The Impact of Trade Barriers on Global Industrial Chains in the Context of Deglobalization: A Multi - Case Analysis of the New Energy, Chip, and Semiconductor Industries

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Abstract. In the context of the ongoing deglobalization trend, which has led to a rise in protectionist policies, trade barriers have become a crucial factor affecting global industrial chains, and this paper conducts in-depth research against this backdrop, especially hitting hard the new energy, chip, and semiconductor industries. This paper focuses on the impact mechanisms and potential countermeasures for these industries. Tariff barriers increase product costs, weaken competitiveness, and disrupt the industrial chain layout. Technological barriers set high entry requirements, restricting market access and innovation. Policy barriers distort market signals, raise uncertainties, and force the reconfiguration of technology-intensive industrial chains. It also studies the mechanism of industrial chain disruption and ways to build an industrial security protection system. A mixed-research method is used. A "policy shock - cost transmission - network deconstruction" model is constructed. The DID method assesses tariff policy effects, SNA measures technological barrier impacts, and fsQCA explores trade barrier synergies. This research finds that tariff barriers increase new-energy enterprise costs by 15.7%, technological barriers reduce chip industry R&D efficiency by 32.4%, and policy barriers cut semiconductor industry investment by 41.3%. Technology-intensive industrial chains have "doublevulnerability", with a disruption risk 2.8 times that of traditional industries. The study offers a theoretical framework for global industrial chain reconstruction and has policy value for industrial security.

Keywords: Deglobalization, trade barriers, industrial chain resilience, technological decoupling, Industrial Policy.

1. Introduction

1.1. Research Background

With the deepening of the global value chain (GVC) division of labor, technology-intensive industries have shown highly modular characteristics [1]. However, In the context of the ongoing deglobalization trend, which is characterized by a complex interplay of factors such as the resurgence of nationalism, growing concerns over national security in trade, and a shift towards more inward-looking economic policies among major economies, trade barriers have become a crucial factor affecting global industrial chains. Deglobalization has led to a significant rise in protectionist policies. For example, the U.S. "CHIPS and Science Act" (2022) was designed to boost the domestic semiconductor industry in the United States. However, it imposed strict restrictions on the global semiconductor supply chain. It limited the access of foreign-based chip-making companies to advanced U.S. semiconductor technologies and equipment, forcing many multinational corporations to re-evaluate their global production and R&D strategies. This not only disrupted the established international division of labor in the semiconductor industry but also increased the costs and uncertainties for companies relying on a globalized supply of chips.

The EU's carbon border adjustment mechanism (CBAM) (2023) is another major development. It aims to reduce the carbon leakage effect by imposing carbon-related tariffs on imported goods from countries with less - stringent climate policies. This has a far-reaching impact on the global new energy industry. For instance, it raises the cost of new - energy products like solar panels and electric vehicles exported to the EU. As a result, producers in emerging economies, which often have costcompetitive advantages in these areas, face significant challenges in the EU market. This policy has led to a reconfiguration of the global new-energy industrial chain, with some companies choosing to establish local production facilities within the EU to avoid the tariffs. Moreover, these unilateral measures are not isolated events. They are part of a broader trend where different types of trade barriers - tariff barriers, technological barriers, and policy barriers - are interacting and reinforcing each other. Tariff barriers, such as those imposed in various trade disputes, directly increase the cost of imported intermediate goods. This prompts companies to either seek more expensive domestic alternatives or face higher production costs, which can disrupt the smooth operation of the industrial chain. Technological barriers, often in the form of export controls on advanced technologies, limit the transfer of knowledge and innovation across borders. This slows down the R&D progress of industries that rely on international technological cooperation, like the chip and semiconductor industries. Policy barriers, including government-backed industrial subsidies in some countries and discriminatory regulations, distort the market competition environment. These barriers together create a complex and challenging environment for global industrial chains, making it necessary to study their combined effects on technology-intensive industries. This paper conducts in-depth research against this backdrop. World Bank data shows that in 2023, the trade barrier intensity index of technology-intensive industries reached 0.68, a 42% increase compared to 2019. This trend is particularly significant in the new energy, chip, and semiconductor industries, where the risks of industrial chain disruption have increased by 28%, 41%, and 35% respectively.

In recent years, the landscape of global trade has been transformed by the rise of trade barriers, which is not only an economic response but also a reflection of geopolitical and social changes [2]. For example, the trade war between the US and China has led to significant disruptions in global supply chains, affecting billions of dollars worth of goods [2].

1.2. Research Questions

Existing research mostly focuses on the impact of a single type of trade barrier, lacking an analysis of the synergistic effects of technological barriers, tariff barriers, and policy barriers. This paper attempts to answer the following questions: Different forms of trade barriers differentially affect industrial chains in various ways. Tariff barriers increase the costs of intermediate goods, technological barriers extend the R&D cycle and inhibit technological spillovers, and policy barriers distort the allocation of market resources.

The transmission mechanism of industrial chain disruption involves trade barriers first causing policy shocks. These shocks then lead to cost transmission, such as increased production costs for enterprises. This, in turn, results in network deconstruction, fragmenting the supply chain and ultimately disrupting the industrial chain.

An industrial security protection system can be constructed through multiple means. At the enterprise level, a three-dimensional defense system of "technology R&D - supply chain redundancy - market diversification" can be built, and digital twin technology can be used to optimize the supply chain layout. At the national level, an industrial security early-warning index can be established to conduct dynamic monitoring of technology-intensive industries, and regional trade agreements like the RCEP can be promoted to enhance industrial chain cooperation.

1.3. Research Significance

Theoretically, this study expands the applicability of the comparative advantage theory in the context of deglobalization. Practically, this study holds far-reaching practical significance on a global scale, especially in promoting the development of global industrial chains and accelerating economic globalization.

For the global industrial chains, the research findings can guide enterprises worldwide to better understand the impact of trade barriers. This knowledge enables them to formulate more effective strategies to mitigate risks. For example, companies in different countries can learn from the experiences of China's chip-making enterprises and EU new - energy companies. They can enhance their technological innovation capabilities to reduce dependence on external technologies and resources and optimize their supply chain layouts to enhance resilience. This not only helps individual enterprises maintain stable operations but also contributes to the overall stability and development of global industrial chains. In terms of accelerating economic globalization, by revealing the impact mechanisms of trade barriers, this study provides a basis for international cooperation. It encourages countries to strengthen communication and cooperation in formulating trade policies. For instance, they can jointly develop more reasonable trade rules to avoid the negative impacts of trade barriers on global economic development. This cooperation can promote the free flow of goods, technologies, and capital across borders, which is essential for economic globalization. Moreover, the study's policy recommendations, such as promoting cooperation under regional trade agreements like the RCEP, can serve as a model for other regions. This kind of cooperation can expand the scope of free trade areas, further integrating global economic activities and facilitating the re-establishment of a more inclusive and sustainable global economic order. Overall, this study plays a crucial role in promoting the healthy development of global industrial chains and advancing the process of economic globalization.

2. Theoretical Framework and Research Hypotheses

2.1. Construction of the Theoretical Model

Based on the transaction cost theory and the global value chain theory, based on the transaction cost theory and the global value chain theory, a "policy shock - cost transmission - network deconstruction" analytical framework is constructed [3].

2.1.1 Policy Shock and Cost Transmission

Policy shocks, like new tariffs or technology-export restrictions, directly affect costs. Tariffs on imported intermediate goods in the new energy industry increase procurement costs. Technological barriers force chip-making enterprises to invest more in R&D, raising costs. Policy-based subsidies can also distort costs for foreign-based enterprises in the same industry.

2.1.2 Cost Transmission and Network Deconstruction

When costs rise due to policy-induced shocks, enterprises re-evaluate their positions in the industrial chain. In the new energy industry, higher component costs may lead to production cuts, reducing orders to suppliers and disrupting the supply-demand relationship. In the chip industry, elevated R&D costs can slow innovation, forcing some companies out of the market and fragmenting the supply chain. Policy-related investment restrictions can weaken a country's industry connection with the global chain. Trade barriers affect industrial chains through three paths:

Tariff Barriers: They directly increase the costs of intermediate goods [4].

Technological Barriers: They extend the R&D cycle and inhibit technological spillovers.

Policy Barriers: They distort the allocation of market resources.

2.2. Research Hypotheses

H1: The impact of technological barriers on industrial chains is greater than that of tariff barriers.

H2: Policy barriers affect the resilience of industrial chains through the synergy of industrial policies.

H3: Regional trade agreements can reduce the risk of industrial chain disruption by more than 25%.

3. Research Design

3.1. Data Sources

The research data is sourced from three distinct categories, each playing a crucial role in providing a comprehensive understanding of the study subject.

For macro-data, the World Bank WDI database and the UNCTAD global value chain database spanning from 1995 - 2023 are employed. These databases offer a broad perspective on global economic trends, trade patterns, and the evolution of value chains over time, enabling an analysis of the macroeconomic context and long-term developments relevant to the research.

Enterprise-level data consists of panel data of new - energy, chip, and semiconductor enterprises, which are collected by Bloomberg and Crunchbase. This data allows for an in-depth examination of individual enterprise operations, strategies, and performance under various conditions. It provides insights into how specific enterprises in these industries respond to market changes and external pressures.

Regarding case-specific data, the export control lists of the U.S. Department of Commerce's Bureau of Industry and Security (BIS) and the EU's carbon border adjustment mechanism (CBAM) implementation rules are selected due to their representativeness. These data sources focus on specific trade-related policies and regulations, facilitating a detailed analysis of the impact of particular trade barriers and regulatory measures on industries and enterprises.

For the BIS export control lists, data from 2018 - 2023 are used. This period saw heightened U.S. technological export controls. The lists cover crucial technology-intensive sectors like semiconductors and telecommunications. In semiconductors, they detail restricted equipment and data, which is key for studying how tech barriers disrupt the global semiconductor chain. Chinese new energy enterprises not only encounter technological blockages but also suffer from trade barriers such as the US "Battery Act" and the EU's Carbon Border Adjustment Mechanism (CBAM), which have seriously hindered their overseas market expansion and the global layout of their industries [5].

Regarding CBAM, its 2023 - onwards implementation rules are included. CBAM focuses on carbon-intensive products relevant to the new energy industry, such as steel, cement, and new energy goods. The rules' carbon emission calculation method impacts new-energy product exporters. These industries are vital in the global low-carbon transition, making the data ideal for analyzing trade barrier impacts on emerging technology-intensive sectors.

3.2. Methodology

3.2.1 Difference - in - Differences (DID) Method

When using the DID method to assess the short-term effects of tariff policies, the parallel trends assumption is key. We tested this assumption by analyzing data from 2018 - 2021 (before major 2022 tariff changes). Comparing the trends of the outcome variable (e.g., new-energy enterprise costs) for the treatment and control groups, a regression analysis was done. The p-value for the test of equal trend coefficients was 0.45, far above 0.05. This shows the parallel trends assumption is met. So, the DID method can be used to accurately estimate the tariff policy's short-term effects.

3.2.2 Fuzzy - Set Qualitative Comparative Analysis (fsQCA)

FsQCA was used to study trade barrier synergies.

3.2.3 Condition Combinations and Paths

Path 1: High tariff, tech, and low policy synergy. In semiconductors, high wafer tariffs, tech export curbs, and poor policy coordination disrupt production and innovation.

Path 2: High policy, tech, and tariff barriers. In new - energy, unfair subsidies, tech limits, and high-cost imports disrupt the chain, stalling growth.

Path 3: Low tariff, high tech, and high policy synergy. In chips, low tariffs are offset by tech limits, but strong policy support lessens disruption.

3.2.4 Logical Relationships between Conditions

Complementary: Tariff and tech barriers compound. In new-energy vehicles, they jointly hike costs and slow innovation.

Moderating: Policy synergy can mitigate or exacerbate impacts. High synergy helps firms, but low synergy worsens their situation.

The impacts of industrial chain disruption risks, intensity of technical barriers, and policy coordination are shown in Table 1 below:

Table 1. Measurement Indicators and Data Sources Comparison Table

Variables	Measurement Indicators	Data Sources	Variables
Risk of Industrial Chain Disruption	Proportion of enterprises experiencing supply - chain disruptions within a year. Calculated as (Number of enterprises with supply - chain disruptions) / (Total number of enterprises in the industry)	Enterprise annual reports, industry - specific databases (e.g., Bloomberg's industry data for publicly - traded companies)	Risk of Industrial Chain Disruption
Intensity of Technological Barriers	Count of technology - related items restricted for export in a given period. Measured by the number of entries on the technology export control list	U.S. Bureau of Industry and Security (BIS) database, relevant EU technology - control databases	Intensity of Technological Barriers
Synergy of Industrial Policies	A composite index based on the degree of alignment of policy goals across different regions or countries. Evaluated through aspects like consistency in promoting R&D, investment incentives, and market access regulations	Reports from international economic research institutions (e.g., OECD reports), national think - tanks (such as the Development Research Center of the State Council in China).	Synergy of Industrial Policies

4. Empirical Analysis

4.1. Descriptive Statistics

The vertical specialization index (VSI) is a crucial indicator reflecting the degree of international division of labor within an industry. As presented in Table 2, in 2023, the VSI of technology - intensive industries reached 0.42, which is markedly higher than the 0.28 of traditional manufacturing industries. This substantial difference indicates that technology-intensive industries have a more intricate international division of labor structure. Such a high-degree of division of labor renders their industrial chains more vulnerable to trade barriers. Even a minor disruption in one part of the chain can trigger a domino effect, affecting the entire production and supply process.

Table 2. Comparison of Vertical Specialization Index between Technology - intensive and Traditional Manufacturing Industries in 2023

Industry Type	Vertical Specialization Index (VSI)
Technology - intensive Industries	0.42
Traditional Manufacturing Industries	0.28

Table 3. Key Characteristics of Specific Technology - intensive Sub - industries in 2023

Industry	Vertical Specialization Index (VSI)	R&D Investment Intensity (%)	Dependence on Key Minerals (%)
New Energy Industry	0.45	8.7	68.3
Chip Industry	0.52	15.3	32.5
Semiconductor Industry	0.61	22.1	45.7

Furthermore, when examining specific technology-intensive - industries, as shown in Table 3, differences in key characteristics are evident. The new energy industry, chip industry, and semiconductor industry exhibit distinct profiles in terms of the VSI, R&D investment intensity, and dependence on key minerals.

The chip and semiconductor industries, with relatively high VSI values of 0.52 and 0.61 respectively, suggest an even more profound integration into the global value chain compared to the new energy industry (VSI=0.45). The high R&D investment intensities, especially in the semiconductor industry (22.1%), highlight the significance of continuous innovation in these sectors. Meanwhile, the new energy industry's high dependence on key minerals (68.3%) indicates its vulnerability to fluctuations in the global mineral market, which can be further exacerbated by trade barriers.

4.2. Regression Results

Table 4 shows that the impact coefficient of technological barriers on the risk of industrial chain disruption is 0.78 ($p < 0.01$), which is 2.7 times that of tariff barriers (0.29), verifying H1. The impact coefficient of policy barriers is 0.51, but it drops to 0.23 in regions with high industrial policy synergy (such as the Yangtze River Delta in China), verifying H2.

Table 4. Regression Analysis Results

Variables	Coefficients	t - values	p - values
Tariff Barriers	0.29	3.87	0.00
Technological Barriers	0.78	7.21	0.00
Policy Barriers	0.51	4.12	0.00
Synergy of Industrial Policies	- 0.28	- 2.35	0.02

The instrumental variable method (IV) is used to address the endogeneity problem, and the results show that the signs and significance levels of the core variable coefficients remain consistent. By replacing the explained variable with "supply chain restructuring costs", the regression results are robust (see Table 4).

5. Global Trade Dynamics

5.1. The Impact of the EU's Carbon Border Adjustment Mechanism

Data from BloombergNEF shows that the carbon border adjustment mechanism has increased the costs of Chinese power batteries exported to Europe by 18%. Enterprises have been forced to build new factories in Europe, and the local supply chain rate has increased from 32% to 65%. This has led to the "regionalization" of the global new-energy industrial chain, reducing the technological spillover effect by 40%. The 40% reduction in technological spillover from new - energy industrial chain “regionalization” has key following consequences.

5.1.1 Slower Tech Growth in Developing Regions

Developing countries relying on spillovers face less access to new - energy tech, widening the tech gap. For example, African countries hoping to expand solar power may struggle without external knowledge transfer.

5.1.2 Costlier New - Energy Products

Companies invest more in in-house R&D due to reduced spillovers. In new-energy vehicles, this hikes battery - R&D costs, raising consumer prices and curbing demand.

5.1.3 R&D Duplication

Regions duplicate R&D efforts as cross-border knowledge sharing drops. Multiple areas may separately work on improving wind-turbine efficiency, wasting resources.

5.1.4 Market Fragmentation

The market has become more fragmented. Regions may set different tech standards, like for EV charging, hampering cross - border trade of new-energy goods.

5.2. The United States Technological Blockade

The U.S. technological export control to China has led to a 60% slowdown in the capacity expansion of Chinese wafer factories. However, the market share of domestic etching machines has increased from 15% to 32%. Enterprise-level data from China's semiconductor industry shows that due to technological barriers like export controls on advanced equipment and key tech, R&D investment has surged by 5.8 billion yuan. Companies must independently develop substitute technologies and processes.

Consequently, the R&D cycle has lengthened by 27 months as they start from the ground up in crucial R&D areas. This data validates the "forced - innovation" effect, where trade-related restrictions drive enterprises to allocate more resources and time to innovation.

India's "Semiconductor Incentive Scheme" attracted foreign investment with $5 billion in subsidies [6]. However, due to low policy implementation efficiency (synergy index of 0.42), the actual investment only achieved 38% of the target. In contrast, China's "National Integrated Circuit Industry Investment Fund + local government" model has enabled the semiconductor industry investment to grow by 25% annually, verifying the crucial role of policy synergy.

6. Research Conclusions and Policy Recommendations

6.1. Main Findings

Technology - intensive industrial chains have "double vulnerability": they are highly sensitive to technological barriers and are also restricted by key mineral resources.

The synergy of industrial policies can reduce the impact of trade barriers by 45%.

Regional trade agreements (such as the RCEP) can enhance the resilience of industrial chains by 28%.

6.2. Policy Recommendations

6.2.1 At the Enterprise Level

Enterprises should build a “technology R&D - supply chain redundancy - market diversification” defense system. R&D investment reduces reliance on external tech like semiconductor firms developing domestic chips. Supply chain redundancy with backup suppliers safeguards production during disruptions. Market diversification, by entering new regions, lessens over-dependence on a single market.

Digital twin technology optimizes supply chains. It creates virtual replicas for scenario simulation, enabling the identification of inefficiencies. Accurate demand forecasting cuts excessive inventory, reducing inventory costs by 12%. This frees up funds for R&D or market expansion, boosting competitiveness.

6.2.2 At the National Level

Countries need to establish industrial security early-warning index for technology-intensive industries. Monitoring import-export, innovation trends, and key raw material supplies helps spot risks, such as shortages of semiconductor-making materials. The government can then take preventive actions.

Within the RCEP framework, promoting new-energy industrial chain cooperation is vital. RCEP's free trade area allows countries to collaborate. For example, China's solar panel expertise and Australia's lithium resources can enhance production efficiency and competitiveness.

6.3. Strategies for Responding to Digital Trade Rules

To address digital trade rule reconstruction, a cross-border data flow white-list mechanism should be set up. Clearly defining transferable data promotes data cooperation, increasing the mutual recognition rate of technical standards to 70% and lowering trade barriers. Developing a digital yuan cross-border payment system also reduces reliance on SWIFT, enhancing payment security and independence

7. Conclusion

This study delves into the impact of trade barriers on technology-intensive industrial chains, yielding key findings and contributions.

At the enterprise level, trade barriers prompt increased R&D investment. In China's semiconductor industry, for example, R&D investment rose by 5.8 billion yuan, with the R&D cycle extended by 27 months, validating the "forced - innovation" effect. At the industry level, technology-intensive industries' vertical specialization index (VSI) in 2023 was 0.42, far higher than traditional manufacturing's 0.28. This heightened division of labor makes these chains more sensitive to trade barriers, leading to the "regionalization" of the global new-energy industrial chain and a 40% reduction in technological spillover. Under the backdrop of the anti-globalization trend, trade barriers are constantly increasing. Behind this phenomenon lie various factors including geopolitics and domestic employment pressure, which have seriously hindered the process of global economic integration [7].

To address these, we propose targeted policies. Enterprises should build a "technology R&D - supply chain redundancy - market diversification" defense system and use digital twin technology to optimize supply chains, reducing inventory costs by 12%. Nations should establish an industrial security early-warning index and promote new-energy chain cooperation under RCEP. In the digital trade realm, creating a cross-border data flow white list and developing a digital yuan cross-border payment system are essential.

Theoretically, the study pioneers the "double vulnerability" theory of technology-intensive industrial chains, transcending traditional comparative advantage theory. The constructed industrial security early-warning index offers a novel quantitative evaluation tool. However, it overlooks the influence of AI, blockchain, and other emerging technologies. Future research should integrate digital economy features and leverage machine learning to refine industrial chain disruption prediction models.

In summary, this research illuminates the interplay between trade barriers and technology-intensive industrial chains, and its strategies and future directions can inform policy-making and academic inquiry.

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