

Global tanker shipping market under geopolitical shifts: current situation, transmission mechanisms and development trends

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Abstract

Purpose – Against the backdrop of eastward shift of global refining capacity, tightening environmental regulations and shipping cyclical fluctuations, geopolitical conflicts have become the key exogenous shock reshaping tanker shipping market fundamentals. This paper aims to reveal the inner transmission logic of geopolitical shocks on global tanker market, identify long-run structural market trends, and propose adaptive strategic principles for industrial stakeholders.

Design/methodology/approach – Based on systems theory and maritime economics, this paper constructs an Situation-Mechanism-Trend (SMT) analytical framework for geopolitical shocks. A mixed-method approach is adopted, including systematic literature coding, event-driven comparative case analysis and descriptive statistical verification using datasets from Clarkson, IEA and Baltic Exchange.

Findings – Five parallel and mutually reinforcing transmission mechanisms of geopolitical shocks are identified: the trade restructuring effect, shipping lane disruption effect, operating cost escalation effect, geopolitical policy compliance constraint effect, and market expectation volatility effect. Six major structural market trends are verified: regionalized trade patterns, long-distance-oriented shipping routes, structurally differentiated tanker capacity, high-volatility freight pricing, green-oriented fleet upgrading, and digitalized shipping operations. The core contradiction of the tanker industry has transformed from aggregate supply-demand imbalance to structural matching and security risks. Six targeted strategic principles are put forward accordingly.

Practical implications – This study integrates scattered geopolitical shock paths into a unified analytical framework, and provides systematic decision-making references for energy traders, shipping enterprises and regulatory authorities.

Originality/value – This study integrates scattered geopolitical shock paths into a unified SMT analytical framework. It clarifies the interaction among multiple transmission mechanisms of geopolitical shocks, and provides systematic decision-making references for energy traders, shipping enterprises and regulatory authorities.

Keywords Geopolitics, Tanker shipping, Capacity development, Shipping cycles, SMT analytical framework

Paper type Research article

1. Introduction

1.1 Research background

The shipping industry is widely recognized as a typical cyclical sector with regular fluctuations. Market cycles are mainly driven by fundamental factors including global economic growth, trade demand and supply-demand balance of shipping capacity, presenting clear alternating booms and recessions that can be rationally predicted based on long-term supply and demand dynamics. As the lifeblood of modern industry, crude oil relies on tanker shipping as the “artery” of global energy supply chains. The operation of tanker shipping directly reflects world economic vitality and energy security, playing an increasingly prominent role in international trade.

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Under the traditional analytical paradigm, freight rates and capacity strategies are basically explained by aggregate supply and demand fundamentals. However, since 2022, the explanatory power of traditional cyclical models has declined significantly: market volatility has far exceeded the range defined by historical cycles, and short-term freight fluctuations are no longer fully matched by changes in nominal capacity and total trade volume. The world is now undergoing an in-depth period of profound changes unseen in a century, accompanied by rising deglobalization and normalized, complicated and long-lasting global geopolitical conflicts. Spillover effects from the prolonged Eastern European military conflict, persistent disruptions to shipping routes in the Red Sea in the Middle East, and fragmentation and restructuring of global energy supply chains have reshaped the underlying logic of the global tanker shipping market. Forced route diversions, extended shipping distances and reduced fleet turnover efficiency demonstrate that geopolitical shocks have become the dominant exogenous driver that reshapes market supply-demand fundamentals, freight pricing mechanisms and capacity allocation. Rather than replacing traditional market fundamentals, geopolitical shocks exert market influences by altering tonne-mile demand, effective fleet capacity and voyage-related cost conditions. Under such circumstances, it has become an urgent practical issue for shipping companies, energy traders and industrial regulators to clarify the logical impacts of geopolitical shifts on the tanker shipping market, accurately predict market trends and formulate scientific capacity development paths.

1.2 Literature review and research gaps

1.2.1 Traditional shipping cycle and market determinants research. Classical maritime economics represented by Maritime Economics (Stopford, 2021) establishes a core analytical framework centered on supply-demand equilibrium, arguing that market cycles are driven by trade demand, fleet capacity, operating costs and other fundamental factors. Traditional models built on cost minimization and efficiency optimization perform well in stable market environments, and provide a foundational theoretical system for shipping market forecasting and capacity strategy formulation.

1.2.2 Geopolitical risks and tanker market impact studies. Research on the nexus between geopolitical risks and the tanker shipping market has expanded rapidly in recent years, forming three mature research streams: volatility spillover effect measurement, event-driven market impact assessment, and trade network restructuring analysis.

In overseas research, foundational measurement studies first established a standardized quantitative paradigm for geopolitical risk assessment. Caldara and Iacoviello (2022) constructed the widely adopted Geopolitical Risk Index (GPR), which provides a unified quantitative basis for empirical research on geopolitical shocks in the maritime shipping sector. Building on this index, Zhang *et al.* (2024) employed a nonlinear autoregressive distributed lag (NARDL) model to verify the asymmetric spillover effect of geopolitical risks on global tanker freight rates, confirming that upward geopolitical shocks exert a far more pronounced impact on freight volatility than downward risk mitigation events.

Industry institutions have maintained long-term systematic tracking of market performance under geopolitical disruptions. Clarkson Research and the Baltic Exchange have continuously monitored route restructuring and capacity utilization changes since the outbreak of the Russia-Ukraine conflict and the Red Sea crisis, verifying that geopolitical conflicts drive sustained freight growth on long-haul routes through trade flow diversion and effective capacity contraction. The International Energy Agency (International Energy Agency, 2025) further noted in its annual report that tiered energy sanctions have reshaped the global refined oil trade landscape, with the Asia-Pacific region replacing Europe as the largest incremental market for seaborne oil trade.

For single-event mechanism research, Notteboom *et al.* (2023) took the Russia-Ukraine conflict as a case to analyze the reconstruction of the European energy shipping network,

finding that large-scale trade diversion has led to a lasting mismatch between tanker capacity structure and route demand structure. [Hastings et al. \(2024\)](#) explored the formation mechanism of the shadow tanker fleet under energy sanctions, arguing that the expansion of unregulated shadow fleets has created a dual-track structure in the global tanker market, widening the freight gap between compliant and non-compliant vessel fleets. [Shibasaki et al. \(2021\)](#) used a global maritime transport simulation model to quantify the capacity gap and freight escalation caused by potential blockages of key chokepoints including the Strait of Hormuz and the Strait of Malacca, providing a quantitative analytical framework for shipping lane disruption effect assessment.

Domestic studies have mainly expanded along three dimensions: volatility transmission, network resilience, and strategic response. In terms of volatility spillover research, [Chi et al. \(2025\)](#) verified the two-way volatility spillover effect between geopolitical conflict risks, the crude oil market and the shipping market through a time-varying spillover model, and confirmed that the tanker shipping market is a net recipient of geopolitical risk shocks. [Li et al. \(2025\)](#) further distinguished the heterogeneous impacts of military conflicts, trade sanctions and policy risks on crude tanker freight indices, finding that military conflict risks have the strongest and most persistent impact on freight volatility.

In terms of trade network and shipping channel resilience research, [Qiu and Zhu \(2025\)](#) constructed a global crude oil maritime transport network model to evaluate overall network resilience under shipping channel blockages, and identified core alternative routes under different risk scenarios. [Liu et al. \(2023\)](#) introduced complex network theory to analyze the evolutionary characteristics of the global tanker trade network under frequent geopolitical shocks, finding that the network presents an obvious trend of regional clustering while overall inter-regional connectivity continues to decline.

In terms of countermeasures and fleet strategy research, [Wang \(2024\)](#) sorted out the restructuring logic of the global shipping pattern under the Red Sea crisis, and proposed targeted response paths for Chinese shipping enterprises from the dimensions of route adjustment and risk prevention and control. [Wang and Lin \(2024\)](#) deeply analyzed the tanker capacity restructuring effect and freight premium formation mechanism amid the Red Sea crisis, and calculated the risk premium level of key long-haul routes. [Liu and Sun \(2022\)](#) discussed the evolution law of the global refined oil trade pattern, and put forward structural optimization strategies for tanker fleets of shipping enterprises under the background of trade restructuring. [Chen and Zhao \(2024\)](#) further constructed a fleet structure optimization model under geopolitical uncertainty, and verified that differentiated capacity allocation by region and route can significantly improve the risk resistance and operational stability of shipping enterprises.

Overall, existing studies have verified multiple individual impact paths of geopolitical risks from different perspectives, laying a solid theoretical and empirical foundation for exploring the correlation between geopolitical risks and the tanker shipping market. However, most studies focus on single events or isolated transmission channels, and there are still prominent deficiencies in systematic full-chain framework construction and multi-mechanism integrated analysis, which are detailed in the research gaps section below.

1.2.3 Research gaps. Three core research gaps are identified through literature combing:

Framework gap: Existing studies rarely construct a systematic full-chain analytical framework that integrates geopolitical situation, transmission mechanisms and long-term market evolution, failing to fully explain the structural changes in the tanker market under continuous multi-point geopolitical shocks.

Mechanism gap: While partial studies have verified the short-term impact of geopolitical conflicts on freight rates, there is insufficient systematic sorting of multi-path transmission mechanisms between geopolitical shocks and market structural changes. The logical hierarchy, interaction relationships and internal logical chain of each transmission path remain unclear.

Strategy gap: Most existing capacity strategy studies are based on traditional cyclical logic, and there is a lack of targeted strategic systems for the new market environment dominated by geopolitical uncertainty.

1.3 Research questions and propositions

1.3.1 Research questions

- RQ1. Through what core transmission mechanisms do geopolitical shocks act on the global tanker shipping market, and what is the internal logic and interaction relationship of each mechanism?
- RQ2. What long-term structural trends has the global tanker shipping market presented under the continuous impact of multi-point geopolitical shocks, and what empirical evidence supports these trends?
- RQ3. What targeted strategic adjustments should industry stakeholders make to adapt to the geopolitics-driven new market pattern?

1.3.2 Core research propositions

- P1. Geopolitical shocks do not directly affect the tanker market, but act on supply and demand fundamentals through five parallel and mutually reinforcing transmission mechanisms.
- P2. Sustained geopolitical shocks drive structural rather than cyclical changes in the global tanker market, which are reflected in trade patterns, route networks, capacity structure and pricing mechanisms.
- P3. Traditional counter-cyclical capacity expansion strategies are no longer fully applicable under high geopolitical uncertainty, and structured dynamic deployment based on scenario analysis can effectively improve the risk resilience of shipping enterprises.

1.4 Paper structure

The remainder of this paper is organized as follows. [Section 2](#) elaborates the theoretical foundations and the SMT analytical framework, as well as the research methodology. [Section 3](#) sorts out core geopolitical events and analyzes the five transmission mechanisms. [Section 4](#) conducts empirical verification of six major market trends under geopolitical restructuring. [Section 5](#) proposes targeted strategic countermeasures combined with the SMT framework. [Section 6](#) summarizes research limitations and future research directions.

2. Theoretical foundations and SMT analytical framework

2.1 Definition of core concepts

2.1.1 Geopolitical shocks. This paper defines geopolitical shocks as exogenous disturbances to cross-border trade and shipping operations caused by interstate conflicts, geopolitical games, targeted sanctions and geopolitics-driven trade barriers, which are divided into two categories:

Physical security shocks: Events that directly affect navigation safety, including armed attacks on merchant ships, shipping lane blockages, and regional military conflicts (e.g. Red Sea vessel attacks, Black Sea shipping security crisis). Such shocks mainly affect the operation efficiency and safety cost of shipping in the short term.

Institutional geopolitical shocks: Policy barriers with explicit geopolitical attributes, including cross-border energy sanctions, trade embargoes, and carbon border adjustment mechanisms tied to geopolitical blocs (e.g. Western energy sanctions against Russia, the EU

Carbon Border Adjustment Mechanism). Such shocks mainly reshape long-term trade patterns and market access rules.

Globally applicable general environmental regulations (e.g. IMO EEXI/CII rules) are not categorized as geopolitical shocks, but are regarded as synergistic regulatory factors that interact with geopolitical shocks to jointly shape market trends.

2.2 Theoretical underpinnings

The SMT analytical framework of this paper is built on three interrelated theories, which correspond to the three logical layers of external shock, internal transmission and market evolution respectively.

2.2.1 System disturbance theory. From the perspective of system theory, the global tanker shipping market is a complex open system. Geopolitical shocks are non-market external disturbances that break the original equilibrium of the system, corresponding to the “Situation (S)” layer of the framework. Such disturbances are transmitted to the interior of the system through multiple intermediate paths, triggering structural adjustments of the system rather than simple short-term cyclical fluctuations.

2.2.2 Maritime supply-demand equilibrium theory. Traditional maritime economics focuses on supply-demand equilibrium determined by trade demand and nominal capacity supply, which constitutes the core logic of the “Mechanism (M)” layer. Under geopolitical shocks, trade flow structure and effective capacity supply (adjusted by navigation efficiency) change simultaneously, leading to structural mismatches between supply and demand on different routes. Notably, changes in tonne-mile demand arising from trade rerouting and extended voyages constitute a key intermediate variable bridging geopolitical events and market equilibrium shifts. The market gradually forms a new structural equilibrium after the impact of shocks.

2.2.3 Risk premium pricing theory. In high-risk navigation scenarios, shipping operators require additional risk compensation for security investment, insurance premiums and opportunity costs of extended voyages, forming a freight risk premium, which corresponds to the “Trend (T)” layer of market performance. The persistence of geopolitical risks makes the risk premium a long-term structural component embedded within freight pricing, rather than a standalone factor that replaces fundamental price formation rules. It ultimately affects the equilibrium price level by changing the supply cost curve of shipping services.

2.3 SMT analytical framework and research methodology

2.3.1 Composition and logical chain of the SMT framework. The SMT framework constructs a complete logical chain of “external shock — internal transmission — system evolution”, corresponding to three progressive analytical layers. [Figure 1](#) illustrates the complete logical chain of the SMT analytical framework covering Situation-Mechanism-Trend.

Situation (S): The exogenous geopolitical shock variable, which is the initial driving force of market changes, including core geopolitical events such as regional conflicts, sanctions games and bloc fragmentation.

Mechanism (M): The intermediate transmission variable, which is the specific path through which geopolitical shocks act on the tanker market. The five identified mechanisms connect the external situation with internal market changes, and act as the core logical link of the framework.

Trend (T): The endogenous evolution result of the market system, which is the long-term structural trend formed by the continuous action of transmission mechanisms, and also the final performance of market system adjustment.

The three layers are logically connected and progressive layer by layer, realizing a systematic analysis from the cause of the shock to the transmission path and then to the development trend.

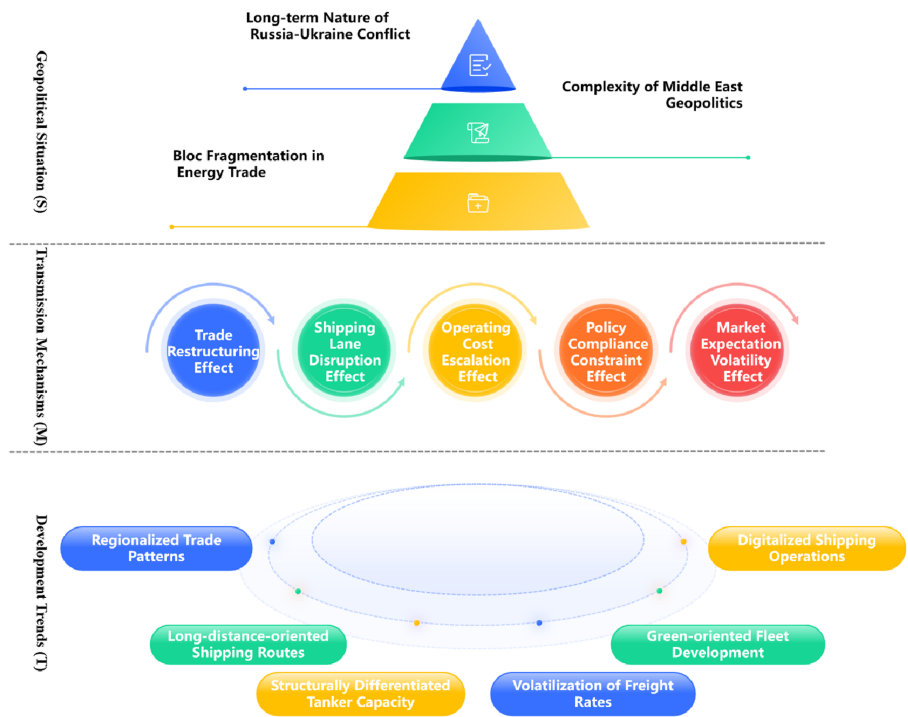


Figure 1. SMT analytical framework of geopolitical shocks

2.3.2 *Research methodology.* This paper adopts a mixed-method research design combining qualitative mechanism analysis and quantitative empirical verification:

2.3.2.1 Systematic literature and industry report coding for transmission mechanism identification. We systematically sorted out 32 peer-reviewed academic papers and 15 authoritative industry reports (Clarkson, IEA, BIMCO, etc.) on geopolitical risks and the tanker market. Drawing on existing literature on risk transmission in maritime economics, we first conducted open coding to extract causal statements linking geopolitical events to market outcomes. Next, axial coding was applied to group scattered causal pathways into conceptual categories, remove overlapping logical paths. The coding process was independently completed by two researchers and cross-validated, with a coding consistency rate of over 85%, ensuring the reliability of mechanism identification. Finally, we iteratively cross-validated these categories against real-world geopolitical event records (Russia-Ukraine conflict, Red Sea crisis). After eliminating redundant and non-market interference factors, five mutually non-exclusive, parallel transmission mechanisms were finalized.

It should be noted that the proposed five-mechanism framework builds upon prior risk-transmission scholarship in shipping economics; our contribution lies in integrating these dispersed causal pathways into a unified SMT logical chain and clarifying their interactive relationships, rather than inventing entirely new causal categories.

2.3.2.2 Event-driven comparative case analysis. Taking the Russia-Ukraine conflict (February 2022) and the Red Sea crisis (November 2023) as core event nodes, we perform descriptive before-and-after comparisons of trade flows, freight rates and capacity turnover efficiency. This comparative case exercise helps illustrate how each transmission mechanism operates in real-world contexts. We do not implement formal econometric event-study methodology, which would require pre-specified estimation/event windows, abnormal

volatility metrics and statistical significance testing. This distinction is explicitly acknowledged in this paper.

2.3.2.3 Descriptive statistical analysis. Based on Clarkson Research fleet data, Baltic Exchange freight index data, and IEA oil trade data from 2020 to 2025, we conducted statistical verification of market trends such as capacity structure, freight volatility and trade regionalization. We compare indicators across pre-shock (2020–2021) and post-shock (2022–2025) periods to observe structural shifts in the tanker shipping market.

3. Geopolitical situation evolution and transmission mechanisms

3.1 Core geopolitical events driving market shocks

Recent frequent geopolitical incidents have generated multi-layered shocks to the tanker shipping market. Four core events constitute the primary driving forces, and each event triggers different combinations of transmission mechanisms:

3.1.1 *Protracted Russia-Ukraine conflict and energy sanctions.* Breaking out in 2022, the conflict has evolved from initial military confrontation into a long-term energy game. Western sanctions on Russian energy via price caps and shadow fleet regulation have developed into normalized regulatory systems. This event mainly triggers the trade restructuring effect and policy compliance constraint effect, restructuring global crude oil trade patterns, shrinking transatlantic short-haul shipping volumes and boosting long-haul transpacific trade routes (International Energy Agency, 2025).

3.1.2 *Complex Middle East geopolitics and red sea shipping crisis.* As the core of global energy supply, the Middle East faces severe security tensions. Recurring armed attacks on merchant vessels in the Red Sea and Gulf of Aden have normalized low-intensity, high-frequency shipping risks. This event mainly triggers the shipping lane disruption effect and operating cost escalation effect: tankers are forced to divert around the Cape of Good Hope, while potential blockage risks in the Strait of Hormuz further amplify regional security risks (Wang and Lin, 2024).

3.1.3 *Bloc fragmentation of global energy trade.* Global energy trade has shifted from integrated globalization to regionalized clustering, splitting the unified market into relatively independent regional trading blocs. The U.S.-led energy alliance, the EU's carbon border mechanism, and China's Asia-Pacific energy cooperation under the Belt and Road Initiative have formed two major energy trade circulation systems: the Western bloc led by the U.S. and EU, and the emerging market bloc represented by China and Russia (Chi et al., 2025). This structural change continuously strengthens the trade restructuring effect and compliance constraint effect in the long run.

3.1.4 *Indo-Pacific geopolitical tensions and trade restructuring.* Against the backdrop of U.S.-China trade decoupling and South China Sea security dynamics, Indo-Pacific geopolitical risks have gradually become an important factor affecting tanker trade in the Asia-Pacific region. While the overall trade volume remains stable, the adjustment of trade routes and supply chain layout has increased the demand for medium and large tankers in intra-Asia-Pacific trade, which together with the Middle East situation affects the core Asia-Pacific tanker market.

3.2 Five transmission mechanisms of geopolitical shocks

Geopolitical events do not directly affect freight rates; instead, they reshape market supply-demand balance through five parallel and mutually reinforcing transmission channels. From the perspective of supply-demand equilibrium, the trade restructuring effect mainly changes the demand structure of shipping services, the shipping lane disruption effect mainly changes the effective supply of capacity, the operating cost escalation effect and compliance constraint effect mainly change the supply cost curve and market access threshold, and the market expectation volatility effect mainly affects the rhythm of future capacity supply. The five mechanisms work together to drive the structural evolution of the market.

3.2.1 Trade restructuring effect. Stable regional supply-demand patterns of global refined oil trade have long existed, yet geopolitical conflicts and multilateral energy sanctions break original trade equilibriums, accelerating import substitution and export market relocation across nations. Traditional mature trade links shrink rapidly, leading to capacity surplus on legacy routes, while emerging cross-ocean trade corridors expand and create capacity shortages. Regionalization and fragmentation of energy trade become core drivers of structural market differentiation (Li *et al.*, 2025). From the perspective of supply-demand fundamentals, this mechanism ultimately changes the spatial structure of shipping demand and the total tonne-mile demand, forming the fundamental driver for freight adjustment and capacity reallocation.

3.2.2 Shipping lane disruption effect. Geopolitical conflicts reduce navigational efficiency in high-risk corridors including the Black Sea and Red Sea, forcing widespread vessel diversions and generating an implicit contraction of effective shipping capacity. With a fixed total number of vessels, extended sailing distances prolong voyage cycles and lower turnover efficiency: nominal fleet tonnage remains unchanged, while actual usable capacity declines. This mechanism directly reduces the effective supply of shipping capacity under a given nominal fleet scale, and pushes up the equilibrium freight rate from the supply side. Statistics from Clarkson Research (2025) show that the Red Sea crisis has reduced the effective capacity of global product tankers by approximately 12% as of the first half of 2025.

3.2.3 Operating cost escalation effect. Deteriorating geopolitical conditions comprehensively push up tanker operating costs across security services, war risk insurance premiums, fuel expenses and port compliance, reshaping the industry's cost pricing system.

Taking the Middle East-Northwest Europe crude oil route as an example, after diverting around the Cape of Good Hope, the one-way voyage distance increases by approximately 3,800 nautical miles, and the single-voyage cycle extends by 10–14 days. Fuel costs account for about 60% of the total voyage cost increase, war risk insurance premiums increase by 2–3 times, and additional security service costs rise by about 15%. The comprehensive voyage cost increases by 45%–55% compared with the Suez Canal route (Baltic Exchange, 2025). In line with risk premium pricing theory, these cost differentials are reflected in freight rates as a risk premium component, superimposed on conventional supply-demand driven price formation. In essence, this mechanism pushes up the supply cost curve of shipping services, and forms a new equilibrium price under the joint action of supply and demand.

3.2.4 Geopolitical policy compliance constraint effect. This mechanism only covers policy constraints with explicit geopolitical attributes, including energy sanctions, trade embargoes, and geopolitics-driven carbon barriers (such as the EU CBAM). These policies establish differentiated market access thresholds for different regional blocs, forcing shipping enterprises to adjust fleet deployment and vessel structure to meet fragmented compliance requirements. From the perspective of market fundamentals, this mechanism divides the originally unified shipping market into segmented sub-markets with different access standards, resulting in structural mismatches of capacity between different blocs and widening freight rate differences between compliant and non-compliant vessels.

It is clarified that global universal environmental regulations (such as IMO EEXI and CII rules) are not a transmission mechanism of geopolitical shocks, but a parallel regulatory driver that interacts with geopolitical policies to jointly accelerate the renewal of the global tanker fleet.

3.2.5 Market expectation volatility effect. Normalized, uncertain geopolitical conflicts have overhauled market expectations and investment logic in the shipping sector, altering capacity supply rhythms from the capital side. Historically, tanker capacity expansion followed clear counter-cyclical patterns based on supply-demand cycles. Unclear timelines for de-escalation of conflicts amplify long-term market uncertainty, prompting most shipping firms to adopt conservative investment strategies and exacerbating structural capacity shortages on specific routes (Zhang, 2023). This mechanism affects the future supply elasticity of the market by

changing the decision-making expectations of market participants, and further amplifies the structural imbalance of supply and demand.

4. Empirical analysis of market trends under geopolitical restructuring

Driven by reshaped geopolitical landscapes, transformed energy trade, and synergistic environmental policies, the global tanker shipping market presents six structural trends. Each trend is the result of the combined action of specific transmission mechanisms, which are verified based on industry data as follows:

4.1 Regionalization of trade patterns

Driven by the trade restructuring effect and policy compliance constraint effect, global energy systems and tanker shipping redirect from unrestricted global circulation to clustered, regionally locked trading blocs, with three distinct core trade circles taking shape:

The Europe-America trading bloc centers on U.S. refined oil exports and Middle Eastern crude imports, forming transatlantic long-distance shipping corridors.

The Middle Eastern trading bloc relies on expanded domestic refining capacity to export oil and gas to the Asia-Pacific, Africa and Europe, acting as the world's primary energy export hub.

The Asia-Pacific trading bloc features massive consumption demand and expanded refining capacity, supporting intra-regional circulation and bidirectional cross-ocean trade.

It should be emphasized that the regionalization trend does not mean complete isolation of blocs. Given the fungibility of crude oil and global price arbitrage mechanisms, inter-bloc trade still maintains a certain scale, but the proportion of intra-regional trade continues to rise. As shown in [Table 1](#), from 2020 to 2024, the proportion of intra-Asia-Pacific tanker trade increased from 32% to 38%, while the proportion of short-haul Europe-Russia crude trade decreased by 17% points, confirming the trend of regional clustering. As shown in [Table 1](#), the shifts of tanker trade flows across different regions can be observed quantitatively.

Meanwhile, the Asia-Pacific region has become the core growth pole of the global tanker market. Sustained energy consumption growth in China, India and Southeast Asia maintains the highest intra-regional oil and gas trade activity globally, and expanded refining capacity drives steady growth in refined oil import and export volumes. Compared with volatile Europe and America, the Asia-Pacific region boasts stable economic and trade cooperation and abundant growth potential, and has become a core strategic region for shipping enterprises to deploy capacity.

4.2 Long-distance orientation of shipping route networks

Driven by the shipping lane disruption effect and trade restructuring effect, persistent geopolitical risks normalize hazards on core shipping corridors, driving structural restructuring of global tanker route networks marked by shrinking short-distance trunk lines, expanding cross-ocean routes and universal diversion practices. Legacy short-distance

Table 1. Changes in inter-regional tanker trade volumes

Trade route	2020 volume	2024 volume	Change rate
Russia – Europe (Crude)	128	42	–67.2%
Middle East – Asia Pacific	572	689	+20.5%
US Gulf – Europe (Product)	78	136	+74.4%
Intra-Asia-Pacific	415	573	+38.1%

Source(s): [Baltic Exchange \(2025\)](#); [Clarkson Research \(2025\)](#)

efficient trunk lines including Black Sea–Europe and Red Sea–Mediterranean lanes suffer sustained volume declines, while demand surges on long-haul cross-ocean routes such as Middle East–Asia Pacific, U.S.–Europe and India–Africa.

To avoid the one-sidedness of absolute judgment, this paper sets three scenarios to judge the long-term trend of route distance:

Baseline scenario (Red Sea crisis resolved within 12 months): 30% of vessels return to the Suez Canal route, the global average tanker voyage distance decreases by 6% but remains 9% higher than the pre-crisis level due to persistent trade restructuring.

Protracted conflict scenario (Red Sea risks last for more than 3 years): Route diversions become standard practice, the global average tanker sailing distance remains 18% higher than the pre-crisis level, and the long-distance orientation of shipping networks is solidified.

Extreme risk scenario (Strait of Hormuz partially blocked): Global oil trade is forced to adjust routes on a large scale, and the average voyage distance further increases by 25%.

At present, the market is generally evolving towards the protracted conflict scenario, and the long-distance trend of route networks has become a medium-term high-probability event. The continuous growth of average voyage distance means that tonne-mile demand will maintain a growth trend higher than the growth rate of physical trade volume, which will form a long-term support for effective capacity demand.

4.3 Structural differentiation of tanker capacity

Driven by the trade restructuring effect and shipping lane disruption effect, while total global tanker tonnage expands steadily, internal capacity presents prominent stratification and upgrading, with large-scale, young and low-carbon fleets as the primary development direction:

By total scale: Global total tanker deadweight tonnage exceeded 620 million DWT in 2025, representing a 17.3% increase from 2020 (Clarkson Research, 2025).

By tonnage structure: Large and ultra-large tankers (VLCC, Suezmax) suited for long-distance ocean shipping see surging demand and orderbook growth, while medium and small tankers for short-distance intra-regional trade maintain stable scale with limited incremental space.

By vessel age structure: Aging high-energy-consumption vessels are rapidly phased out, with the share of ships aged above 20 years declining from 18.2% in 2020 to 12.7% in 2025, driving overall fleet rejuvenation.

By power structure: Low-carbon dual-fuel and energy-efficient vessels account for over 75% of outstanding newbuilding orders. According to BIMCO (2025) shipyard delivery forecasts, low-carbon compliant vessels will account for more than 40% of the global tanker fleet by 2030, and the industry will complete a new round of green structural upgrading in an orderly manner during 2026–2030.

The structural differentiation of capacity essentially reflects the mismatch between the original capacity structure and the new demand structure under geopolitical shocks, which is a concrete manifestation of the structural adjustment of supply and demand fundamentals.

4.4 High volatility and differentiation of freight rates

Driven by the operating cost escalation effect, shipping lane disruption effect and market expectation volatility effect, global tanker freight rates have departed from traditional mild cyclical fluctuations and entered a new phase featuring high volatility, strong cross-route differentiation and persistent risk premiums.

It should be clarified that this change does not mean that the supply-demand pricing mechanism has been replaced. Geopolitical risks, extended voyage distances driven by route diversion, and differentiated compliance requirements have become key intermediate determinants reshaping freight formation by altering underlying market fundamentals including tonne-mile demand, effective available capacity and voyage operating costs. The risk premium is essentially a structural component of the equilibrium freight rate under the

new supply-demand conditions, rather than an independent pricing factor beyond the supply-demand framework.

Taking the Baltic Dirty Tanker Index (BDTI) as the sample, we calculated the monthly variance of freight rates in the pre-conflict baseline period (2020–2021) and the geopolitical shock period (2022–2025). The results show that the freight rate variance of the Middle East-Europe geopolitically exposed route has increased by 112% (doubled) compared with the pre-conflict baseline, while the variance of the intra-Asia-Pacific stable route has only increased by 23%, verifying the significant difference in volatility between high-risk and stable routes (Baltic Exchange, 2025).

Long-distance high-risk ocean routes sustain elevated freight rates supported by cost premiums and capacity shortages, while short-distance intra-Asia-Pacific routes display stable rates with narrow premium margins, cementing long-term rate hierarchies across shipping lanes.

4.5 Green-oriented fleet development

Driven by the policy compliance constraint effect and global synergistic environmental regulations, mutual reinforcement between global shipping green regulations and geopolitical carbon barriers transforms green compliance from a competitive advantage into a mandatory market entry threshold.

On the policy side, mandatory IMO rules covering vessel energy efficiency (EEXI) and carbon intensity ratings (CII) impose strict carbon and efficiency constraints across the full vessel lifecycle. On the market side, the EU CBAM and green port surcharges in Europe and North America sharply raise operating costs for high-carbon aging vessels, shrinking their market viability.

Against this backdrop, dual-fuel propulsion, energy-saving retrofits, intelligent efficiency management and low-carbon vessel operations have become industrial standards. Low-carbon compliant ship types dominate newbuilding orders, and energy-saving retrofits for existing tonnage are accelerated industry-wide, pushing the sector into a comprehensive, mandatory low-carbon transition.

4.6 Digitalization of shipping operations

Driven by the demand for refined management under complex geopolitical risks, against the background of complex route adjustment and refined compliance management, digital technology has become a core tool for shipping enterprises to cope with geopolitical risks and improve operational efficiency, and the digital transformation of shipping operations has become an important trend:

Intelligent route optimization: Integrating multi-dimensional data such as real-time geopolitical risk warnings, freight fluctuations, fuel prices and port congestion, algorithmic route planning systems can dynamically adjust navigation routes to balance safety, cost and timeliness.

Digital fleet scheduling: Based on AIS big data and digital twin technology, shipping enterprises can realize global real-time monitoring of fleet status and intelligent capacity allocation, improving turnover efficiency under long-distance routes.

Smart compliance management: Digital systems can automatically identify sanctions lists, track carbon emission data, and complete regional policy compliance inspections, reducing compliance risks under fragmented trade blocs.

Predictive vessel maintenance: Remote monitoring and fault early warning systems reduce the maintenance cost and failure rate of vessels on long-haul voyages, and support refined operation management.

5. Strategic countermeasures and practical implications

Intensified global geopolitical games, energy restructuring and green transition will sustain structural transformation across the tanker shipping sector over the long run. Targeted

countermeasures are proposed corresponding to the five transmission mechanisms and six market trends identified in the SMT framework, forming a closed-loop strategic system from risk response to structural adaptation:

5.1 Safety priority: build a full-cycle geopolitical risk prevention and control system

Corresponding to the shipping lane disruption effect and physical security shocks, establish a full-spectrum risk prevention and control system integrating early warning, risk mitigation, emergency response and compliance management. Build dynamic monitoring mechanisms for geopolitical developments in key sea areas (Red Sea, Black Sea, Strait of Hormuz), set graded risk warning thresholds, and dynamically adjust route plans and deployment strategies according to risk levels. Establish emergency response plans for high-risk sea areas, and reserve alternative route schemes and emergency disposal procedures, so as to enhance the enterprise's emergency disposal capacity and risk resilience.

5.2 Green low-carbon transition: build compliance advantages under dual constraints

Corresponding to the geopolitical policy compliance constraint effect and green fleet development trend, position low-carbon transformation as a core corporate strategy. Prioritize orders for LNG and methanol dual-fuel low-carbon newbuilds, accelerate energy-saving retrofits of existing fleets, optimize low-carbon operational management, and explore carbon accounting, emission reduction and carbon trading, so as to meet the dual compliance requirements of global environmental regulations and regional geopolitical carbon barriers, and build differentiated green shipping competitiveness.

5.3 Structural optimization: adjust fleet composition matching long-distance and regionalization trends

Corresponding to the trade restructuring effect and structural differentiation trend of capacity, optimize fleet composition from three dimensions: tonnage, vessel age and propulsion systems. Appropriately increase the proportion of large tankers suitable for cross-ocean long-haul routes to match the growth of long-distance trade and tonne-mile demand; maintain a reasonable scale of medium and small tankers to meet the demand of intra-Asia-Pacific regional trade; establish standardized mechanisms for phasing out aging vessels to improve the overall compliance and environmental performance of the fleet.

5.4 Scenario-based dynamic capacity deployment: replace traditional cyclical expansion strategies

Corresponding to the market expectation volatility effect and the limitation of traditional cyclical logic, abandon homogeneous extensive capacity expansion and implement scenario-based dynamic capacity deployment. Construct multi-scenario simulation models of geopolitical evolution, dynamically adjust newbuilding order rhythm and capacity layout according to different risk scenarios, and allocate capacity differentially by route and region. On core long-distance trunk lines, leverage scale economies to reduce unit transport costs; on intra-regional short-distance routes, focus on improving route adaptability and turnover efficiency, so as to supplement and optimize the traditional counter-cyclical planning that is no longer fully applicable.

5.5 Digital and intelligent empowerment: improve operational efficiency under complex environments

Corresponding to the digitalization trend of shipping operations, apply digitalization and intelligence to resolve efficiency bottlenecks in traditional fleet operations. Develop intelligent scheduling and route optimization systems integrating multi-dimensional data including geopolitical risks, freight fluctuations, fuel prices and vessel conditions to realize

intelligent capacity allocation, automatic route optimization and precise resource matching. Deploy remote vessel monitoring, fault early warning and intelligent maintenance systems to cut operational costs on long-haul voyages and enable refined shipping management via digital tools.

5.6 In-depth industrial cultivation: build an ecological layout to cope with fragmented trade

Corresponding to the trade restructuring effect and regionalized trade pattern, integrate cross-industry resources and deepen upstream and downstream collaboration with refineries, energy traders and port logistics operators to build industrial ecosystems. Co-develop shared shipping infrastructure and regional trade resources for core trade blocs, strengthen market bargaining power and risk-sharing capacity, and expand stable cooperative customer groups in the Asia-Pacific core market to support long-term stable growth.

6. Limitations and future research

6.1 Research limitations

First, this paper constructs a systematic SMT analytical framework and conducts empirical verification with industry macro data, but does not use micro-level AIS vessel data for more precise econometric testing, and the causal identification of transmission mechanisms can be further strengthened. The mechanism analysis in this paper is mainly based on qualitative combining, and a structured mathematical model has not been constructed to decompose and measure the contribution of each transmission mechanism.

Second, the scenario analysis of route trends is based on the current geopolitical pattern, and the prediction of long-term trends still has certain uncertainties due to the high unpredictability of geopolitical events.

Third, the countermeasures are proposed from the overall industry level, and targeted strategies for different types and scales of shipping enterprises need to be further expanded.

6.2 Future research directions

Future research can use micro AIS trajectory data and panel econometric models to more accurately identify the causal effects of different geopolitical shocks on the tanker market, and quantify the contribution of each transmission mechanism. In addition, research on differentiated capacity strategies for different ship types and enterprise scales under geopolitical uncertainty can be carried out to further enrich the research system of geopolitical shipping economics. Future work may also draw on existing risk-transmission modelling approaches from maritime economics to further formalize and quantify the magnitude of each identified transmission channel.

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