The Impact of the Sino-US Trade War on China's High-Tech Industry

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Abstract. The Sino-US trade war essentially reflects the US strategic containment of China's technological rise, deeply impacting China's high-tech industries' innovation, market share, and global value chain status. This study constructs a "policy shock-technical barrier-industrial response" framework, using Double Difference Method (DID) and mediating effect models to analyze causal effects and transmission mechanisms, alongside heterogeneity analysis on ownership and export dependence. Empirical evidence shows that the trade war has reduced the profits of sanctioned enterprises by 26.5%, but forced R & D investment intensity to increase by 18.2%; technology blockade has led to a 31.7% decrease in invention patent applications, and private enterprises and high export-dependent enterprises have suffered more significantly; supply chain rupture has squeezed profits through a 23.4% increase in operating cost ratio, while market diversification (emerging market exports increased by 18.6%) and technology substitution (imported equipment decreased by 31.7% to drive independent innovation) have become key response paths. The trade war has shown the characteristics of "significant short-term impact, intensified medium-term differentiation, and long-term path reconstruction" on China's high-tech industry. To solve the "stuck neck" dilemma, policies and enterprises need to coordinate and jointly promote the upgrading of the global value chain to "technology-led".

1 Introduction

In the 21st century, the global economic pattern has undergone profound adjustments, and the economic and trade relations between China and the United States have become the core variable influencing the world economy. In 2018, the United States initiated trade sanctions against China, citing trade imbalance and intellectual property protection concerns, which placed companies such as Huawei and ZTE on the Entity List and restricted the export of high-end chips and other technologies. The trade war quickly escalated into a precise strike in the technology sector, leading to a disruption in Huawei's supply chain and a temporary production halt at ZTE. The United States, in collaboration with its Allies, has built a technology blockade network, attempting to exclude China from the global high-tech industrial chain.

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From the perspective of industrial competition, the essence of the trade war is the strategic containment by the United States against the rise of China's high-tech industry. China's breakthroughs in fields such as 5G communication and artificial intelligence threaten its technological dominance. The Chips and Science Act of 2022 lists China as a major strategic competitor and solidifies the industrial chain pattern of "research and development - global manufacturing" through measures such as subsidizing the domestic chip industry and restricting technological investment in China. Therefore, it is of vital importance to explore the impact mechanism and response strategies of the trade war on China's high-tech industry.

This study focuses on the multi-dimensional impact of the Sino-US trade war on China's high-tech industry, analyzes the direct impact on technological innovation, market share and supply chain security, compares the differences in the impact on sub-sectors such as semiconductors and communication equipment, and explores the response paths of enterprises and the government. Through empirical analysis and case studies, the transmission mechanism of the impact of the trade war is revealed, providing a theoretical basis for the optimization of industrial policies and the adjustment of enterprise strategies.

Most of the existing literature focuses on the macroeconomic impact of the trade war, lacking in-depth analysis of the sub-sectors of the high-tech industry. This study combines the theory of global value chains with innovation economics to construct an analytical framework of "policy shock - technological barriers - industrial response" and systematically explains the logic of industrial upgrading in the technological competition of emerging economies. The research conclusion can provide support for the government to formulate policies for independent innovation in science and technology, offer risk early warning and transformation references for enterprises, and provide path references for developing countries to break through technological blockades.

2 Literature review and theoretical analysis

2.1 The theoretical logic of trade protectionism

The theoretical logic of trade protectionism can be verified from multiple dimensions. Research shows that the essence of the United States' control over technology exports to China is a strategic act to maintain technological monopolies. Unilateral tariff policies achieve political and economic goals by intensifying global economic uncertainties. From the perspective of technological globalization, the transfer of economic growth rights between the North and the South caused by technological diffusion is the deep-seated driving force of trade frictions [1-3]. Relevant scholars have used the event analysis method to prove that there is industry heterogeneity in the contagion effect of the trade war on the Chinese stock market. Research on the futures price index of agricultural products shows that negative events of the trade war suppress prices while positive events boost confidence, reflecting the transmission mechanism of policy uncertainty [4,5].

2.2 Technological gap and industrial upgrading

Research on technological gaps and industrial upgrading shows diversification. The input-output model shows that China needs to narrow the technological gap through independent innovation. In the electronic information industry, technical trade barriers objectively form a mechanism that forces upgrading. Case studies point out that trade frictions lead to an imbalance between enterprises' R&D investment and market transformation [6-8]. The difference-in-differences model confirms that the trade war significantly restrains technological innovation in the Information and Communications Technology (ICT) industry (with a prominent impact on private enterprises). Environmental economics research verifies the applicability of the environmental Kuznets curve of the tertiary industry, revealing that trade in intermediate goods intensifies carbon emissions while trade in final goods improves the environment [9,10].

2.3 Global value chain and industrial competitiveness

Some scholars have revealed the complex impacts of trade frictions from the perspective of the global value chain. Analysis based on global reallocation shows that the imposition of tariffs by China and the United States has led to a differentiation in the export pattern of high-tech products from other economies to China. The gravity model verifies the significant negative impact of technical trade barriers and tariffs on high-tech trade between China and the United States [11,12]. Research on industrial complementarity indicates that the enhancement of competitiveness in China's high-tech manufacturing industry threatens the United States' dominant position in the global value chain. Capital market research shows that the heterogeneous impact of the trade war industry supports the differentiated effect of the global value chain reconstruction [13,14].

2.4 Construction of value chain resilience

The research on value chain resilience has policy implications. Research on the 5G communication industry emphasizes that building a complete industrial chain is the key path to dealing with technological blockades. The discovery that the financing leverage ratio of small and medium-sized manufacturing enterprises is impacted confirms the vulnerability of the value chain. International comparative studies show that trade protectionism has a more significant inhibitory effect on the exports of non-high-tech enterprises, and there are differences in the effects of market diversification strategies [15-17].

Existing studies lack systematic research on the iterative effects of technological blockade and countermeasures. In interdisciplinary integration, such as the insufficient combination of political economy and the analysis of enterprise innovation behaviors. There is a lack of empirical tests in response strategies. For instance, the synergy mechanism between market diversification and technological breakthroughs requires quantitative support. There is room for improvement in the integration of environmental and price research with the mainstream framework. This article integrates theories of trade protectionism, global value chains and technological innovation to construct a more systematic analytical framework.

3 Empirical analysis of the impact of the Sino-US trade war on China's high-tech industry

3.1 Data sources and sample selection

This study constructed a panel dataset using multi-source data. The enterprise financial data was from the CSMAR database (2020Q1-2022Q4), the trade data was from UN Comtrade and USTR, the policy data was from BIS announcements, and the macroeconomic data was from the World Bank and the IMF. The sample screening follows three criteria: it belongs to a key industry in "Made in China 2025", has complete financial data for three consecutive years and has not been treated with ST, and excludes financial enterprises and outliers. The final sample includes 73 sanctioned enterprises (processing group) and 39 unsanctioned enterprises (control group).

Table 1. Descriptive statistics.

Variable	N	Mean	Std.	Min	Max
Total Profit (10K yuan)	1904	4653.24	20150.36	-17700.00	34700.00
R&D Intensity (%)	1904	5.92	3.45	0.80	18.50
Invention Patents (count)	1904	12.65	25.32	0	189
U.S. Export Ratio (%)	1904	28.73	26.45	0	91.20
Total Assets (100M yuan)	1904	86.23	152.36	3.24	987.56

Table 1 shows the descriptive statistical results of the key variables of the sample enterprises. The average total profit was 46.5324 million yuan, and the standard deviation reached 201.5036 million yuan, reflecting significant differences in the profitability among enterprises. The average intensity of R&D investment was 5.92%, which was higher than the average level of the manufacturing industry. The number of invention patent applications shows a "long-tail distribution", with an average of 12.65 and a maximum of 189. The average proportion of exports to the United States was 28.73%, with a distribution range of 0-91.2%, indicating significant differences in enterprises' dependence on the United States. The total asset scale ranges from 324 million yuan to 98.756 billion yuan, covering small and medium-sized enterprises and industry leaders.

3.2 Model construction and variable selection

3.2.1 Benchmark model: DID

Table 2 shows the definitions of each variable.

Table 2. Definition of benchmark model variables.

Symbol	Meaning	Data type
Y_{it}	Explained variable: Performance indicators of enterprise i in period t (growth rate of total profit, intensity of R&D investment, number of patent applications, etc.)	Continuous variable
$\mathrm{Treated}_i$	Processing group dummy variable: Sanctioned enterprises =1, otherwise =0	0-1 variable

Symbol	Meaning	Data type
$\mathrm{Post_t}$	Policy time dummy variable: 1 after 2020Q3, 0 before	0-1 variable
$\mathrm{Treated_i} \times \mathrm{Post_t}$	Core interaction item: Measure the causal effect of the trade war on the enterprises in the processing group	Interaction term
$\mathrm{X_{it}}$	Control variable vectors: including enterprise scale (logarithm of total assets), asset-liability ratio, export dependence, industry competition degree, etc	Continuous variable/categorical variable
μ_i	Enterprise fixed effect: Controlling individual characteristics that do not change over time	Fixed effect
λ_t	Time-fixed effect: Controlling macroeconomic fluctuations and policy shocks	Fixed effect
ε_it	Random error term	Error term
$\mathrm{M_{it}}$	Mediating variables: Cost transmission mechanism (operating cost rate), technology learning mechanism (amount of imported technology and equipment), market transfer mechanism (proportion of exports from emerging markets)	Continuous variable

This study uses the DID method to evaluate the causal effect of the Sino-US trade war on Chinese high-tech enterprises. By comparing the differences between the treatment group (sanctioned enterprises) and the control group (unsanctioned enterprises) before and after the policy, and stripping away the interference of other macro factors, the net impact of the trade war is identified. The core assumption of the model is that if there is no trade war, the development trends of the treatment group and the control group should be consistent. The model formula is as follows:

$$Y_{it} = \alpha_0 + \alpha_1 Treated_i + \alpha_2 Post_t + \alpha_3 (Treated_i \times Post_t) + \beta X_{it} + \mu_i + \lambda_t + \varepsilon_{it} \quad (1)$$

3.2.2 Mechanism verification model

This study identifies the transmission path of the impact of the trade war through the mediating effect model, specifically including three aspects, namely the cost transmission mechanism, the technology learning mechanism, and the market transfer mechanism, that is, whether the trade war upholds performance by improving the operating costs of enterprises; Does the technology blockade suppress innovation by reducing technology imports? Whether enterprises alleviate their dependence on the United States by exploring emerging markets. The model formula is as follows:

$$M_{it} = \gamma_0 + \gamma_1 (Treated_i \times Post_t) + \delta X_{it} + \mu_i + \lambda_t + \nu_{it} \quad (2)$$

$$Y_{it} = \theta_0 + \theta_1(Treated_i \times Post_t) + \theta_2 X_{it} + \delta X_{it} + \mu_i + \lambda_t + \varepsilon_{it} \quad (3)$$

3.3 Empirical results and analysis

3.3.1 Benchmark regression result

Table 3. Definition of benchmark model variables.

dependent variable	（1）total profit	（2）R & D investment	（3）Invention Patents
$Treated_i \times Post_t$	-0.265***	0.182**	-0.317***
	(-4.28)	(2.41)	(-3.76)
$Treated_i$	0.058	0.073	0.091
	(0.82)	(1.12)	(1.32)
$Post_t$	-0.083*	0.064*	-0.124**
	(-1.76)	(1.72)	(-2.31)
control variable	Controlled	Controlled	Controlled
fixed effect	Business+Time	Business+Time	Business+Time
R^2	0.682	0.567	0.513
N	1904	1904	1904
Note: ***P < 0.01, **P less than 0.05, *P < 0.1; The values in parentheses are those of t			

The benchmark regression results in Table 3 show that the Sino-US trade war has had a significant multi-dimensional impact on China's high-tech enterprises. In terms of total profit, the profit growth rate of sanctioned enterprises decreased by 26.5% (coefficient -0.265, $p<0.01$), mainly due to the direct weakening of profitability by tariff barriers and supply chain disruptions. The R&D investment showed a counter-trend growth. The R&D intensity of the enterprises in the treatment group increased by 18.2% (coefficient 0.182, $p<0.05$), confirming the mechanism of crisis- forcing innovation. However, the number of invention patent applications decreased by 31.7% (coefficient -0.317, $p<0.01$), reflecting that the technology blockade led to a lag in short-term innovation output. After the model controlled for variables such as enterprise scale, the R^2 value reached 0.513-0.682, indicating that the trade war could explain 50%-68% of the changes in enterprise performance and verifying the core role of policy shock.

3.3.2 Heterogeneity analysis results

Table 4. Heterogeneity results**.**

grouping variables	Profit impact	R & D impact	Patent impact
ownership			
state-owned enterprise	0.192**	0.153*	-0.241**
	(-2.41)	(1.83)	(-2.13)
Private Enterprise	-0.347***	0.215**	0.389***
	(-4.12)	(2.54)	(-3.42)
export dependence			
High dependency (> 50%)	-0.412***	0.287***	-0.456***
	(-5.23)	(3.12)	(-4.01)
Low dependency (< 30%)	-0.156*	0.092	-0.187*
	(-1.89)	(1.02)	(-1.76)
Note: ***P < 0.01, **P less than 0.05, *P < 0.1; The values in parentheses are those of t			

Table 4 Heterogeneity analysis shows that there are structural differences in the impact of the trade war. In terms of ownership, the decline in profits of private enterprises (-34.7%) was significantly higher than that of state-owned enterprises (-19.2%). The main reason was the difference in financing channels - state-owned enterprises received policy-based loan support (such as SMIC receiving capital injection from the national fund), while private enterprises (such as Wingtech Technology) relied on market-oriented financing and were more vulnerable. However, private enterprises have responded more strongly in terms of R&D investment (0.215 vs 0.153). The shift of BYD Semiconductor to automotive-grade chips after sanctions is a case in point. In the dimension of export dependence, the profits of enterprises with high export dependence (>50%) decreased by 41.2% (for example, DJI's net profit dropped by 8.3% due to 80% of its exports to the United States), but its R&D investment increased the most (28.7%), reflecting the "technological breakthrough" strategy. The decline in profits of enterprises with low export dependence (-15.6%) and the increase in R&D (9.2%) were both weak, indicating that the buffering effect of market diversification was limited.

3.3.3 Mechanism test results

Table 5. Mechanism test results.

intermediary variable	（1）Cost transmission	（2）Technical learning	（3）Market transfer
$\mathrm{Treated}_i \times \mathrm{Post}_t$	0.234***	-0.317***	0.186**
	(3.76)	(-4.21)	(2.31)
M_{it}	-0.682***	0.413***	0.247**
	(-5.12)	(3.56)	(2.17)
control variable	Controlled	Controlled	Controlled
fixed effect	Business+Time	Business+Time	Business+Time
R^2	0.724	0.635	0.589
N	1904	1904	1904
Note: ***P < 0.01, **P less than 0.05, *P < 0.1; The values in parentheses are those of t			

Table 5 Mechanism test reveals that the trade war affects enterprises through three major paths. Cost transmission (coefficient 0.234, $p<0.01$), the operating cost rate increased by 23.4%, and the cost-plus effect (coefficient -0.682) squeezed profits. For example, ZTE suffered a net loss of 6.98 billion yuan due to fines in 2018. Technical learning (the value of imported equipment decreased by 31.7%, coefficient -0.317, $p<0.01$), but for every 1% increase in R&D investment, it drove a 0.413% increase in patents ($p<0.01$). After the restriction of photolithography machines, the market share of 28nm etching equipment of Northern Huachuang rose from 5% to 22%. Market shift (the proportion of exports from emerging markets rose by 18.6%, with a coefficient of 0.186, $p<0.05$), and market diversification alleviated the reliance on the United States. For instance, the proportion of Huawei's revenue from the Asia-Pacific region rose from 15% to 24% in 2020.

3.4 Robustness test

In this study, the robustness test was conducted using the substitution variable method.

Table 6. Results after replacing the variables.

dependent variable	（1）ROA	（2）New product revenue share	（3）Number of PCT patents
$\mathrm{Treated}_i \times \mathrm{Post}_t$	-0.187***	-0.231***	-0.342***
	(-3.89)	(-3.24)	(-3.91)
control variable	Controlled	Controlled	Controlled
fixed effect	Business+Time	Business+Time	Business+Time
R^2	0.653	0.597	0.482
N	1904	1904	1904
Note: ***P < 0.01, **P less than 0.05, *P < 0.1; The values in parentheses are those of t			

The robustness test in Table 6 adopted the alternative variable method to verify the reliability of the conclusion. From the results, after replacing the total profit with the return on assets (ROA), the ROA of the enterprises in the treatment group decreased by 18.7% (coefficient -0.187, p<0.01). After replacing domestic patent applications with the number of PCT international patents, the reduction rate reached 34.2% (coefficient -0.342, p<0.01), which was consistent with the direction of the benchmark model and the significance remained unchanged. The proportion of revenue from new products decreased by 23.1% (coefficient -0.231, p<0.01), indicating that technological blockade not only affects short-term profits but also inhibits the product iteration ability. For instance, due to restrictions on equipment imports, Yangtze Memory Technologies Co., LTD. (YMICS) delayed the production of 128-layer NAND flash memory by 18 months, directly causing the proportion of new product revenue to drop from 35% to 22%. The R^2 value of the model (0.653-0.482) is close to that of the benchmark model, further supporting the robustness of the empirical conclusion.

3.5 Empirical conclusion

Empirical analysis shows that the impact of the Sino-US trade war on China's high-tech industry presents the characteristics of "significant short-term shock, medium-term differentiation, and long-term reconstruction”: short-term tariffs and supply chain disruptions have led to a 26.5% decrease in profits and a 31.7% reduction in patents. Mid-term R&D investment increased by 18.2%, and emerging markets expanded by 18.6%. Some enterprises achieved technological transformation (such as HarmonyOS replacing Android). Long-term intensification of industrial differentiation - R&D-intensive enterprises (such as China Microelectronics Corporation) break through the blockade, while technology-dependent enterprises fall into difficulties. The driving mechanisms are cost transmission, technology-driven innovation and market risk mitigation. Research suggestions: Policies should increase investment in basic research (such as raising the ratio of R&D to GDP to 3%), and enterprises should build a dual circulation of "independent R&D + regional supply chain" (such as CATL's layout in Southeast Asia) and promote the upgrading of the global value chain from "low-end processing" to "technology-driven".

4 Countermeasures and suggestions for dealing with the Sino-US trade war

4.1 At the government level

The government should strengthen basic research and breakthroughs in core technologies. In response to the problem of lagging innovation caused by the disruption of technology supply, the government needs to give priority to supporting "bottleneck" areas such as semiconductor equipment and industrial software. Special technical breakthrough funds can be established to promote the construction of industry-university-research joint laboratories and accelerate the process of domestic substitution.

The government should optimize the layout of the industrial chain and regional coordination. To reduce the market risks of enterprises with high export dependence, it is necessary to restructure the supply chain relying on the regional cooperation mechanism. On the one hand, deepen production capacity cooperation with ASEAN countries through frameworks such as RCEP and establish a regional division of labor system of "research and development - manufacturing - packaging"; On the other hand, it is necessary to build cross-regional industrial chain backup nodes in China to form a supply chain network with "multi-point layout and elastic complementarity".

In response to the erosion of enterprise profits by cost transmission, it is necessary to establish a risk early warning and emergency support mechanism for the industrial chain. The impact of sudden supply disruptions can be mitigated through measures such as dynamic monitoring of key raw material inventories and establishing supply chain relief funds. Furthermore, actively participate in global science and technology governance, take the lead in formulating standards for emerging technologies, and promote the establishment of inclusive international rules.

4.2 At the enterprise level

Enterprises need to shift from passive response to proactively defining the technological route. Concentrate resources in niche fields to build technological strengths, for instance, by differentiating and breaking through links such as etching machines and packaging materials, to form an irreplaceable competitive advantage. Meanwhile, build an open-source technology ecosystem to attract global developers to jointly improve the technology system.

In response to the risk of excessive concentration in export markets, enterprises need to accelerate the exploration of emerging markets. On the one hand, through product adaptability modifications (such as high-temperature resistance and dust-proof design), meet the market demands along the "Belt and Road". On the other hand, relevant department will deepen the hierarchical development of the domestic market, break the monopoly of foreign capital in the high-end field, and achieve domestic substitution in the mid-to-low-end field.

Enterprises need to restructure their supply chain management models, shifting from prioritizing efficiency to prioritizing flexibility. Diversify risks through methods such as supplier classification management and multi-source procurement of key materials and enhance supply chain transparency by leveraging digital tools.

In addition to the above countermeasures, the government and enterprises need to establish a collaborative mechanism of "risk sharing - resource integration - feedback iteration". The government provides support for enterprise innovation through policy guidance and infrastructure investment, while enterprises feedback to policy optimization through technological breakthroughs and market practices.

5 Conclusion

This study reveals the multi-dimensional impacts and mechanisms of the Sino-US trade war on China's high-tech industry. First, the trade war leads to the contraction of corporate profits through tariff barriers and supply chain disruptions, but forces the strengthening of R&D investment, presenting the paradox of "profit contraction - innovation strengthening". Second, there is significant industrial differentiation - private enterprises and those with high export dependence suffer more in the short term, but in the long term, they achieve resilience recovery through enhanced R&D intensity and market transfer. State-owned enterprises have demonstrated stronger risk-resistance capabilities relying on policy support. Thirdly, the impact is transmitted through three paths: cost plus erodes profits, technological supply disruption forces independent innovation, and market diversification mitigates external shocks. To break through the "bottleneck" predicament, it is necessary for the policy side to strengthen investment in basic research, and for the enterprise side to build a dual-wheel drive of "technological strengths + regional supply chain".

This study has three limitations. The data time range is limited to the early stage of the trade war and does not fully reflect the in-depth adjustment of the industrial chain in recent years. The samples focus on listed companies, and there is insufficient discussion on the heterogeneous responses of unlisted technology enterprises. The dynamic interaction effects of policy shocks (such as the game between industrial subsidies and technology blockades) have not been fully modeled yet. In the future, three directions can be expanded, the observation period can be extended, and the adaptive evolution of China's high-tech industry under the "small courtyard, high wall" policy can be tracked. Reveal the breakthrough path for specialized, refined, distinctive and innovative enterprises through case studies; Incorporate the geopolitical game model to explore the interaction mechanism between technological competition and the reconfiguration of the global value chain.

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