Research on the Impact of Obstruction in International Shipping on the Global Trade Structure and China's Coping Strategies

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Abstract. This paper studies the impact of international shipping disruptions on the global trade structure. It analyzes the causes such as public health emergencies and geopolitical conflicts, and their effects on trade and supply chains. China's situation is emphasized, including its supply chain vulnerability and resilience. Short - and medium-to-long-term strategies are proposed, like diversifying transportation channels, supporting technology - intensive industries, etc., aiming to enhance China's and the global supply chain resilience.

Keywords: International shipping; Global trade; Supply chain; China; Strategies

1 Introduction

1.1 Background and Significance of the Study

The international shipping system is the “artery” of the global economy, which has long been responsible for more than 80% of international trade cargo transportation[1]. It is not only an important material foundation for the integration of the world economy, but also a key support for the normal operation of the modern international division of labor system. However, in recent years, the international shipping system is facing unprecedented systemic risk challenges, which present new features of diversification and compounding.

From the point of view of transportation costs, drastic fluctuations in shipping prices caused by shipping disruptions have become an important factor affecting global trade. Taking the New Crown epidemic as an example, the 40-foot container shipping price on the Asia-Europe route soared from US$2,000 before the epidemic to a historical peak of US$14,000[4]. This extreme price volatility not only directly increased trade costs, but also had a profound impact on the prices of end consumer goods through chain transmission. In terms of time efficiency, delivery delays due to shipping disruptions are also not negligible. Data show that the average delay on major shipping routes during the epidemic reached 2-3 weeks[5], and this increase in time costs had a serious impact on manufacturing firms adopting the just-in-time (JIT) production model.

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As the world's largest manufacturing and trading country, China occupies a particularly important strategic position in the international shipping network. On the one hand, China's port clusters, represented by the above seaport and Ningbo Zhoushan Port, have developed into the world's most important maritime hubs, with annual container throughput accounting for nearly 30% of the global total[6]. On the other hand, China's deep industrial integration into the global value chain makes its supply chain system particularly sensitive to shipping disruptions. Especially in high value-added industries such as electronics and automobiles, the stability of international shipping is directly related to the normal operation of the whole industry chain.

It is noteworthy that China has demonstrated unique institutional advantages and infrastructural resilience in coping with the risk of shipping disruption. The rapid development of the China-Europe liner has provided an important alternative to maritime transportation for Asia-Europe trade, with its volume increasing by more than 50% year-on-year during the epidemic[5]. At the same time, China's well-developed domestic logistics network and strong manufacturing base provide an important buffer against fluctuations in international shipping. This diversified coping capacity is not only important for China's own economic development, but also for maintaining the stability of the global supply chain.

1.2 Research Objectives

This study is committed to building a systematic analytical framework to explore the impact of international shipping disruptions on the global trade structure and its coping strategies. In terms of empirical research, this study will systematically assess the vulnerability and resilience characteristics of China's supply chain system in the face of international shipping disruptions. At the same time, the study will provide an in-depth analysis of the differential characterization of different industrial sectors affected by shipping disruptions, with a special focus on highly time-sensitive industries versus commodity trade.

Based on the above studies, this study ultimately aims to propose a system of targeted policy recommendations. Based on international experience[7] and China's special institutional advantages and industrial characteristics, it will provide actionable policy solutions to enhance supply chain resilience. These recommendations will cover a variety of dimensions such as port infrastructure upgrading, multimodal transport network optimization, digital technology application, and international cooperation mechanism innovation, and aim to form systematic solutions.

2 Causes and Characteristics of International Shipping Obstruction

2.1 Main Driving Factors

The difficulties facing the global shipping industry are diverse and complex, especially in the face of multiple shocks in recent years, shipping uncertainty and vulnerability are

increasing. Public health emergencies, geopolitical conflicts and frequent adjustments to environmental policies have become important factors affecting the development of the global shipping industry. Disruptions in international shipping not only affect the stability of the global supply chain, but also aggravate the profound changes in the global trade structure, resulting in the rise of transportation costs, the decline of logistics efficiency, and the transformation of shipping modes and the reconstruction of supply chains[4]. This section will provide a detailed analysis of the main drivers of international shipping disruptions and their characteristics, exploring how these factors affect global trade flows, the stability of international supply chains, and national shipping policies.

2.1.1 Public Health Emergencies.

Public health emergencies, particularly the COVID-19 outbreak, have profoundly altered the global shipping landscape. Public health events often trigger a chain reaction involving port operations, shipping company operations, and global supply chain management[7]. The global spread of COVID-19 not only poses a huge public health risk, but also has an unprecedented impact on the global economy, trade and logistics. The epidemic has led governments to implement strict blockade and isolation policies, the efficiency of port operations has been greatly reduced, ship navigation has been restricted, shipping companies have faced high operating costs, and the mobility of the global shipping network has been severely tested.

2.1.2 Geopolitical Conflicts.

In addition to public health emergencies, geopolitical conflicts have also become important factors affecting international shipping. In recent years, with the changes in the international political situation, especially the game between major powers and the intensification of regional conflicts, the shipping industry has faced unprecedented challenges. The conflict between Russia and Ukraine is a case in point. Since Russia's invasion of Ukraine in February 2022, shipping lanes in the Black Sea have come under serious threat, and global trade flows, especially in Eurasia, have been affected. The Black Sea is not only an important trade route for Russia, Ukraine and their neighbors, but also connects shipping routes between Europe and Asia. The conflict led to massive shipping disruptions, with many shipping companies suspending services to the region and some vessels being forced to divert to other shipping lanes, further straining the global shipping market[8].

In addition, tensions in hot spots such as the South China Sea also pose a threat to global shipping security and access to sea lanes. For example, the South China Sea shipping corridor is one of the busiest maritime transport routes in the world, with huge amounts of energy and goods passing through it every year. As disputes in the region intensify, shipping companies need to consider more risks and security measures, which makes shipping more expensive and adds to the uncertainty of transportation.

2.2 China's Response Strategy

As the world's largest goods trading country and shipping power, China has adopted a number of strategies to deal with the uncertainty of the shipping market when dealing with the challenge of international shipping obstruction. First, improving the efficiency of ports and shipping networks, especially during peak periods, can effectively reduce port congestion and improve logistics efficiency. Second, strengthen communication and coordination with international shipping partners to reduce uncertainties caused by policy differences and geopolitical conflicts. At the same time, China is also promoting the development of green shipping, and through strengthening the implementation of environmental protection policies, reducing the carbon emissions of the shipping industry and further enhancing the international competitiveness of shipping enterprises.

China should continue to strengthen the construction of its domestic shipping network, especially under the framework of the Belt and Road Initiative, to enhance port connectivity with countries along the route. In addition, strengthening the sharing of shipping data and improving the emergency response capacity of the global shipping system are also the key to solving the problem of obstructed international shipping in the future.

3 Reconfiguration of Global Trade Patterns

3.1 Trend of Supply Chain Regionalization

3.1.1 Wave of Supply Chain Regionalization in the Reconstruction.

The double impact of the new crown epidemic and geopolitical conflicts is pushing the global supply chain from "efficiency priority" to "security and control". The World Trade Organization (WTO) Global Trade Report 2023 shows that in 2022, the regionalization index of global trade in intermediate goods rose to 58.7 (49.2 in 2016). This trend is particularly obvious in the United States "nearshore outsourcing" strategy: Mexico's exports to the United States in 2023 increased by 14.2% year-on-year (U.S. Department of Commerce data), of which electronic equipment and automotive parts accounted for 37%[1], the Monterrey Industrial Park gathered Tesla, General Motors, and other enterprises with nearly 100 supporting factories, the formation of a radius of 300 kilometers "4 hours". The Monterey Industrial Park gathers nearly 100 supporting factories of Tesla, GM and other enterprises, forming a 300-kilometer radius of the "4-hour supply chain circle". But regionalization is not simply a geographic reorganization. McKinsey's "Global Value Chain Reconstruction" report points out that multinational corporations are balancing efficiency and security through the "digital twin + regional hub" model: Germany's Siemens set up an "industrial meta-universe lab" in Chengdu, which connects real-time production data from 32 suppliers in southwest China to the Munich headquarters' system. Germany's Siemens established in Chengdu "industrial meta-universe laboratory", 32 suppliers in southwest China's production data real-time access to the Munich headquarters system, so that the supply chain disruption response speed increased by 60%; TSMC in the United States in the construction of the wafer fab in Arizona, the use of "Taiwan research and development of

U.S. manufacturing" separation of the structure, the core process data is still retained in the park in Hsinchu. This new form of "physical decentralization and data centralization" is reshaping the traditional logic of geo-trade.

3.1.2 The Strategic Game between the Return of Manufacturing and Emerging Markets.

The "re-industrialization" policy of developed countries is triggering global capacity redistribution. The U.S. "Chip and Science Act" has attracted more than 200 billion U.S. dollars in semiconductor investment (Brookings Institution 2023 statistics)[2], but the effect shows obvious differentiation: Intel's new fab in Ohio due to a shortage of local technical workers, the construction progress lagged behind by 40%; and Tesla's Mexican Super Factory through the "modularization of production + China's equipment imports "mode, to realize the Model 2 model mass production cost 12% lower than the Shanghai factory (Reuters supply chain cost analysis). This ambivalence is even more pronounced in the European Union, where European Steel Association data for 2023 show a 19% drop in regional electric arc furnace steel production as a result of soaring energy prices[2], forcing Volkswagen to turn to Turkey to source low-carbon steel, and accidentally spawning the emergence of the Istanbul-Berlin "Hydrogen Steel Corridor".

3.1.3 Digital Trade Rules and the Competition for Data Sovereignty.

Innovations at the practical level are breaking through theoretical disputes. The "cross-border data trusted circulation pilot" constructed in Qianhai, Shenzhen, realizes the "availability and invisibility" of cross-border e-commerce transaction data through blockchain technology[1], and will process more than 120 million orders in 2023 (data from the Shenzhen Municipal Bureau of Commerce); the "Digital Economy Partnership Agreement" signed by Singapore, Chile, and New Zealand. The Digital Economy Partnership Agreement (DEPA) signed by Singapore, Chile and New Zealand is the first of its kind to provide zero tariffs on digital products and exceptions for the protection of source code, establishing a model for the trade of artificial intelligence algorithms. However, the digital divide is still widening: according to a report by the African Development Bank, the trade deficit in digital services of African countries will reach 47 billion dollars in 2023, an increase of 83% compared with 2020, reflecting the lack of infrastructure and the right to speak on standards.

3.2 Direct Shocks Faced by China

In the face of systemic shocks, the infrastructure layout at the government level is strategically deep. 2023, the number of rail-sea intermodal shuttle trains in the new western land and sea corridor exceeded 9,300 (data from the National Development and Reform Commission), and 21 customized routes, such as the ASEAN Fruit Cold Chain Special Line and the Chongqing Automobile and Motorcycle Parts Special Train, have been opened up. In the field of digital infrastructure, Ningbo Zhoushan Port on-line "easy port" platform, through blockchain technology will customs, shipping compa-

nies, freight forwarders and other 134 nodes of real-time sharing of data, so that cross-border trade documents processing time from 56 hours compressed to 4 hours (World Bank "Doing Business 2023" case). This dual network of "digital twins of physical channels" is building a new trade ecology with stronger risk resistance.

3.3 China's Systematic Restructuring of Global Supply Chain Changes

China's systematic reconstruction to cope with the changes in the global supply chain

Facing the deep adjustment of the global trade pattern, China is building a more resilient economic ecosystem through the three-dimensional strategy of upgrading the logistics network, deepening regional cooperation and leapfrogging the industrial chain. As the main artery of land transportation, China-EU shuttle train will exceed 18,200 trains in 2023 (data of China Railway Group), and on the basis of traditional routes, it has innovated and launched "customized special train" - the special train for LCD panels from TCL Poland factory will be delivered directly to "Xi'an Lodz" in 12 days, which is 60% higher than the sea transportation, and only 1/5th of the cost of air transportation (company's global supply chain report). The cost is only 1/5 of air transportation (company's global supply chain report). What's more strategic is the extension effect of China-Laos Railway: from the opening in December 2021 to the end of 2023, the cumulative total value of transported goods will exceed RMB 42 billion, driving Xishuangbanna to build a cold chain logistics hub facing ASEAN[2], and reducing the transportation loss rate of durian from Yunnan to Bangkok from 35% to 8% (monitoring data of Kunming Customs), and this kind of "corridor economy" is reshaping the geography of the regional industry.

4 Analysis of the Vulnerability and Resilience of China's Industrial Chains

4.1 Structural Contradictions and Risks of Industrial Chain Vulnerability

The vulnerability of China's industrial chains is first manifested in the external dependence on key resources and technologies. Taking the energy sector as an example, although experts had warned of the long-term risk of China's dependence on imported crude oil as early as 2009 [3], by 2022, the import dependency ratio of crude oil remained as high as 72%, with a high concentration of import sources (the top five source countries accounted for more than 60%). This dependence is not limited to the energy sector. In the semiconductor industry chain, the import ratio of core equipment such as photolithography machines and deposition equipment exceeds 80%. Delays in the transportation of key materials like photoresist once led to a 12% production capacity loss for electronic enterprises in the Yangtze River Delta region in 2022. Behind this "path lock-in" phenomenon is the combined effect of technical standards, patent barriers, and the global division of labor system. Research indicates that under the outsourcing cooperation model, the technological upgrading speed of Chinese enterprises is significantly lower than that of enterprises with independent supply chains, which

further exacerbates the irreversibility of dependence[9]. For example, the technology iteration cycle of a foreign-funded automotive parts factory in China is 18 months longer than that of its domestic factory, resulting in a lag in the research and development of electric control systems for new energy vehicles in China compared to the international advanced level.

4.2 Intrinsic Dynamics and Reinforcement Paths of Industrial Chain Resilience

4.2.1 The Scale Synergy Effect of the Entire Industrial Chain.

The resilience of China's industrial chains originates from the world's most complete industrial system. Among the 41 major industrial categories and 666 minor industrial categories classified by the United Nations, China has a 100% coverage rate of major categories and a 97% coverage rate of minor categories. Taking new energy vehicles as an example, the localization rate increased to 85% in 2023, with the domestic production rate of core components such as power batteries and motors exceeding 90%. This completeness demonstrates strong recovery capabilities in crises: during the international shipping disruption in 2022, the Shenzhen electronics industry cluster restored 85% of its production capacity within 72 hours through local supplier substitution. Song's[10] "Cluster Network Resilience" theory is validated here: research shows that for every 10% increase in the local supporting rate of the industrial chain, the production capacity loss caused by external shocks can be reduced by 23%. For example, the Chengdu-Chongqing region's electronics information industry introduced enterprises such as BOE and Unigroup, increasing the local supporting rate from 42% in 2018 to 68% in 2023, and maintained a stable output of 70% during the Southeast Asia supply chain disruption in 2022.

4.2.2 The Elastic Adjustment Empowered by Digital Technology.

The application of industrial Internet and digital twin technology has injected new momentum into the resilience of the industrial chain. By 2023, China's industrial Internet platform had connected more than 80 million devices, building a full-chain digital system covering design, production, and logistics. The Haier COSMOPlat platform can complete supply chain risk assessment and generate alternative plans within 15 minutes through real-time data modeling, improving the response efficiency to emergencies by 40%. This practice confirms Song's[10] "Digital Capability-Resilience" positive correlation theory: for every one-level increase in digitalization, the supply chain recovery speed can be accelerated by 18%. For example, during the COVID-19 outbreak in Shanghai in 2022, SAIC Group used digital twin technology to simulate 136 scenarios of parts supply interruptions and ultimately controlled the production capacity loss to within 12% through dynamic scheduling, far below the expected value of 30% under traditional management models.

4.3 Dynamic Adjustment Mechanisms under the Dual-Circulation Pattern

Policy instruments play a key role in enhancing resilience. The "Red-Yellow-Blue" three-tier early warning mechanism established by the National Food and Strategic Reserves Administration can automatically trigger the release of reserves when crude oil prices fluctuate by more than 20%. During the sharp increase in international aluminum prices in 2022, this mechanism released 2 million tons of strategic reserves, keeping the cost increase of new energy vehicles within 5%. In addition, 30 national-level emergency industrial bases have formed a "72-hour regional support circle." For instance, during the Han River flood in 2023, the Wuhan base allocated 500 tons of waterproof materials to surrounding automotive factories within 12 hours, ensuring the uninterrupted operation of the supply chain.

5 China's Coping Strategies and Path Design

5.1 Short-term Strategies - Alleviating Supply Chain Disruption Risks

5.1.1 Diversification of Transportation Channels.

Given the increasing risks of international shipping disruptions, expanding diversified transportation channels is crucial. This study focuses on two strategic solutions: extending the China-Europe Railway Express network and developing Arctic shipping routes. The China-Europe Railway Express has achieved significant progress, now connecting over 20 European countries and forming a modern "Iron Silk Road" transport system[10]. For instance, the Xi'an-based "Chang'an" freight train accounts for 30.54% of China's total rail freight volume, with an impressive annual growth rate of 97.5%[11] Leveraging innovations in land port trade, this model reduces reliance on traditional sea routes, offering key advantages: transit time is cut to around 10 days, and reliability surpasses that of maritime shipping. To further enhance its efficiency, the following measures are recommended: Establishing a China-Europe trade dialogue mechanism for policy coordination;Improving operational efficiency and service quality in inland cities;Advancing comprehensive opening-up under the Belt and Road Initiative.

Meanwhile, climate change has improved the navigability of Arctic routes. Research shows that under normal conditions, the Arctic Northeast Passage handles over 50% of high-value, time-sensitive container shipments; during disruptions like Suez Canal congestion, this share exceeds 70% [12], highlighting its role in risk resilience. To address current challenges, three key steps should be taken: Strengthening icebreaking cooperation with Russia and other nations to reduce costs; Advancing ice-class vessel R&D, particularly Arc7-capable ships[12]; Developing Arctic-ready port infrastructure to facilitate high-value, time-sensitive cargo transport.

5.1.2 Emergency Stockpile Management System.

To address the risks of international shipping disruptions, this study proposes establishing a national strategic stockpile system for critical materials, with rare earth elements as a prime example. As a strategic national resource, China possesses the

world's largest rare earth reserves (including the Bayan Obo Mine in Baotou and Ganzhou's tungsten resources). However, overexploitation has significantly depleted medium and heavy rare earth reserves in five southern provinces. Data indicates that in 2010, China accounted for over 90% of global rare earth exports[13] .The study recommends implementing a "three-pronged" reserve strategy:At the mining stage: Establish mineral deposit conservation mechanisms to meet medium-to-long-term demand; At the production stage: Implement national strategic reserves to effectively respond to sudden risks;At the export stage: Enforce mandatory corporate reserves to enhance market regulation capabilities.

5.2 Medium-to-Long-Term Strategies: Restructuring Global Production Networks

5.2.1 Supporting Technology-Intensive Industries.

Technology-intensive industries serve as key drivers for upgrading China's industrial chains, reshaping global value chain dominance through technological breakthroughs and strategic planning. This includes providing policy guidance for industries like new energy vehicles and semiconductors, focusing on overcoming "bottleneck" technologies while strengthening supply chain resilience through strategic reserves and global cooperation.

The new energy vehicle industry has emerged as one of China's most prominent strategic emerging industries. As emphasized by the General Office of the State Council, priority must be given to core technology breakthroughs and innovation capabilities[12]. Therefore, China should continue deepening reform and opening-up, using strategic policy support to overcome bottlenecks in charging infrastructure and battery technology, promote healthy industry development, consolidate and expand global influence, and enhance the irreplaceability of China's NEV industry.

The semiconductor industry, as a key technology sector, is crucial for national security and risk resilience. As one of the world's top three semiconductor manufacturing centers and the largest semiconductor consumer market, China should, as He Mingke (2023) suggests, enhance competitiveness across four PERG dimensions (Product, Enterprise, Region, Global) during the fourth global semiconductor supply chain restructuring. This includes ensuring supply chain security through strategic reserves of key materials (such as silicon wafers and photoresists). Externally, China should stabilize cooperation with foreign and Taiwanese-funded enterprises while promoting deeper integration between domestic substitution and global supply chains.

5.2.2 Developing Digital Logistics Platforms.

Logistics platforms serve as crucial vehicles for resource allocation. Taking Cainiao Network as an example, its cross-border logistics expansion into ASEAN and European markets demonstrates the potential of digital platforms in consolidating multimodal transport resources and innovating international trade models. Moving forward, it is essential to further leverage the advantages of such platforms, break down

cross-domain service barriers, and provide robust support for China's response to international risks.

5.2.3 Fiscal Subsidies and International Negotiations.

At the domestic level, small and medium-sized enterprises (SMEs), due to factors like their scale, are more vulnerable to the impacts of international shipping disruptions. Therefore, China could establish an SME risk buffer mechanism, using subsidies to reduce these enterprises' sensitivity to fluctuations in shipping costs and alleviate pressure from rising freight rates, thereby enhancing their risk resilience. This approach would utilize public fiscal resources to address market failures and improve the bargaining position of enterprises in the global division of labor. At the international level, China could work to reshape the power structure of global shipping governance. For instance, by aligning international emission reduction strategies and decarbonization requirements with China's "dual carbon" goals, the country could help redefine the power distribution framework of international shipping under a unified global carbon reduction target.

6 Conclusion

In conclusion, international shipping disruptions, driven by public health emergencies and geopolitical conflicts, have significantly impacted the global trade structure. China, as a major trading and shipping power, faces both challenges and opportunities. Its supply chain shows vulnerability in key resources and technologies but also demonstrates resilience through a complete industrial system and digital technology. To address these issues, China has adopted short - term strategies like diversifying transportation channels and establishing an emergency stockpile system, and medium - to - long - term strategies such as supporting technology - intensive industries and developing digital logistics platforms. These strategies aim to enhance China's and the global supply chain resilience and adapt to the evolving global trade environment.

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