The Impact of LNG Shipping Cost Fluctuations on China's Economy under Geopolitics

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Abstract. Geopolitical risks are reshaping global LNG shipping costs by disrupting energy supply and transit routes, posing significant challenges to China's economy, which heavily relies on LNG imports. This study develops a unified quantitative framework linking geopolitical risks, LNG shipping costs, and macroeconomic impacts. By incorporating supply-side shocks and transit-route disruptions into a CGE model, the study evaluates how fluctuations in LNG shipping costs affect China's macroeconomic performance and LNG import volumes under multiple scenarios. The results yield two main findings. First, Iran's entry into the global LNG market generates only limited positive effects on China's economy. By 2030, China's real GDP increases by only 0.026%. However, when transportation through both the Strait of Hormuz and the Indonesian straits is disrupted simultaneously, China's real GDP declines by 0.812%, indicating that the negative effects of transport disruptions outweigh the benefits of expanded supply. Second, global LNG trade patterns shift significantly. Iran gains the largest economic benefits, while traditional exporters such as Australia experience economic contraction. The United States and Russia, benefiting from geographic advantages, achieve positive economic growth under most maritime chokepoint disruption scenarios.

Keywords: LNG shipping costs; geopolitical risk; GTAP model; international trade; energy security.

1 Introduction

Liquefied Natural Gas (LNG), as a relatively clean and efficient fossil fuel, plays an important role in the global energy transition. China, one of the world's largest energy consumers, has become increasingly dependent on LNG imports and is now the largest LNG importer globally. In recent years, geopolitical tensions have emerged as a key driver of LNG shipping costs. For instance, the Russia–Ukraine conflict has reshaped global natural gas trade patterns, prompting major importers to shift toward LNG supplies from the United States and the Middle East to reduce reliance on Russian pipeline gas. This adjustment in trade flows has increased LNG shipping costs by lengthening shipping distances, tightening regional shipping capacity, and reconfiguring maritime logistics networks. Consequently, LNG shipping cost fluctuations are

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influenced not only by market supply and demand but also by complex geopolitical dynamics. Such uncertainty poses risks to global energy security and macroeconomic stability. Therefore, assessing the economic impacts of LNG shipping cost fluctuations under geopolitical tensions is essential for understanding their transmission mechanisms and informing effective policy responses.

Existing studies suggest that geopolitical factors influence energy transportation costs through both supply-side and transport corridor channels. On the supply side, diversification of energy sources can enhance market resilience by reducing risks associated with concentrated supply. After the outbreak of the Russia–Ukraine conflict, EU sanctions on Russian energy sharply reduced gas supply, driving European prices above €300/MWh and exposing the vulnerability of heavy dependence on a single supplier [1]. On the corridor side, the security of key maritime routes directly affects the stability and cost of energy transportation. Michail N.A. et al. [2] analyzed six major global maritime natural gas trade routes and found that sudden increases in geopolitical risk significantly raise LNG carrier spot charter rates, with an estimated impact of about 25%. Geopolitical shocks to transportation costs also generate broader economic consequences. Rising costs increase end-user energy prices and transmit to other consumer goods, thereby reducing household welfare. Kremer et al. [3] show that in EU-27 countries highly dependent on Russian gas, the share of household energy expenditure increased by an average of 4.2% after the Russia–Ukraine conflict, with the burden on low-income households rising 2.3 times more than that on high-income groups. Energy transportation cost fluctuations reduce firm productivity and related industrial output. Dang et al. [4] find that the geopolitical–energy uncertainty index significantly lowers firms' total factor productivity, particularly for energy-intensive and small firms. In addition, Iheonu et al. [5], based on a study of 39 countries in Sub-Saharan Africa, find that energy price volatility significantly suppresses manufacturing and industrial growth, with countries at lower levels of industrialization experiencing more severe adverse effects.

Overall, geopolitical tensions affect energy transportation costs through supply and corridor channels and generate macroeconomic impacts through price transmission and supply–demand adjustments. To extend the existing literature, this study makes three contributions. First, it clarifies the transmission mechanisms through which geopolitical factors influence LNG maritime transportation costs. Second, supply-side and corridor-side shocks are represented by changes in LNG trade volumes and freight rates and incorporated into a computable general equilibrium (CGE) model to simulate their macroeconomic effects. Third, the LNG sector is separated from the natural gas sector to construct a global multi-region input–output database with an independent LNG sector, addressing the aggregation limitations of conventional CGE models.

2 Method

2.1 Empirical Model

The Global Trade Analysis Project (GTAP) model is a widely used multi-region, multi-sector CGE model for analyzing international trade and policy issues. Based on the GTAP framework and considering the characteristics of the shipping industry, this study develops a model to examine the impacts of LNG maritime transportation cost fluctuations on international trade and economic performance. Specifically, the model characterizes the relationship between shipping technological progress $ams_{e,i}$ and unit transportation costs $UTC_{e,i}'$, while accounting for the interaction with transport volume $Q_{e,i}$. Following the principle of economies of scale, unit transportation costs are assumed to follow a power-function relationship with transport volume:

$$UTC_{e,i}' = UTC_{e,i} \cdot Q_{e,i}^{\beta-1} \cdot (1 - \alpha \cdot ams_{e,i}) \tag{1}$$

where $UTC_{e,i}$ denotes the baseline unit transportation cost, β is the scale effect parameter, and α measures the impact of technological progress on transportation costs.

To capture the structure of the global LNG trade network and its rebalancing mechanisms under policy shocks and geopolitical changes, this study reaggregates the regional classification in the GTAP 11 database. The regional aggregation follows the principle of prioritizing key trade nodes, highlighting major LNG suppliers and consumers as well as the concentration of China's import sources. On the supply side (Fig. 1(a)), Qatar, the United States, Australia, Russia, Malaysia, and Indonesia constitute the main sources of China's LNG imports. On the demand side (Fig. 1(b)), China, Japan, South Korea, India, and the European Union represent the largest LNG consumption and import markets globally, accounting for approximately 80% of total global LNG imports. Based on these trade structure characteristics, the regions in the GTAP 11 database are aggregated into 13 regions: China, Japan, South Korea, India, the European Union, Iran, Qatar, the United States, Australia, Russia, Malaysia, Indonesia, and the Rest of the World (ROW).

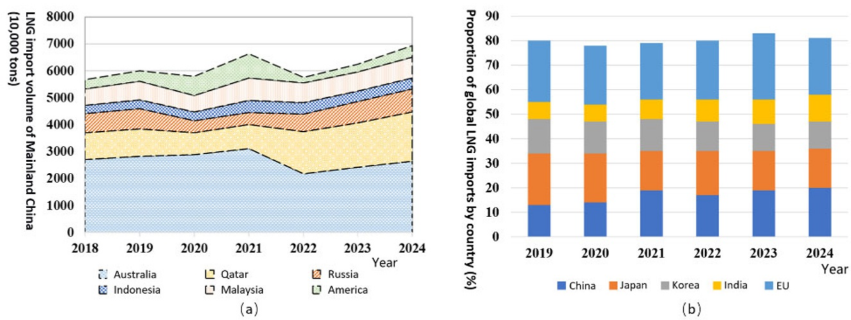

Fig. 1. (a) Major sources of LNG imports to mainland China. (b) Major LNG importing countries worldwide

2.2 Data Processing and Scenario Design

Regarding sectoral classification, this study reaggregates the original 65 sectors in the GTAP database according to their relevance to LNG production, transportation, and consumption, resulting in 11 sectors: the LNG sector, chemical industry, fossil fuel sector, electricity sector, LNG shipping sector, other heavy industry, light industry, agriculture, other transportation sectors, public and construction sector, and services.This sectoral structure centers on the LNG value chain, emphasizing its upstream and downstream linkages. Specifically, the LNG sector represents liquefied natural gas production, while the LNG shipping sector captures the specialized maritime transport involved in LNG international trade. The chemical industry is treated as a key downstream consumer closely linked to LNG demand, whereas the fossil fuel sector includes other energy sources such as coal, oil, and conventional natural gas. The remaining sectors are aggregated according to their indirect roles in related economic activities.

As shown in Table 1, the scenarios capture geopolitical tensions by adjusting key model parameters. The first group assumes changes in the international political landscape leading to the easing or removal of sanctions on Iran. One scenario considers partial sanctions relief, under which Iran's LNG exports remain constrained, while another assumes complete sanctions removal, allowing Iran to become a major participant in the global LNG market. The second group assumes geopolitical restrictions on key maritime nodes along LNG shipping routes, increasing transportation costs. The Strait of Hormuz and the Indonesian deep-water straits are selected due to their importance for China's LNG imports and global shipping routes. The Strait of Hormuz serves as the main export corridor for Middle Eastern LNG, while the Indonesian straits connect major Asia-Pacific exporters—such as Australia, Indonesia, and Malaysia—with East Asian markets. Restrictions on these routes would lengthen shipping distances, reduce fleet efficiency, and raise LNG landed costs in East Asia. In a high-intensity scenario, simultaneous disruptions in both straits would place substantial pressure on the global LNG maritime transport system.

Table 1. Case Scenario Description

Scenario	Scenario classification
(1) LNG embargoes of varying degrees on imports from a specific country	S1: Partial sanctions relief on Iran with limited export capacity
	S2: Full sanctions removal on Iran with unrestricted LNG exports
(2) Restrictions on key maritime transport nodes	S3: Heightened geopolitical tensions in the Strait of Hormuz
	S4: Security risks in the Indonesian straits
	S5: Concurrent risks in the Strait of Hormuz and the Indonesian deep-water straits

3 Result

3.1 Impacts on Real GDP across Regions

Table 2 reports the impacts of LNG shipping cost fluctuations on regional real GDP. The gradual recovery of Iran's LNG exports is reshaping the global LNG market and influencing the economic performance of both exporters and importers. Under Scenario S1, although Iran's export capacity remains limited, increased market competition places pressure on traditional exporters. Under Scenario S2, intensified competition further amplifies these effects. GDP declines in the United States and Australia expand to 0.110% and 0.136%, respectively. In contrast, importing economies experience modest gains, with Mainland China's GDP rising to 0.026% and Japan's to 0.037%. Iran benefits the most, with GDP increasing by 0.821% in S2, highlighting the strong economic stimulus generated by LNG export expansion. Under scenarios involving restrictions at key maritime nodes (S3–S5), major LNG-importing countries experience significant GDP losses, with impacts intensifying as disruptions affect more critical routes. Mainland China, the world's largest LNG importer, experiences the most pronounced economic effects across all scenarios, reflecting its strong dependence on key Asia-Pacific shipping corridors, particularly the Indonesian straits. When risks shift to the Indonesian straits (S4), which lie closer to China's main import routes, China's GDP decline expands sharply to 0.589%, highlighting the vulnerability of its energy import supply chain. Under the most severe scenario (S5), where both major routes are disrupted, the GDP decline further increases to 0.812%, indicating that compounded disruptions at multiple maritime nodes could seriously threaten China's energy security and economic stability.

Table 2. Case Scenario Description

Region	S1	S2	S3	S4	S5
	2030	2030	2030	2030	2030
Mainland China	0.014	0.026	-0.188	-0.589	-0.812
Japan	0.026	0.037	-0.145	-0.291	-0.284
South Korea	0.020	0.029	-0.183	-0.115	-0.141
India	0.024	0.038	-0.168	-0.061	-0.091
EuropeanUnion	0.017	0.029	-0.156	-0.016	-0.023
Iran	0.301	0.821	-0.010	0.015	-0.042
Qatar	-0.006	-0.056	-1.096	0.269	-0.065
United States	-0.092	-0.110	0.181	0.214	0.325
Australia	-0.078	-0.136	0.059	-0.089	-0.012
Russia	0.006	0.012	0.009	0.114	0.221
Malaysia	-0.015	-0.018	0.026	-0.094	-0.098
Indonesia	-0.009	-0.015	0.049	-0.084	-0.086
Rest of the World (ROW)	0.009	0.025	-0.023	-0.012	-0.037

3.2 China's LNG Imports by Source Country

China's LNG imports from major source countries vary significantly across scenarios. Under S1 and S2, the introduction of Iran as a new supplier leads to a systematic adjustment in China's LNG import structure, with additional supply substituting for existing sources. As shown in Fig. 2, imports from most traditional suppliers decline, with the United States experiencing the largest drop, falling 3.58% below the baseline in S2. In contrast, imports from Iran increase substantially in both scenarios, indicating that expanded supply and cost advantages shift demand toward lower-cost sources. Under S3–S5, China's LNG import structure becomes increasingly differentiated as geopolitical shocks intensify. The United States and Russia gradually become more prominent suppliers. U.S. imports rise from 2.12% in S3 to 7.58% in S5, reflecting its supply flexibility and market-based export mechanism. In contrast, traditional suppliers such as Qatar, Australia, and several Southeast Asian exporters lose market share. Although Qatar shows a temporary increase in S4, its exports decline again in S5, suggesting that stronger shocks constrain its role in China's LNG import structure.

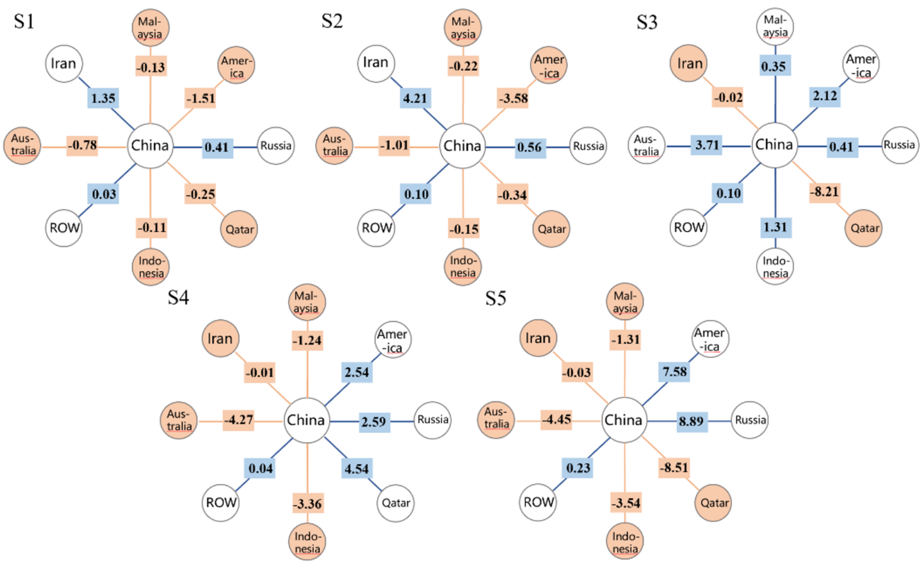

Fig. 2. Changes in China's LNG Imports from Major Source Countries under Different Scenarios (%, relative to the baseline)

4 Conclusion

This study examines the macroeconomic impacts of LNG shipping cost fluctuations under different geopolitical tensions. By incorporating scenarios involving varying degrees of LNG embargoes from specific exporting countries and disruptions at critical maritime transport nodes, the analysis evaluates how geopolitical shocks reshape the global LNG trade structure and influence China's economic performance. The results indicate that changes in LNG supply conditions significantly affect the global LNG market and regional economic outcomes. The easing of sanctions on major exporters, such as Iran, intensifies market competition and reshapes China's LNG import structure, benefiting importing economies while exerting pressure on traditional exporters. In contrast, geopolitical disruptions to key maritime corridors, particularly the Strait of Hormuz and the Indonesian straits, substantially increase transportation costs and negatively affect the economic performance of LNG-importing countries. Among all regions, China experiences the most pronounced economic impacts due to its high dependence on seaborne LNG imports and critical Asia–Pacific shipping routes. These findings highlight the importance of diversifying LNG supply sources and strengthening the security of key maritime transport corridors in order to enhance the resilience of China's energy supply chain and safeguard national energy security.

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Disclosure of Interests

The authors have no competing interests to declare that are relevant to the content of this article.

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