Economic Analysis Letters

Homepage: https://www.anserpress.org/journal/eal

Geopolitical Challenges and Natural Gas Supply

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ABSTRACT

This study examines the impact of the Russia-Ukraine conflict, which began on February 24, 2022, on natural gas prices and supply security in major global markets. Six months after the conflict's onset, natural gas prices surged by an average of 78.65% across international markets. Notably, prices in the European Union, Russia, the United Kingdom, Japan, and South Korea saw substantial increases, while price hikes in China, the United States, and Australia were comparatively smaller. Despite these price fluctuations, the security of natural gas supply in key international markets remained largely unaffected. Using the Differences-in-Differences (DID) method, the study analyzed the conflict's impact on supply security, employing a mediation effects model to examine the roles of supply, demand, and price. The findings reveal that the conflict significantly reduced natural gas supply security, with negative effects on both supply and demand, although price changes did not mediate this reduction in supply security. Furthermore, the regional impact on supply security was minimal, likely due to the high integration of the global natural gas market. Overall, the Russia-Ukraine conflict notably influenced natural gas supply security by affecting supply and demand factors.

KEYWORDS

The Russia-Ukraine Conflict; Supply Security; Natural Gas Prices; International Markets

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ISSN 2972-3272
doi: 10.58567/eal04010006

Received 20 February 2025; Accepted 4 April 2025; Available online 22 May 2025; Version of Record 15 March 2025

1. Introduction

Natural gas is a crucial energy source for modern society, essential for both businesses and households. A disruption in supply directly impacts economic production and daily life. Six months after the onset of the Russia-Ukraine military conflict on February 24, 2022, natural gas prices in major international markets increased by an average of 78.65%. However, there were notable differences among markets: the European Union, Russia, the United Kingdom, Japan, and South Korea saw significant price hikes, while China, the United States, and Australia experienced smaller increases. Despite these price fluctuations, there was no major imbalance between supply and demand in key international markets, and natural gas supply security remained largely unaffected (see Figures 1 and 2). Geopolitical events can disrupt energy supplies, significantly increasing gas price volatility and impacting the availability, distribution, and security of energy resources, as shown by studies such as San-Akca et al. (2020), Ediger and Berk (2018), Hache (2018), and Khan et al. (2023). However, the impact of geopolitical risks on energy security varies depending on the specific context and factors involved (Bin Zhang et al., 2023; Chien-Chiang Lee et al., 2024; Ying Tung Chan et al., 2024; Qiang Wang et al., 2024). Lee and Yuan et al. (2024) indicated that geopolitical risk can have both negative and positive effects on energy security. This article investigates the impacts of the Russia-Ukraine conflict on natural gas prices in major global markets and examines whether it has affected the security of natural gas supply.

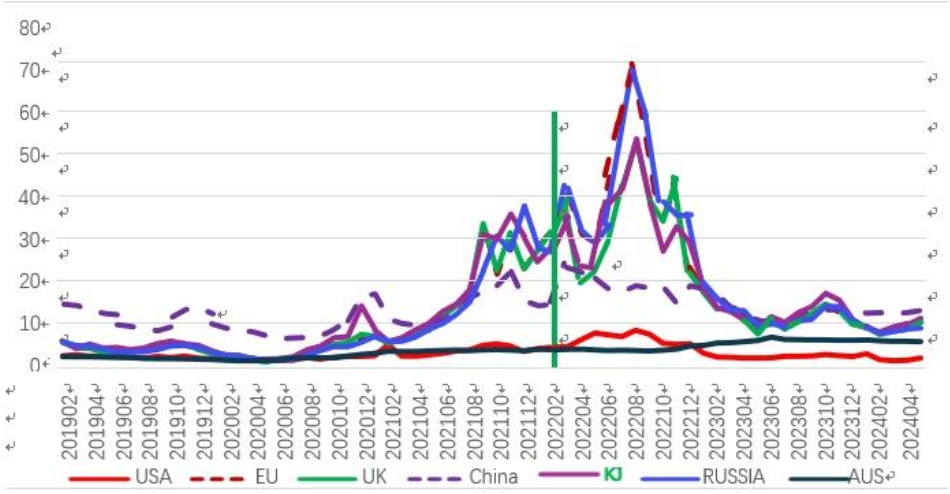

Figure 1. Changes in Natural Gas Prices in Major Markets Worldwide in the Two Years Before and After the Russia-Ukraine Conflict.

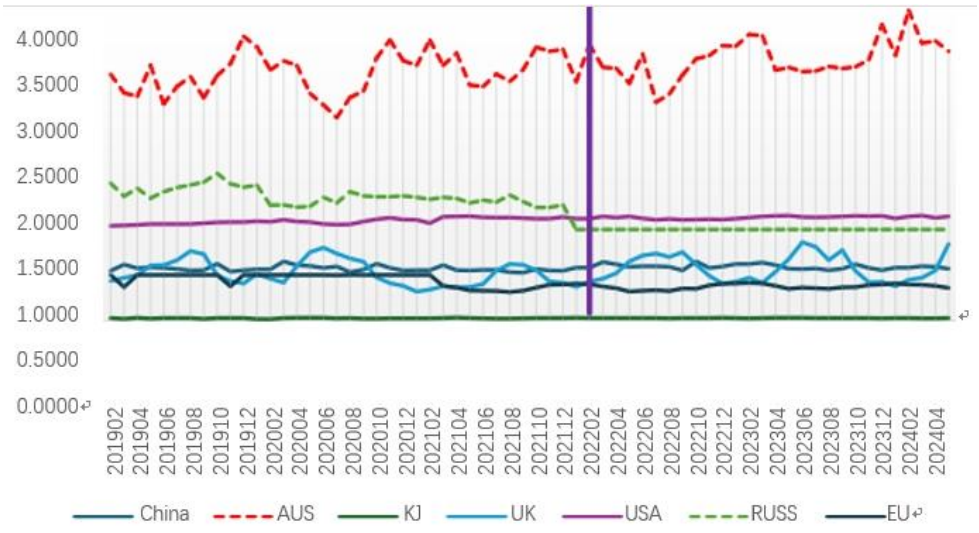

Figure 2. Changes in Energy Security Levels of Major Countries and Regions. Around the World in the Two Years Before and After the Russia-Ukraine Conflict.

2. Literature review

2.1. Geopolitical conflicts and energy security

Academic research on geopolitical conflicts and energy security mainly focuses on the economic impacts of these conflicts, the effects on energy prices, and the factors influencing energy security. However, there is limited literature examining the direct relationship between geopolitical conflicts and energy security.

Geopolitical risk is often considered a "double-edged sword" with both negative and positive effects on energy security (Khalid Khan et al., 2023). Many studies suggest that geopolitical conflicts increase risks, disrupting international relations and potentially reducing energy security, especially for countries dependent on energy imports (Muñoz et al., 2015). However, some cases show that geopolitical risks may not always be detrimental to energy security. For example, following the Russia-Ukraine conflict, the EU announced a new energy investment plan of up to 300 billion euros, aiming for energy independence, which could enhance energy security within the EU (Chien-Chiang Lee et al., 2024).

2.2. Geopolitical conflicts, natural gas price fluctuations and supply security

The research on the impact of geopolitical conflicts on natural gas prices highlights several key studies. Geopolitical risks typically affect natural gas prices through supply chain disruptions, increased market uncertainty, and investor sentiment fluctuations. Chițu et al. (2024) noted that the Ukraine war, market recovery post-pandemic, and tensions in the Middle East significantly impacted natural gas prices, while Yousfi and Bouzgarrou (2024) further analyzed how these geopolitical events amplified price volatility by increasing uncertainty. Several studies, such as Nick and Thoenes (2023), have shown that geopolitical conflicts complicate natural gas market mechanisms by altering market expectations and investor behavior. Geopolitical conflicts also influence market speculation, exacerbating price volatility, as highlighted by Chițu et al. (2024), who found that while speculation is often overstated, it amplifies volatility during key events. This view is aligned with Gupta and Pierdzioch (2022), who found that increased market uncertainty leads to heightened price volatility. Regional geopolitical conflicts not only affect local markets but also impact global prices, as shown by Ha (2023), who indicated that regional conflicts influence global markets through connectivity, supported by Scholtens and Yurtsever (2012). Finally, Vivoda (2022) suggested that diversifying import sources can mitigate the impact of geopolitical risks on natural gas prices, especially in light of increased global market uncertainty.

2.3. Natural gas price fluctuations and supply security

Natural gas price fluctuations are driven by various factors, with geopolitical conflicts being a significant one, especially when global supply chains are disrupted (Brown and Yücel, 2023). Geopolitical risks cause both short-term price volatility and long-term market instability (Nick and Thoenes, 2014). Additionally, changes in uncertainty and market expectations play a critical role in natural gas price volatility (Gupta and Pierdzioch, 2022). Oil price fluctuations, along with the vulnerability and market dependence of natural gas supply chains, significantly affect supply security (Yousfi et al., 2024). The global connectivity of markets ensures that regional political conflicts impact global natural gas supply security (Scholtens and Yurtsever, 2012). To mitigate the energy security crisis caused by geopolitical conflicts, strategies such as market diversification and policy regulation are recommended. Diversifying import sources is key to enhancing supply security (Botão et al., 2023; Vivoda, 2009).

Regarding the Russia-Ukraine conflict, event studies focus on abnormal changes in natural gas supply security following such events. Various models, including the Supply Chain Model, Input-Output Model, Scenario Analysis Model, System Dynamics Model, Geopolitical Risk Model, and Event Study Methodology, can be used to analyze the impact of the conflict on energy security. However, each model has its limitations, such as the difficulty in obtaining energy supply chain data for the Supply Chain Model or the large workload required for global analyses with the Input-Output Model. The Scenario Analysis Model is useful for uncertain situations, and the System Dynamics Model is applicable for analyzing resource system security but may lack practicality in certain contexts.

The Geopolitical Risk Model, while insightful, has low predictive accuracy. Considering this limitation, our paper adopts the Event Study Methodology for analysis. This approach allows for a more focused examination of the immediate impact of the Russia-Ukraine conflict on natural gas supply security, providing a clearer understanding of abnormal changes following the event. The following outlines the specific analytical methods employed in this study.

3. The impact of Russian-Ukrainian conflict on security of natural gas supply

We employ the Differences-in-Differences (DID) method to assess the impact of the Russia-Ukraine conflict on natural gas supply security. Following (Bai, 2021; Bai and Qin, 2014; Bai and Qin 2015), a binary dummy variable, treat, is constructed based on the extent to which regions are directly impacted by the conflict. Regions significantly affected, including the EU, the UK, Japan, South Korea, and Russia, are assigned Treat = 1, while less affected regions, such as China, the US, and Australia, are assigned Treat = 0. For periods after February 2022, marking the onset of large-scale conflict, Conflict = 1; for periods before February 2022, Conflict = 0. To control for individual regional and monthly time variations, we formulate a DID model with double fixed effects.

$$Y_{it} = a_0 + a_1 DID_{it} + \beta X_{it} + \delta_i + y_t + \varepsilon_{it} \quad (1)$$

Where the dependent variable Y_{it}, represents the level of natural gas supply security measured by the supply-to-demand ratio (supply quantity/demand quantity), with robustness checks using the supply security coefficient $Dsafe_{it}$ value as a substitute. DID_{it} stands for $\text{treat}_{it} \times \text{conflict}_{it}$, the focus is on the estimated value of a_1, which examines the differential impact of the Russia-Ukraine conflict on natural gas supply security. X_{it} represents the set of control variables, including demand data, weather data, and other variables. δ_i and y_t denote individual and month fixed effects, respectively, and ε_{it} represents the random disturbance term.

3.1. The Mechanism of the Russia-Ukraine Conflict's Impact on Natural Gas Supply Security

This paper employs a mediation effect model to examine the mechanisms through which the Russia-Ukraine conflict influences natural gas supply security, considering both the supply and demand sides. On the supply side, the conflict disrupted pipelines transporting Russian gas through Ukraine, resulting in reduced supply, which caused a natural gas shortage in Europe, price increases, and short-term local supply shortages. This led to price hikes and adjustments within the supply chain. In the long term, after supply chain reorganization and adjustments, a supply rebalance is expected. To capture the impact on supply security, this paper uses natural gas supply quantity as a measure. On the demand side, the conflict increases economic uncertainty, drives up prices of alternative energy sources, reduces supply, and consequently decreases demand for natural gas. The impact on demand is reflected through natural gas demand quantity. In summary, supply quantity and demand quantity are used as mediating variables in the construction of the mediation effect model.

First, we test the direct effect of the Russia-Ukraine conflict on natural gas supply security using the equation (2).

$$Dsafe_{it} = a_0 + a_1 Treat_{it} \times conflict_{it} + \beta X_{it} + \delta_i + y_t + \varepsilon_{it} \quad (2)$$

Next, we examine the direct impact of the Russia-Ukraine conflict on natural gas supply and demand.

$$Supply_{it} = a_0 + a_1 Treat_{it} \times conflict_{it} + \beta X_{it} + \delta_i + y_t + \varepsilon_{it} \quad (3)$$

$$Demand_{it} = a_0 + a_1 Treat_{it} \times conflict_{it} + \beta X_{it} + \delta_i + y_t + \varepsilon_{it} \quad (4)$$

$$Price_{it} = a_0 + a_1 Treat_{it} \times conflict_{it} + \beta X_{it} + \delta_i + y_t + \varepsilon_{it} \quad (5)$$

Finally, after examining the impact of the Russia-Ukraine conflict, we test the effects of natural gas supply and demand on supply security using equations (6), (7) and (8) respectively.

$$Dsafe_{it} = a_0 + a_1 Treat_{it} \times conflict_{it} + a_2 Demand_{it} + \beta X_{it} + \delta_i + y_t + \varepsilon_{it} \quad (6)$$

$$Dsafe_{it} = a_0 + a_1 Treat_{it} \times conflict_{it} + a_3 Supply_{it} + \beta X_{it} + \delta_i + y_t + \varepsilon_{it} \quad (7)$$

$$Dsafe_{it} = a_0 + a_1 Treat_{it} \times conflict_{it} + a_3 Price_{it} + \beta X_{it} + \delta_i + y_t + \varepsilon_{it} \quad (8)$$

3.2. Regional Differences in the Impact of the Russia-Ukraine Conflict on Natural Gas Supply Security

We perform regression estimates on Model (1) using various sample groups[1]: the full sample data, the sample from the Russia-Ukraine conflict period (the 10 months before and after the large-scale conflict, referred to as CM), the sample excluding the conflict period, and samples distinguishing between regions close to and distant from the conflict. This approach allows us to examine the regional differences in the impact of the Russia-Ukraine conflict on natural gas supply security.

4. Positive analysis

4.1. Data and Statistical description

This paper uses monthly frequency time series data from the Energy Security Index, which measures the degree of energy security as the ratio of energy supply to demand. The data on natural gas prices, production, and consumption are sourced from the EIA, covering the period from February 2019 to April 2024. Air temperature data are obtained from the World Weather Information Service (WWIS). Descriptive statistics for the relevant variables are presented in Table 1.

Table1. the descriptive statistics and natural gas supply security correlations.

	China (1)	Australia (2)	KJ (3)	UK (4)	USA (5)	Russia (6)	EU (7)
Panel A: Descriptive statistics of natural gas supply security							
Mean	0.578	2.792	0.025	0.543	1.11	1.201	0.414
Std Dev	0.03	0.235	0.003	0.145	0.032	0.197	0.068
Max	0.649	3.40	0.031	0.859	1.039	1.161	0.501
Min	0.524	2.23	0.015	0.317	1.151	1	0.312
Panel B: Bivariate Correlations							
China	1						
Australia	0.097	1					
KJ	0.131	-0.0002	1				
UK	-0.076	-0.488	0.1005	1			

[1] Please see (Xiao, et.al., 2021; Xiong, et.al., 2023; Zhou, et.al., 2021; Kong, et.al., 2015; Qin, et.al., 2020; Qin, et.al., 2022; Bai, et.al., 2022; Bai and Ho, 2022, 2023; Qin and Bai 2014; Bai and Recce, 2023; Zhou, et.al., 2022)

USA	-0.142	0.485	0.225	-0.151	1		
Russia	-0.374	-0.332	-0.343	-0.126	-0.683	1	
EU	-0.017	-0.116	-0.203	-0.105	-0.705	0.623	1

Note: Columns (1) to (7) in panel A report descriptive statistics for degree of security natural gas supply, which is for seven countries and regions. Panel B reports the bivariate correlations.

Table1 offers summary statistics of the data used in our analysis for the full sample period from February 2019 to May 2024. Panel A shows descriptive statistics for the monthly degree of security of natural gas supply (DSGS) changes. The United of States, Australia and Russia both have a mean greater than one, consistent with their high level of natural gas supply security. Australia, the United Kingdom and Russia have a high standard deviation, which implies impact of Russia-Ukraine conflict on natural gas supply security in the three countries is greater than others. Panel B tabulates the bivariate correlation coefficients. As expected, the DSGS on EU and Russia have a correlation coefficient of 62%, however, the DSGS on the USA and EU, Russia have a negative correlation coefficient of 68.3% and 70.5%.

4.2. Baseline regression

The baseline regression results in Table 2 show that the Russia-Ukraine conflict has a significantly negative impact on natural gas supply security across different models, confirming that the conflict reduces supply security. Regression results from three models reveal that the coefficient for the Treat × Conflict term is consistently negative, indicating the robustness of this negative effect. This impact is channeled through supply, demand, and price changes. Specifically, disruptions in supply and demand caused by the conflict result in price fluctuations, which eventually help to restore balance through price adjustments. Supply, demand, and price serve as mediators in this process. The next section will further examine these mediating effects.

Table 2. The impact of the Russia-Ukraine conflict on natural gas supply security.

	Dsafe		
	(1)	(2)	(3)
Treat × conflict	-0.101***	-0.127***	-0.055***
	(0.057)	(0.0169)	(0.0121)
Const	4.06***	3.158***	2.035***
	(0.187)	(0.284)	(0.242)
Control variables	Yes	Yes	Yes
Region	No	Yes	Yes
Time	No	No	Yes
Observes	448	448	448
R^2	0.7434	0.7318	0.6512

*Note: Standard errors are in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively. Same notation applies below.*

4.3. Mediation effect test

The estimated results in Table 3 examine the impact of the Russia-Ukraine conflict on natural gas supply security from the supply side. Column (1) shows that the conflict negatively affects natural gas supply security. In Column (2), the core explanatory variable, Treat × Conflict, has a negative and statistically significant regression coefficient on the mediator variable, Supply, at the 1% level, indicating that the conflict has reduced the supply of natural gas. Column (3) presents the joint significance results of the Russia-Ukraine conflict and supply changes on natural gas supply security, with the coefficient estimates for Treat × Conflict and Supply being statistically significant at the 1% and 5% levels, respectively. Furthermore, the coefficient for Treat × Conflict decreases from –

0.0875 in Column (1) to –0.055 in Column (3), suggesting that part of the impact of the Russia-Ukraine conflict on supply security occurs through reduced supply levels. This confirms the "Russia-Ukraine conflict – supply level – supply security" transmission mechanism.

Table 3. the mediation effect test of supply changes on natural gas supply security.

	Dsafe (1)	Supply (2)	Dsafe (3)
Treat × conflict	-0.0875***	-0.054***	-0.055***
	(0.0158)	(0.017)	(0.0121)
Supply			0.604***
			(0.033)
Const	4.267***	3.693	2.035***
	(0.277)	(0.30005)	(0.242)
Control variables	Yes	Yes	Yes
Region	Yes	Yes	Yes
Time	Yes	Yes	Yes
Observes	448	448	448
R^2	0.3051	0.4083	0.6512

The test results in Table 4 further support the validity of the proposed transmission mechanisms, specifically "Russia-Ukraine conflict – demand level – supply security" and "Russia-Ukraine conflict – price changes – supply security." Column (2) examines the impact of the Russia-Ukraine conflict on demand levels, with the estimated coefficient for Demand being significantly positive, indicating that the conflict has increased natural gas demand. In Column (3), the estimated coefficient for the mediator variable Demand is negative and statistically significant, suggesting that the conflict significantly reduces natural gas supply security. Additionally, the absolute value of the estimated coefficient for Treat × Conflict decreases from 0.0747 to 0.055, indicating that demand levels (Demand) act as a mediator in the effect of the Russia-Ukraine conflict on reducing natural gas supply security.

Table 4. the mediation effect test of demand changes on natural gas supply security.

Variables	Dsafe (1)	Demand (2)	Dsafe (3)
Treat × conflict	-0.0747***	0.029	-0.055***
	(0.0183)	(0.0204)	(0.0121)
Demand			-0.672***
			(0.028)
Const	0.304	2.574***	2.035***
	(0.350)	(0.392)	(0.242)
Control variables	Yes	Yes	Yes
Region	Yes	Yes	Yes
Time	Yes	Yes	Yes
Observes	448	448	448
R^2	0.6512	0.3985	0.6512

The results in Table 5 further suggest that the transmission mechanism of "Russia-Ukraine conflict – price changes – supply security" does not hold. Column (2) shows that the Russia-Ukraine conflict significantly increased natural gas prices, as indicated by the positive coefficient for Price. However, in Column (3), the mediator variable Price is positive but not statistically significant, implying that price changes do not mediate the effect of the Russia-

Ukraine conflict on natural gas supply security. Additionally, the coefficient for Treat × Conflict increases slightly from 0.051 to 0.055, suggesting that natural gas prices do not play a significant mediating role in the reduction of supply security due to the conflict.

Table 5. The mediation effect test of price changes on natural gas supply security.

Variables	Dsafe (1)	Price (2)	Dsafe (3)
Treat × conflict	-0.051***	13.29***	-0.055***
	(0.0107)	(1.17)	(0.0121)
Price			0.0003
			(0.0004)
Const	2.032***	8.049***	2.035***
	(0.242)	(0.527)	(0.242)
Control variables	Yes	Yes	Yes
Region	Yes	Yes	Yes
Time	Yes	Yes	Yes
Observes	448	448	448
R^2	0.6516	0.6773	0.6512

4.4. The impact of Russian-Ukrainian conflict on security of natural gas supply in different region

To further assess the different impact of the Russia-Ukraine conflict on natural gas supply security, we estimate model (1) in counterfactual scenario in which the Russia- Ukraine conflict did not occur. To construct this counterfactual scenario, we remove all months relating to the Russia-Ukraine conflict events (RUCE) for natural gas price change. After removing these extreme months, we perform regressions for the model (9).

Table 6. The impact of the Russia-Ukraine conflict on natural gas supply security in different sample.

	Degree ofnatural gas supply security				
	(1) adjacent conflict zone	(2) Non-adjacent conflict areas	(3) RUCE sample	(4) Removing RUCE	(5) Entire sample
Treat× conflict	-0.0512*** (0.0086)	-0.0723*** (0.0255)	-0.044*** (0.0139)	-0.054*** (0.0148)	-0.051*** (0.0108)
Const	1.417*** (0.192)	3.602*** (0.594)	2.196*** (0.343)	1.975*** (0.321)	2.032*** (0.242)
Control variables	Yes	Yes	Yes	Yes	Yes
Region	Yes	Yes	Yes	Yes	Yes
Time	Yes	Yes	Yes	Yes	Yes
Obs	192	256	147	301	448
R^2	0.9238	0.7935	0.6648	0.643	0.6516

Table 6 presents the results for different samples, revealing that the impact of the Russia-Ukraine conflict on natural gas supply security is consistently and significantly negative across all samples, including the conflict period, the period excluding the conflict, and the full sample period. The regional differences in impact are minimal, with the absolute value of the coefficients for regions near the conflict and those farther away differing by only 2.1%. This suggests that in a highly globalized world, conflicts in one region can exert similar effects on natural gas supply security on a global scale.

4.5. The impact of other conflicts on security of natural gas supply

Whether different geopolitical conflicts have varying impacts on natural gas supply security remains to be further proven. This paper selects the Red Sea Crisis (the international crisis triggered by the Houthi armed forces' attack on passing merchant ships in the Red Sea on October 18, 2023) and the Gaza Crisis for further analysis on the

impacts of different geopolitical conflicts on natural gas supply security. The analysis results are shown in Table 7.

Table 7. The impact of different geopolitical conflicts on the supply security of natural gas.

	Degree of natural gas supply security		
	The Russia-Ukraine conflict	Gaza Crisis	the Red Sea Crisis
Treat× conflict	-0.055***	-0.364*	-0.053
	(0.0121)	(0.195)	(0.277)
Const	2.035***	1.524***	1.50***
	(0.242)	(0.077)	(0.085)
Control variables	Yes	Yes	Yes
Region	Yes	Yes	Yes
Time	Yes	Yes	Yes
Obs	448	448	448
R^2	0.6512	0.4035	0.3981

As can be seen from Table 7, different geopolitical conflicts have varying impacts on global natural gas supply security. The Gaza Crisis has the most significant negative impact, while the Red Sea Crisis has the weakest and insignificant effect. The Russia-Ukraine conflict has a significant impact, but it is not as great as that of the Gaza Crisis on natural gas supply security. The reason is that the United States, as the world's largest economy, has a significant share in the global production and consumption of natural gas. In 2024, its natural gas production accounted for 25.9% of the world's total, and its consumption accounted for 23.4%. The significant impact of the Gaza Crisis may be closely related to its impact on the United States, whereas the Red Sea Crisis, although it also targets past U.S. vessels, has a lesser impact.

5. Conclusions

Through empirical analysis, we have reached the following conclusions: (1) The Russia-Ukraine conflict has a significant and positive impact on natural gas prices, with substantial effects in regions close to the conflict, such as Russia, the European Union, the United Kingdom, Japan, and South Korea, which heavily depend on natural gas imports. In contrast, countries like China, the United States, and Australia, with lower reliance on natural gas imports—especially the U.S. and Australia—experience relatively smaller price impacts. (2) The conflict also significantly negatively affects natural gas supply security, as indicated by supply security indicators. This impact is uniform across regions, whether close or distant from the conflict, likely due to the global integration of the natural gas supply market. (3) The impact of the Russia-Ukraine conflict on supply security is mediated by changes in supply and demand, which amplify the negative effects. However, changes in natural gas prices do not mediate the impact and do not play an intermediary role in reducing supply security.

Funding Statement

This research received no external funding.

Acknowledgments

Acknowledgments to anonymous referees' comments and editor's effort.

Conflict of interest

All the authors claim that the manuscript is completely original. The authors also declare no conflict of interest.

Author contributions

Conceptualization, Data curation and Formal analysis: Xiaomei Lv; Methodology and Software: Lunwu Liu; Writing original draft: Lunwu Liu; Supervision, validation, review and editing: Min Bai.

References

Bai, M. (2021). Are firm characteristics priced differently between opposite short-sales regimes? *International Finance*, 24(1), 95-118. https://doi.org/10.1111/infi.12378

Bai, M., Bai, F., and Qin, Y. (2022). Emerging economies openness and efficiency. *Managerial and Decision Economics*, 43(3), 659-672. https://doi.org/10.1002/mde.3413

Bai, M., Cai, J., and Qin, Y. (2021). Ownership discrimination and private firms financing in China. *Research in International Business and Finance*, 57, 101406. https://doi.org/10.1016/j.ribaf.2021.101406

Bai, M., and Ho, L. (2022). Corporate social performance and firm debt levels: Impacts of the COVID-19 pandemic and institutional environments. *Finance Research Letters*, 47, 102968. https://doi.org/10.1016/j.frl.2022.102968

Bai, M., and Ho, L. (2023). How do gold and oil react to the COVID-19 pandemic: A review. *Energy & Environment*, 34(7), 2876-2902. https://doi.org/10.1177/0958305X221150143

Bai, M., Ho, L., Lu, Y., and Qin, Y. (2023). Labor protection and dynamic leverage adjustments in the OECD countries. *International Review of Economics and Finance*, 83, 502-527. https://doi.org/10.1016/j.iref.2022.08.015

Bai, M., Li, X.-M., and Qin, Y. (2016). Short-selling constraints and stock-valuation pattern: a regime–event analysis. *Applied Economics*, 48(56), 5462-5484. https://doi.org/10.1080/00036846.2016.1176118

Bai, M., and Qin, Y. (2014). Short-sales constraints and liquidity change: Cross-sectional evidence from the Hong Kong Market. *Pacific-Basin Finance Journal*, 26, 98-122. https://doi.org/10.1016/j.pacfin.2013.12.003

Bai, M., and Qin, Y. (2015). Short sales constraints and price adjustments to earnings announcements: Evidence from the Hong Kong market. *International Review of Financial Analysis*, 42, 304-315. https://doi.org/10.1016/j.irfa.2015.08.002

Bai, M., and Qin, Y. (2015). Commonality in liquidity in emerging markets: Another supply-side explanation. *International Review of Economics & Finance*, 39, 90-106. https://doi.org/10.1016/j.iref.2015.04.006

Bai, M., Qin, Y., and Dasgupta, A. (2022). Does waste disclosure waste? *Business Strategy and the Environment*. https://doi.org/ 10.1002/bse.3166

Bai, M., Qin, Y., and Zhang, H. (2021). Stock price crashes in emerging markets. *International Review of Economics and Finance*, 72(1), 466-482. https://doi.org/10.1016/j.iref.2020.12.015

Bai, M., and Reece, M. (2023). COVID-19 Pandemic and International Energy Performances. *The Journal of Prediction Markets*, 17(2), 83-106. https://doi.org/10.5750/jpm.v17i2.2104

Botão, R. P., de Medeiros Costa, H. K., and Dos Santos, E. M. (2023). Global Gas and LNG markets: demand, supply dynamics, and implications for the future. *Energies*, 16(13), 5223. https://doi.org/10.3390/en16135223

Brown, S. P., and Yücel, M. K. (2008). What drives natural gas prices? *The Energy Journal*, 29(2), 45-60. https://doi.org/10.5547/ISSN0195-6574-EJ-Vol29-No2-3

Cai, W., Bai, M., and Davey, H. (2022). Implementing environmental protection tax in China: An alternative framework. *Pacific Accounting Review*, 34(3), 479-513. https://doi.org/10.1108/PAR-02-2021-0020

Chan, Y. T., Punzi, M. T., and Zhao, H. (2024). Navigating geopolitical crises for energy security: Evaluating optimal subsidy policies via a Markov switching DSGE model. *Journal of Environmental Management*, 349, 119619. https://doi.org/10.1016/j.jenvman.2023.119619

Chiţu, L., Ferrari Minesso, M., and Manu, A. S. (2024). Speculation in oil and gas prices in times of geopolitical risks. Economic Bulletin Boxes, 2.

Gupta, R., and Pierdzioch, C. (2022). Forecasting the realized variance of oil-price returns: a disaggregated analysis of the role of uncertainty and geopolitical risk. *Environmental Science and Pollution Research*, 29(34), 52070-52082. https://doi.org/10.1007/s11356-022-19475-6

Ha, L. T. (2024). A wavelet analysis of dynamic connectedness between geopolitical risk and renewable energy volatility during the COVID-19 pandemic and Ukraine-Russia conflicts. *Environmental Science and Pollution Research*, 31(12), 17994-18009. https://doi.org/10.1007/s11356-023-25288-y

Jiang, H., Qin, Y., and Bai, M. (2020). Short-selling threat and real earnings management – international evidence. *Journal of International Accounting Research*, 19(2), 117-140. https://doi.org/10.2308/jiar-52639

Khan, K., Khurshid, A., and Cifuentes-Faura, J. (2023). Energy security analysis in a geopolitically volatile world: A causal study. *Resources Policy*, 83, 103673. https://doi.org/10.1016/j.resourpol.2023.103673

Kong, L. L., Bai, M., and Wang, P. (2015). Is disposition related to momentum in Chinese market? *Managerial Finance*, 41(6), 600-614. https://doi.org/10.1108/MF-08-2014-0222

Lee, C. C., Yuan, Z., He, Z. W., and Xiao, F. (2024). Do geopolitical risks always harm energy security? Their non-linear effects and mechanism. *Energy Economics*, 129, 107245. https://doi.org/10.1016/j.eneco.2023.107245

Nick, S., and Thoenes, S. (2014). What drives natural gas prices?—A structural VAR approach. *Energy Economics*, 45, 517-527. https://doi.org/10.1016/j.eneco.2014.08.008

Qin, Y., and Bai, M. (2014). Foreign Ownership Restriction and Momentum - Evidence from Emerging Markets. *International Review of Finance*, 14(2), 237-261. https://doi.org/10.1111/irfi.12026

Qin, Y., Pan, G., and Bai, M. (2020). Improving market timing of time series momentum in the Chinese stock market. *Applied Economics*, 52(43), 4711-4725. https://doi.org/10.1080/00036846.2020.1761534

Qin, Y., Yang, Z., and Bai, M. (2022). Heterogeneous firm-level responses to the US 2018 tariff announcement. *International Journal of Managerial Finance*, 18(1), 94-117. https://doi.org/10.1108/IJMF-05-2021-0248

Scholtens, B., and Yurtsever, C. (2012). Oil price shocks and European industries. *Energy Economics*, 34(4), 1187-1195. https://doi.org/10.1016/j.eneco.2012.05.008

Vivoda, V. (2009). Diversification of oil import sources and energy security: a key strategy or an elusive objective? *Energy Policy*, 37(11), 4615-4623. https://doi.org/10.1016/j.enpol.2009.06.007

Vivoda, V. (2023). Friend-shoring and critical minerals: exploring the role of the minerals security partnership. *Energy Research and Social Science*, 100, 103085. https://doi.org/10.1016/j.erss.2023.103085

Wang, Q., Zhang, C., and Li, R. (2024). Impact of different geopolitical factors on the energy transition: The role of geopolitical threats, geopolitical acts, and geopolitical risks. *Journal of Environmental Management*, 352, 119962. https://doi.org/10.1016/j.jenvman.2023.119962

Xiao, L., Bai, M., Qin, Y., Xiong, L., and Yang, L. (2021). Financial slack and inefficient investment decisions in China. *Managerial and Decision Economics*, 42(4), 920-941. https://doi.org/10.1002/mde.3285

Xiong, L., Xiao, L., Bai, M., Qin, Y., and Yang, L. (2023). The religion effect on corporate cash holding in China: Buddhism and Taoism. *International Journal of Finance and Economics*, 28(4), 4420-4457. https://doi.org/10.1002/ijfe.2639

Yousfi, M., and Bouzgarrou, H. (2024). Geopolitical risk, economic policy uncertainty, and dynamic connectedness between clean energy, conventional energy, and food markets. *Environmental Science and Pollution Research*, 31(3), 4925-4945. https://doi.org/10.1007/s11356-023-31492-7

Zhang, B., Liu, Z., Wang, Z., and Zhang, S. (2023). The impact of geopolitical risk on energy security: Evidence from a GMM panel VAR approach. *Resources Policy*, 86, 104222. https://doi.org/10.1016/j.resourpol.2023.104222

Zhou, D., Bai, M., Liang, X., and Qin, Y. (2021). The Early-life Political Event Experience of the Chair of the Board and the Firm's Innovation Decision. *Australian Accounting Review*, 31(3), 186-212. https://doi.org/10.1111/auar.12345

Zhou, D., Zhou, H., Bai, M., and Qin, Y. (2022). The COVID-19 outbreak and corporate cash-holding levels: Evidence from China. *Frontiers in Psychology*, 13, 942210. https://doi.org/10.3389/fpsyg.2022.942210