demand shocks, turning the EDI-performance link negative and exacerbating energy transition inequalities. This framework highlights GPR as the boundary condition driving sign reversal, consistent with the study's baseline (positive at GPR = 0) and high-risk scenarios.

Collectively, RDT and Contingency Theory provide the theoretical foundation for the moderating role of GPR. Low GPR sustains dependence benefits for oil and gas firms in concentrated energy markets, whereas high GPR precipitates economic crises, validating the predicted interaction in eight major oil economies.

2.2. Literature review on related studies

2.2.1. Empirical studies on impact of energy diversification on oil & gas firm performance

The recent literature connects energy diversification strategies at both firm and national levels to financial performance in the oil and gas sector, particularly through the lenses of strategic adaptation to energy transitions and the profitability implications for incumbents, as measured by ROA and ROE. Using a sample of 129 European energy firms from 2009–2015, Westerman et al. (2020) document a negative relationship between both industrial and international diversification strategies and firm performance, measured by ROA and Tobin's

Q. A univariate comparison suggests that renewable firms exhibit higher profitability than conventional firms, but this difference disappears in multivariate regressions, while the negative effect of diversification remains robust (Westerman et al., 2020). Case-based evidence from PT Adaro Energy, an Indonesian coal giant, presents a contrasting picture for targeted diversification into low-carbon activities. Examining the period 2015–2023, Auditua and Samputra (2025) find that, post-diversification into clean water, solar, hydro, and steam power, the firm's ROE surged from 13.1% (2017) to 43.4% (2022), with concurrent improvements in ROA, liquidity, and equity growth. However, this suggests that while selective diversification aligned with market trends can enhance resilience, broader or forced diversification may not yield similar benefits, particularly in contexts where hydrocarbon dependence remains high (Auditua & Samputra, 2025). These mixed findings align with broader conceptual work on business models in the energy transition. Reviews of oil and gas business models argue that portfolio diversification into renewables, CCUS, and digital efficiency tools is a strategic pathway to maintain profitability under climate constraints (Adebayo et al., 2024; Afeku-Amenyo et al., 2023; (Lawal et al., 2024). However, outcomes depend on strategic fit, capabilities, and regulatory context; in environments favoring hydrocarbons, limited diversification can preserve high ROA and ROE by reinforcing the centrality of oil and gas operations. Based on these results, we propose the hypothesis:

H1: Energy diversification lower oil & gas firm performance

2.2.2. Empirical studies on moderating role of geopolitical risk in the relationship between energy diversification and oil & gas firm performance

Existing research has not yet examined the moderating role of GPR in the specific relationship between energy diversification (or concentration) and oil and gas firm performance. Firm-level studies increasingly incorporate GPR through interaction terms with diversification strategies, demonstrating that GPR alters the way diversification influences outcomes. Using Chinese A-share firms, Li and Cheng (2023) show that higher GPR significantly increases corporate risk-taking, but horizontal diversification weakens and vertical diversification strengthens this effect. In a related setting, Guo (2024) finds that product, geographic, and technological diversification interact with GPR in explaining internationalization performance: product diversification mitigates the negative GPR–internationalization effect, while geographic diversification amplifies it. In both cases, diversification indices and GPR enter multiplicatively, and the marginal effect of diversification on performance-related outcomes is explicitly GPR-dependent. Liu et al. (2024a) show that GPR significantly increases an index of energy market vulnerability, meaning markets with concentrated fossil-fuel structures become more fragile as GPR rises. Systemic-risk evidence from 212 energy firms in 36 countries indicates that a country's GPR intensifies risk spillovers among its energy firms, with indirect effects via energy trade flows particularly strong for fossil-fuel companies and in oil-consuming countries (Liu et al., 2024b). Historical oil-stock studies likewise find that GPR lowers oil returns and increases oil volatility (Qin et al., 2020; Smales, 2019), implying that in high-GPR regimes, the profitability and valuation of oil-linked assets become more uncertain. Qin and Zhang (2024) further identify supply-demand and uncertainty channels through which GPR transmits to

energy returns and volatility, with effects varying across market conditions. These mechanisms support a regime-dependent story: In relatively low-GPR environments, concentration on oil and gas (low energy diversification) can enhance returns for oil and gas firms due to strong, undisturbed demand and pricing power. In high-GPR environments, the same concentration magnifies exposure to sanctions, price caps, supply disruptions, and macro crises, eroding profitability and increasing risk for oil and gas firms (Liu et al., 2024b; Qin & Zhang, 2024; Konovalova & Abuzov, 2023; Liu et al., 2024a). Gamso et al. (2023) review risk-management strategies - ownership versus operating control, stakeholder management, portfolio diversification, and pre-planned exit - which are explicitly designed to cope with changing GPR levels. A broader review of GPR and energy markets identifies "oil and uncertainty in different scenarios" and "uncertainty and the oil market: a geographic perspective" as core research streams, underscoring that GPR alters the payoff to different energy-exposure configurations over time and space (Chiaramonte et al., 2025). Based on these results, we propose the hypothesis:

H2: Geopolitical risk moderates the relationship between energy diversification and oil & gas firm performance

2.2.3. Research gap

Despite the growing body of literature on the direct effects of energy diversification on oil and gas firm performance and the moderating influences of geopolitical risk (GPR) in related domains, significant gaps remain in integrating these elements within a unified framework. Existing studies predominantly examine diversification's impact in isolation, often revealing mixed or negative associations with metrics like ROA and ROE, as seen in European energy firms (Westerman et al., 2020) or selective successes in emerging markets (Auditua & Samputra, 2025). Similarly, GPR's role as a moderator is well-established in general firm-level outcomes (Li & Cheng, 2023; Guo, 2024) and energy market vulnerabilities (Liu et al., 2024a; Liu et al., 2024b), but no research has empirically tested its conditioning effect on the specific relationship between national-level energy diversification (measured via EDI) and oil and gas firm performance. This oversight is particularly evident in macro-micro analyses, where national energy concentration's benefits in low-GPR contexts and risks in high-GPR regimes remain conceptually suggested but unquantified across major oil-producing nations.

Furthermore, prior work largely overlooks temporal and cross-country variations, such as the 2008–2024 period encompassing global financial crises, energy transitions, and escalating GPR events like the Russia-Ukraine conflict. By focusing on eight oil powerhouses (e.g., Saudi Arabia, Russia, the United States), this study addresses these gaps through panel data regression, hypothesizing a regime-dependent moderation: positive EDI-performance links at low GPR (reflecting stable hydrocarbon rents) inverting to negative at high GPR (due to amplified disruptions). This contributes novel insights into how macro-level GPR moderates the micro-level implications of energy policies, informing strategic resilience in volatile geopolitical landscapes.

3. Research Methodology

3.1. Model specification

The research model is based on the work of Qin and Zhang (2024). To investigate the moderating role of geopolitical risk in the relationship between energy diversification and oil&gas firm performance. The addition of other control variables is based on the research of Li and Cheng (2023) and Guo (2024). The applied model can be presented as follows:

$$Performance_{i,t} = \beta_0 + \beta_1 \text{ x } EDI_{c,t} + \beta_2 \text{ x } GPR_{c,t} + \beta_3 \text{ x EDIxGPR}_{c,t} + \sum_{k=4}^{11} \beta_k Controls_{k,i,c,t} + \varepsilon_t + \gamma_c + u_{i,t}$$

Where

β_0: The intercept coefficient

β_j: The slope coefficient (j=$\overline{1,11}$)

$u_{i,t}$: The disturbance term of the model represents other factors that affect economic growth but are not included in the model

ε_t: Year Fixed Effects

γ_c : Country Fixed Effects

$Performance_{i,t}$: the performance of company i at year t

$EDI_{c,t}$: the Energy Diversification Index of country c at year t

$GPR_{c,t}$: the geopolitical risk index of country c at year t

EDIxGPR$_{c,t}$: the moderating variable calculated by multiplying EDI and GPR

$\sum_{k=4}^{11} \beta_k Controls_{k,i,c,t}$: Control variables in both national and firm level

3.2. Data and Variables

Our dataset covers 312 oil&gas firms across 8 major oil economies, which are the United States, the United Kingdom, Russia, China, Norway, Brazil, India and Canada from 2008 – 2024. Due to the data availability as well as this period's coverage of numberous gepolitical events such as the global financial crisis, COVID-19 and the Russia-Ukraine war, the 17-year period from 2008 – 2024 is selected to be the time scope of this research. While all the financial proxies are extracted from the LSEG database, the macroeconomic indicators such as GDP and Inflation are collected from the World Development Indicators. The Energy Diversification Index (EDI) and Geopolitical Risk Index (GPR) are calculated by Gozgor & Paramati (2022) and Caldara & Iacoviello (2022) respectively. The detail descriptions of the variables are shown as below:

Table 1: Variable descriptions

Variable	Description	Source
ROA	Return on asset of a firm	LSEG database
ROE	Return on equity of a firm	LSEG database

lnMC	Natural logarithm of a firm's market capitalization	LSEG database
EDI	Energy diversification index reflecting the diversification in energy consumption of a country	Gozgor & Paramati (2022)
GPR	Geopolitical risk index reflecting the geopolitical concern of a country	Caldara & Iacoviello (2022)
EDIxGPR	The moderating variable generated by multiplying EDI and GPR	
lnCash	Natural logarithm of a firm's cash holdings	LSEG database
Size	Natural logarithm of a firm's total assets	LSEG database
lnDebt	Natural logarithm of a firm's total debt	LSEG database
lnDPS	Natural logarithm of a firm's dividend per share	LSEG database
Quickratio	Quickratio of a firm	LSEG database
Leverage	Leverage ratio of a firm	LSEG database
GDP	Annual GDP growth percentage of a country	World Development Indicator
Inflation	Inflation rate of a country	World Development Indicator

Source: Author's summary (2026)

To investigate the moderating role of geopolitical risk in the relationship between energy diversification and oil&gas firms, we utilize ROE as the main dependent variable to represent the performance of oil&gas firms. Moreover, ROA and the natural logarithm of market capitalization are also employed as dependent variable for robustness checks. Meanwhile, specific indexes, which are EDI and GPR, are kept unchanged to serve as the independent and moderating variable. The control variable set includes both national and firm proxies to control the error terms of the model. To ensure the robustness of the model and the ease of interpretation, we winsorize the ratio-form variables such as ROA, ROE, Quickratio, lnDPS, Leverage as well as use the lnMC, lnCash, Size, lnDebt, lnDPS in the form of natural logarithm. All in all, the research has collected the balanced panel data with all the variables being shown by 3660 observations. The descriptive statistical results are shown as below:

Table 2: Descriptive statistics of dataset

Variable	Obs	Mean	Std. dev.	Min	Max
ROA	3,660	3.928814	10.55377	-45.78	31.28
ROE	3,660	5.283508	30.00255	-151.65	92.17
lnMC	3,660	14.70566	2.204407	5.529429	19.96452

EDI	3,660	0.2219785	0.1040606	0.1201986	0.5202253
GPR	3,660	1.088952	0.9784594	0.0257366	3.690387
EDIxGPR	3,660	0.2001317	0.1429691	0.0052992	0.8649017
lnCash	3,660	11.80265	2.686392	0	17.50268
Size	3,660	15.16866	2.213383	4.672829	19.99759
lnDebt	3,660	13.4832	2.825786	0.6931472	19.02483
lnDPS	3,660	0.5626919	0.8391885	0	4.510859
Quickratio	3,660	1.309719	1.38524	0.14	9.4
Lever	3,660	27.54414	17.24555	0.08	77.29
GDP	3,660	3.40848	3.249832	-10.0479	10.59627
Inflation	3,660	3.083306	2.513181	-0.7281653	15.5344

Source: Author's calculation (2026)

To check for the issue of multicollinearity, the correlation matrix is employed. The result shows the value of all correlation coefficient being below 0.8, showing no potential of multicollinearity issue.

Table 3: Correlation matrix

	ROA	EDI	GPR	lnCash	Size	lnDebt	lnDPS	Quickratio	Leverage	GDP	Inflation
ROA	1										
EDI	0.1146	1									
GPR	0.0448	-0.4086	1								
lnCash	0.2145	0.152	0.0943	1							
Size	0.2509	-0.0036	0.1604	0.7429	1						
lnDebt	0.1818	0.0164	0.15	0.619	0.7986	1					
lnDPS	0.1868	-0.0884	0.0217	0.2105	0.3833	0.3035	1				
Quickratio	-0.0377	-0.1097	0.0018	-0.0394	-0.2748	-0.4472	-0.0728	1			
Leverage	-0.1194	0.0223	0.0612	-0.0234	0.1302	0.4503	-0.0272	-0.3401	1		
GDP	0.176	0.6595	-0.1689	0.088	-0.0081	0.008	-0.1275	-0.0951	0.0099	1	
Inflation	0.2565	0.0741	-0.0255	-0.021	0.0609	0.0049	0.263	0.0252	-0.0758	0.0692	1

Source: Author's calculation (2026)

3.3. Estimation process

To check for the moderating role of geopolitical risk in the relationship between energy diversification and oil&gas firm performance, the three methods of Ordinary Least Square for Pooled Data (POLS), Fixed Effect Model (FEM) and Random Effect Model (REM) are applied. After conducting various tests to check for the model's defects, the results indicate that the Fixed Effects Model (FEM) appears to be the most suitable model among the three.

Table 4: Results of tests

Test	Objective	Result	Conclusion
F-Test for FEM	Compare between FEM and POLS	P-value = 0.0000 < 0.05	The Fixed Effects Model is more effective than the POLS model
Breusch - Pagan Lagrange	Compare between REM and POLS	P-value = 0.0000 < 0.005	The Random Effects Model is more effective than the POLS model
Hausman Test	Compare between FEM and REM	P-value = 0.0000 < 0.05	The Fixed Effects Model is more effective than the Random Effects Model

Source: Author's calculation (2026)

After choosing the Fixed Effect Model as the most suitable one among the three models, the research tested the issues of Autocorrelation and Heteroskedasticity. The result is that there is both Autocorrelation and Heteroskedasticity in the Fixed Effect Model. This conclusion lead to the need of a more suitable model fixing both these issues.

Table 5: Results of Wooldridge and Modified Wald test

Test	Objective	P-value	Conclusion
Wooldridge test	Test the Autocorrelation in panel data	0.0000 < 0.05	There is first-order Autocorrelation in panel data
Modified Wald test	Test the Heteroskedasticity in the Fixed Effect Model	0.0000 < 0.05	There is Heteroskedasticity in the Fixed Effect Model

Source: Author's calculation (2026)

Afterwards, the Driscoll Kraay Fixed Effect model is chosen to estimate the coefficients in the research model. The Driscoll Kraay Fixed Effect model is used to fix the

Heteroskedasticity and Autorcorrelation issues in the normal Fixed Effect model (Vogelsang, 2012).

4. Result and Discussion

4.1. Result

Employing the Fixed Effects model as the baseline model as well as Driscoll Kraay Fixed Effects model as the main one, the research has the following estimation results of the moderating role of geopolitical risk in the relationship between energy diversification and oil&gas firm performance.

Table 6: Estimation results

	FEM	Driscoll Kraay
	ROE	ROE
EDI	35.814**	35.814*
	(14.261)	(20.016)
GPR	28.059***	28.059**
	(4.978)	(10.140)
EDIxGPR	-123.413***	-123.413**
	(25.524)	(43.545)
lnCash	0.687*	0.687
	(0.392)	(0.423)
Size	6.686***	6.686***
	(1.185)	(1.608)
lnDebt	1.882***	1.882**
	(0.715)	(0.723)
lnDPS	-1.645*	-1.645
	(0.954)	(1.722)
Quickratio	0.533	0.533

	(0.498)	(0.729)
Leverage	-0.838***	-0.838***
	(0.055)	(0.126)
GDP	0.322	0.322
	(0.293)	(0.354)
Inflation	0.991***	0.991***
	(0.283)	(0.331)
Constant	-113.655***	-113.655***
	(13.676)	(21.241)
Observations	3660.000	3660.000
R-squared	0.234	

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Source: Author's calculation (2026)

Moreover, to check the robustness of the model, we replace ROE by ROA and lnMC to represent the oil&gas firm performance. The results show the consistent conclusion with the main model, confirming the robustness of the model.

Table 7: Robustness checks

	Driscoll Kraay	Driscoll Kraay
	ROA	lnMC
EDI	22.478***	2.237**
	(7.489)	(0.972)
GPR	8.871**	0.644***
	(3.681)	(0.134)
EDIxGPR	-43.149**	-3.026***
	(15.643)	(0.633)

lnCash	0.342*	0.048***
	(0.168)	(0.008)
Size	3.267***	0.688***
	(0.601)	(0.040)
lnDebt	-0.184	-0.002
	(0.327)	(0.012)
lnDPS	-0.739*	0.158***
	(0.380)	(0.039)
Quickratio	0.131	0.029*
	(0.318)	(0.015)
Leverage	-0.199***	-0.014***
	(0.027)	(0.001)
GDP	0.082	0.012
	(0.097)	(0.013)
Inflation	0.407***	-0.023*
	(0.131)	(0.011)
Constant	-45.657***	3.421***
	(7.691)	(0.643)
Observations	3660.000	3660.000

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Source: Author's calculation (2026)

4.2. Discussion

As presented by the estimation results, the energy diversification index is shown to positively affect oil&gas firm performance. This conclusion confirm the hypothesis H1 and the work of Lawal et al. (2024).. Notably, as the energy diversification index increases, the concentration in energy consumption of a country also increases. As a result, such country can be considered as dependent on a limited number of energy source. In most cases, these minor power sources are often fossil fuels such as coal, oil and gas. Consequently, the oil&gas can reap the benefits of high energy concentration ratio of a country as they become the only and more reasonable choice of energy provision.

In addition, the negative sign of the moderating variable's coefficient admits the hypothesis H2 and the statements of Qin and Zhang (2024). To be more specific, with the value of geopolitical risk index being 1, the coefficient of EDI would be turn out to be approximately -87.6. This result implies that at the high level of geopolitical risk, the monopoly impact of energy concentration would does more harm than good. The limited sources of energy would drive an economy to power crisis, which disrupt the whole economy as well as the supply for oil&gas firms. As a consequence, the too high risk of geopolitical events would reverse the initial influence of energy diversification on oil&gas firm performance.

5. Policy implications and conclusion

5.1. Policy implications

The regression results suggest that energy diversification and geopolitical risk should not be treated as separate policy domains. Their interaction needs to be incorporated into both national energy strategy and firm-level risk management. Once geopolitical risk intensifies, the same dependence becomes a structural weakness, magnifying exposure to sanctions, supply disruptions, transport bottlenecks, and market uncertainty. This implies that policymakers in major oil economies should avoid relying on fossil-fuel concentration as a long-term source of competitive advantage. Although such concentration may generate short-run profitability, it reduces resilience when geopolitical conditions deteriorate. Therefore, governments should accelerate the transition toward a more diversified domestic energy portfolio in order to reduce systemic dependence on a narrow set of energy inputs and revenue channels.

More specifically, the policy message for oil-producing countries is not to pursue diversification only for environmental reasons, but also for financial and geopolitical resilience. Energy diversification should be embedded into national industrial policy, infrastructure planning, and fiscal stabilization frameworks. In countries where oil and gas firms remain strategically important, governments should support gradual portfolio adjustment rather than abrupt transition pressure. This may include incentivizing investment in cleaner energy segments, encouraging technological upgrading, and strengthening domestic value chains that are less vulnerable to international shocks. At the same time, public authorities should improve scenario-based planning for periods of high geopolitical tension, especially in relation to sanctions risk, export route disruption, and oil price spikes.

In other words, a more diversified energy system functions not only as a sustainability mechanism but also as a buffer against external instability.

The findings also generate important implications for firm managers in the oil and gas sector. Since the effect of energy concentration on firm performance is conditional on the geopolitical environment, managers should not interpret short-term gains under fossil-fuel dependence as evidence of long-term security. Oil and gas companies should strengthen strategic flexibility by adopting more adaptive investment and risk-management models, including improving supply-chain resilience, rebalancing geographic exposure, and integrating geopolitical risk monitoring into financial planning and capital budgeting.

5.2. Conclusion

This study examines the impact of energy diversification on oil and gas firm performance in eight major oil economies over the period 2008–2024, with geopolitical risk introduced as a moderating variable. By linking the Energy Diversification Index with firm-level profitability measures such as ROA and ROE, the study provides a macro-micro perspective on how national energy dependence shapes corporate outcomes in the oil and gas sector. The results show that the effect of EDI is not constant across contexts. When geopolitical risk is low, a higher EDI, indicating lower diversification and stronger dependence on traditional energy sources, is associated with better firm performance. This finding reflects the continued profitability of oil and gas firms in economies where hydrocarbon demand remains central and relatively undisturbed.

However, the interaction results indicate that this positive relationship weakens and can reverse under high levels of geopolitical risk. In periods of intensified geopolitical tension, concentration in national energy structures no longer provides stability but instead amplifies vulnerability. Under such conditions, oil and gas firms are more exposed to supply-chain disruptions, sanctions, price controls, transport risks, and volatility in global demand. Thus, the same structural dependence that supports profitability in stable periods becomes a source of fragility in unstable ones.

Overall, the study contributes to the literature in three ways. First, it extends research on energy diversification by focusing on firm performance in major oil economies rather than only macroeconomic or environmental outcomes. Second, it introduces geopolitical risk as a meaningful boundary condition that shapes the EDI-performance nexus. Finally, it shows that energy diversification should be understood not only as a transition objective, but also as a resilience strategy in an increasingly uncertain geopolitical environment.

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