



# A Study on the Regional Heterogeneity of AI Technology-Driven New Productivity Empowering High-Quality Development of China's Foreign Trade: An Empirical Test Based on Provincial Panel Data

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**Abstract.** Against the backdrop of the technological revolution reshaping the global trade and economic landscape, China's foreign trade urgently needs to transition from traditional factor-driven growth to high-quality development. This paper constructs a comprehensive evaluation system for provincial AI Technology-Driven New Quality Productive Forces and high-quality foreign trade development based on the theoretical framework of AI technological innovation and regional heterogeneity. It employs a two-way fixed effects model to conduct empirical tests on panel data from 30 provinces spanning the years 2011–2022. The findings reveal that AI-driven New Quality Productive Forces have a significant positive impact on the high-quality development of foreign trade, exhibiting gradient-based regional heterogeneity. Specifically, this is manifested in the application of technologies such as machine learning algorithms to optimize supply chain scheduling, natural language processing to improve cross-border communication efficiency, and computer vision to accelerate intelligent quality inspection. Among them, the eastern region has achieved efficient empowerment through technological advantages such as machine learning algorithms to optimize supply chains and computer vision to improve quality inspection efficiency. The central region has lagged behind in penetration due to insufficient application of predictive maintenance algorithms in the industrial Internet. The western region has been constrained by shortcomings in digital infrastructure, such as a lack of edge computing nodes, which have hindered the implementation of technology. Among the control variables, R&D intensity contributes the most, government intervention exhibits a divergent effect, and transportation infrastructure faces regional structural mismatches. Based on these findings, a three-dimensional differentiated policy system of "macro-level technological systems, meso-level digital industries, and micro-level enterprise technological innovation" is proposed to provide a path for promoting the development of New Productive Forces through AI technology and driving the coordinated development of quality, efficiency, and sustainability in China's foreign trade.

**Keywords:** New Quality Productive Forces, High-Quality Development of Foreign Trade, AI technology, Machine learning algorithms, Regional Heterogeneity

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## 1 Introduction

The global economic and trade landscape is undergoing a profound restructuring driven by technological revolutions such as AI and blockchain. As a major goods trading nation, China urgently needs to break through the development bottlenecks of its traditional factor-dependent foreign trade model. Currently, it faces systemic challenges such as rising labor costs eroding comparative advantages, tightening resource and environmental constraints limiting the expansion of high-pollution industries, and escalating trade frictions increasing external risks. These challenges create a pressing tension with the urgent need for foreign trade transformation and upgrading in line with China's high-quality economic development phase. Against this backdrop, New Productive Forces characterized by improvements in total factor productivity have become the key to overcoming development challenges by leveraging AI technology to drive industrial upgrading and trade value chain advancement.<sup>[1]</sup> Its development is systematically supported by the national innovation-driven strategy, AI industry support policies, and digital trade institutional innovations. However, significant differences in technological resource endowments and digital institutional environments across regions may lead to heterogeneous outcomes in terms of enabling effects<sup>[2]</sup>.

AI technology reshapes trade processes through three major computer technology paths: First, machine learning algorithms predict the timing of overseas market demand, which increases the inventory turnover rate of export enterprises by 15%-20%; Second, computer vision technology is applied to product quality inspection, keeping the deviation of export goods pass rate within 0.5%<sup>[3]</sup>; Third, Natural Language Processing (NLP) empowers intelligent customer service in cross-border e-commerce, with the real-time response rate in multiple languages increased to over 90%. Smart contracts combined with blockchain and AI achieve automated trade settlement, compressing the cross-border payment cycle from 3-5 days to within 24 hours.

While existing research has focused on the mechanisms linking new-quality productive forces to the quality of foreign trade, there remain gaps in understanding the specific computer technology platforms driving new-quality productive forces through AI technology, the micro-level mechanisms underlying regional differences in technological application, the dynamic pathways of their interactions, and the synergistic effects of policy coordination. Therefore, this study utilizes panel data from 30 provinces in China from 2011 to 2022 to construct a fixed-effects model and empirically test the driving effects of New Quality Productive Forces centered on AI technology on High-Quality Development of Foreign Trade and its regional differentiation patterns. By establishing a multi-dimensional evaluation system and conducting rigorous econometric tests, this study aims to reveal the intensity of the impact of New Quality Productive Forces on China's foreign trade quality, its spatial differentiation characteristics, and key moderating mechanisms, thereby providing theoretical foundations and empirical support for optimizing regional innovation ecosystems and trade policy systems.

## 2 Literature Review

In terms of analyzing the essence of New Quality Productive Forces, Zhang L., & Pu Q. (2023) systematically expounded on the characteristics, theoretical innovations, and value implications of New Quality Productive Forces, constructing a theoretical framework for understanding this concept. Xue Q., Shi D., & Shi K. (2024) delved into its formation logic, pointing out that digitization, intelligence, and green development are the hallmarks of New Quality Productive Forces. Liu W. (2024) emphasized from a macro perspective that New Quality Productive Forces are the key driving force behind socio-economic development, and their development relies on the synergy of multiple factors. While foreign studies have not directly focused on the relationship between New Quality Productive Forces and foreign trade, Chen D. (2024) explores the impact of New Quality Productive Forces on accounting transformation, Song S. (2024) analyzes the core role of AI technology in the formation of New Quality Productive Forces and Li Y., & Chen G. (2024) examine the promotional mechanisms of digital finance for the development of New Quality Productive Forces.

In the study of the impact mechanism of New Quality Productive Forces on the High-Quality Development of China's Foreign Trade, Qiu B., Yi Y., & Sun S. (2024) pointed out that AI innovation plays a core role in the formation of New Quality Productive Forces, and its application in various aspects of foreign trade can enhance the technological content and added value of export products. Wang J. (2024) conducted a detailed analysis of how New Quality Productive Forces facilitate the transformation of export trade toward quality and efficiency through paths such as improving production efficiency and promoting product innovation. Zhou H., & Duan X. (2024) observed that New Quality Productive Forces, relying on new energy technologies, drive the green transformation of foreign trade industries, but also face practical challenges such as high technological costs and inconsistent international standards. Kong L., Liu X., & Gao Q. (2024) empirically verified the positive promoting effect of New Quality Productive Forces on the High-Quality Development of China's Foreign Trade using provincial panel data. Porter, M. E. (1990) theory of competitive advantage emphasizes the importance of technological innovation in enhancing trade competitiveness, providing a theoretical perspective for understanding the role of New Quality Productive Forces<sup>[4]</sup>. Zhou, S., Wang J., & Lin X. (2023) pointed out that artificial intelligence drives high-quality economic development by optimizing the manufacturing innovation chain, with heterogeneous effects across regions and industries, and requires policy support for infrastructure, talent, and collaborative innovation.

Regarding the factors influencing the High-Quality Development of China's Foreign Trade, Lin H., & Zhang J. (2024) point out that, under the backdrop of the development of New Quality Productive Forces, composite talent is crucial to the High-Quality Development of China's Foreign Trade, and innovative talent cultivation models are needed.

Although existing research has yielded fruitful results, it has not yet systematically explained the regional differentiation mechanism by which new productive forces centered on AI technology drive the improvement of foreign trade quality through a chain

of technological pathways, namely, "machine learning algorithm optimization—computer vision quality inspection upgrades—NLP cross-border service enhancements." Nor has it revealed the impact of differences in computer technology foundations, such as computing power support and algorithm application, between different regions on the effectiveness of policies. Future research should strengthen interdisciplinary integration, dynamically track changes in international markets, and comprehensively consider multi-dimensional factors to provide more forward-looking theoretical support for the upgrading of China's foreign trade.

### 3 Model Construction and Data Sources

#### 3.1 Sample Selection and Data Sources

This study utilizes panel data from 30 provinces in China (excluding Tibet) from 2011 to 2022, forming a balanced panel sample (N=360). The data are sourced from the National Bureau of Statistics, the General Administration of Customs, the Ministry of Commerce, and authoritative yearbooks such as the China Statistical Yearbook and the China Science and Technology Statistical Yearbook. For missing annual values in certain provinces, linear interpolation was used to fill in the gaps, ensuring data continuity. The sample covers the three major economic regions of eastern, central, and western China, providing a comprehensive reflection of the regional heterogeneity in High-Quality Development of China's Foreign Trade.

#### 3.2 Variable Selection and Explanation

The dependent variable is High-Quality Development of China's Foreign Trade (HDFT). An evaluation system comprising four dimensions and 16 indicators was constructed, and the entropy method was used to determine the weights of the indicators, resulting in the calculation of China's comprehensive index for high-quality foreign trade development.

The core explanatory variable is Technology-driven New Quality Productive Forces (TNQPF). An evaluation index system for the development of New Quality Productive Forces has been constructed, including seven first-level indicators such as AI technology maturity, blockchain application depth, and industrial Internet penetration rate, as well as 18 second-level indicators. The entropy method was also used to determine the weights of indicators at each level, and the development level of China's New Quality Productive Forces was calculated. Among them, the indicators for AI technology maturity are detailed in Table 1:

**Table 1.** AI Technology Maturity Indicators.

Indicator Dimension	Specific Indicator	Measurement Method	Data Sources
Technology R&D Capability	Number of AI-related patent authorizations in the region	Proportion of invention patents	China Science and Technology Statistical Yearbook

	AI-related R&D personnel density	Number of R&D personnel per 10,000 people	Provincial Statistical Yearbooks
	AI Core Industry Output Value Share	Output Value/GDP	China Digital Economy Development White Paper
Industrial Application Penetration	AI technology application rate in industrial enterprises	Smart manufacturing equipment networking rate in large-scale enterprises	China Foreign Trade Statistical Yearbook
Infrastructure Support	Data Center Rack Scale	Number of Standard Racks	Local Statistical Bulletin
	5G base station density	Number of 5G base stations per square kilometer	Communications Industry Statistics Bulletin
Commercialization implementation results	AI-related enterprise revenue growth rate	(Current year revenue - Previous year revenue) / Previous year revenue	Enterprise Check Enterprise Database, Local Science and Technology Department Public Data
	Share of smart product exports	Smart product exports/total foreign trade exports	General Administration of Customs of the People's Republic of China

Since there are many factors that influence the High-Quality Development of China's Foreign Trade, in order to ensure the accuracy of the results and reduce other confounding factors, this paper combines existing literature research and includes four control variables: degree of government intervention (DGI), level of economic development (EDL), level of transportation infrastructure (TI), and research and development intensity (RDI) (Table 2).

**Table 2.** Definition of variables and data sources.

Variable category	Variable Name	Variable	Measurement method	Data source
Dependent variable	High-Quality Development of China's Foreign	HDFT	Entropy method synthesized composite index	Author's calculations
Core explanatory	Technology-driven New Quality Productive	TNQPF	Entropy method synthesized composite index	Author's calculations
Control variable	Degree of Government Intervention	DGI	Composite index synthesized using entropy val-	National Bureau of Statistics
	Level of Economic Development	EDL	General government expenditure / GDP	National Bureau of Statistics
	Transportation Infrastructure	TI	ln (per capita GDP)	National Bureau of Statistics
	R&D Intensity	RDI	ln (total freight volume)	China Statistical Yearbook

### 3.3 Model Setting

This study uses panel data from 30 provinces in China (excluding Tibet) from 2011 to 2022 to construct a fixed effects model to examine the impact of New Quality Productive Forces on the High-Quality Development of China's Foreign Trade.

$$HDFT_{it} = \beta_0 + \beta_1 TNQPF_{it} + \beta_k control_{it} + \mu_i + \gamma_t + \varepsilon_{it} \quad (1)$$

Where  $i$  represents the province,  $t$  represents the year, HDFT represents High-Quality Development of China's Foreign Trade, TNQPF represents Technology-driven New Quality Productive Forces, control represents a series of control variables,  $\beta_0$  represents the intercept term,  $\beta_1$  and  $\beta_k$  represent the regression coefficients for the corresponding variables,  $\mu_i$  represents the individual fixed effect,  $\gamma_t$  represents the time fixed effect, and  $\varepsilon_{it}$  represents the random disturbance term.

## 4 Analysis of Empirical Results

### 4.1 Benchmark Regression Results

To rigorously examine the causal effects of Technology-Driven New Quality Productive Forces (TNQPF) on the high-quality development of China's foreign trade (HDFT), this study constructed a fixed-effects model based on the results of the Hausman test. The estimation results based on panel data from 30 provinces in China from 2011 to 2022 are shown in Table 3.

**Table 3.** Benchmark regression results of Technology-Driven New Quality Productive Forces on the High-Quality Development of China's Foreign Trade.

Variable	(1)	(2)	(3)	(4)	(5)
TNQPF	0.2523*** (0.0492)	0.2478*** (0.0493)	0.2245*** (0.0494)	0.2158*** (0.0461)	0.1912*** (0.0480)
DGI		0.0430* (0.0246)	0.1318*** (0.0286)	0.1365*** (0.0282)	0.1205*** (0.0270)
LED			0.0718*** (0.0138)	0.0552*** (0.0138)	0.0482*** (0.0133)
TI				0.0196*** (0.0065)	0.0168** (0.0064)
RDI					0.6385** (0.2872)
_cons	0.2272*** (0.0136)	0.2195*** (0.0138)	-0.5883*** (0.1540)	-0.5911*** (0.1518)	-0.5136*** (0.1445)
N	360	360	360	360	360
adj. R2	0.9835	0.9835	0.9860	0.9862	0.9865

Note: \* $p < 0.1$ , \*\* $p < 0.05$ , \*\*\* $p < 0.01$

The estimation results based on the fixed-effects model (Table 2) indicate that Technology-Driven New Quality Productive Forces (TNQPF) have a significant positive driving effect on High-Quality Development of China's Foreign Trade (HDFT). As control variables such as government intervention, economic development level, transportation infrastructure, and R&D intensity are gradually incorporated, the coefficient of TNQPF remains statistically significant at the 1% level and maintains a robust direction of effect. Column (5) shows that for every one-unit increase in TNQPF, the level of High-Quality Development of China's Foreign Trade increases by an average of 19.12%, which strongly validates the core claim of the research hypothesis.

The mechanism of control variables further reveals the multidimensional driving pathways. DGI exhibits a weak positive effect in the initial model, but its impact significantly strengthens after controlling for EDL, indicating that the positive effects of government actions depend on the regional economic foundation. It may play a role by optimizing the institutional environment for AI algorithm applications (such as data security regulations) and public resource allocation (such as computing infrastructure). EDL themselves also demonstrate a highly robust positive contribution, highlighting the foundational support of economic scale for trade upgrading. The improvement of TI significantly promotes China's foreign trade development, confirming the effect of enhanced logistics efficiency on reducing trade costs. The coefficient for RDI is 0.6385 and passes the 5% significance test, indicating the positive contribution of innovation investment. However, attention should be paid to the issue of estimation precision suggested by its large standard error.

The overall performance of the model is excellent. The adjusted  $R^2$  value has improved steadily from 0.9835 in Column (1) to 0.9865 in Column (5), indicating that the variable introduction strategy is reasonable and has strong explanatory power for sample variations. Although the TNQPF coefficient decreases reasonably with the increase in control variables, its statistical significance and positive direction of effect remain unchanged, further reinforcing the reliability of the core conclusions. The benchmark regression results comprehensively confirm that technology-driven new productive forces, through innovation-driven and technology spillover, especially the in-depth application of computer technologies such as machine learning and computer vision, have become the core driving force for breaking through the traditional bottlenecks in China's foreign trade development.

## 4.2 Stability Test

To verify the reliability of the benchmark regression conclusions, this study re-estimated the results using the core explanatory variables lagged by one period and excluding data from the special period of the epidemic (Table 4).

**Table 4.** Results of robustness tests.

Variable	(1) Lag model	(2) Regression by year
L. TNQPF	0.1592***(0.0465)	
TNQPF		0.1415**(0.0622)

DGI	0.1315***(0.0287)	0.0325(0.0268)
LED	0.0518***(0.0153)	0.0238*(0.0138)
TI	0.0189**(0.0079)	0.0214***(0.0078)
RDI	0.8023***(0.2865)	0.9634***(0.3506)
cons	-0.5951***(0.1768)	-0.2843***(0.1339)
N	330	270
adj. R2	0.9858	0.9912

Note: \* $p < 0.1$ , \*\* $p < 0.05$ , \*\*\* $p < 0.01$

In the lagged model, the coefficient of the first-order lagged variable of Technology-Driven New Quality Productive Forces(TNQPF) is 0.1592 and passes the 1% significance test, with its statistical significance highly consistent with the benchmark model. In the annual regression, the current coefficient of TNQPF is 0.1415 and passes the 5% significance test. Although the standard error increases due to the reduction in sample size, the economic significance remains stable. This indicates that the promotional role of TNQPF in High-Quality Development of China's Foreign Trade is not affected by lag effects or abnormal events, and the core conclusions exhibit strong robustness.

The direction of influence of control variables is highly consistent with the benchmark regression. The promotional effect of RDI is the most prominent: the lagged model coefficient of 0.8023 and the annual regression coefficient of 0.9634 both pass the 1% significance test, significantly improved compared to the benchmark value, highlighting the core position of innovation-driven development.; TI maintains a robust positive impact, with coefficients of 0.0189 and 0.0214 passing the 5% and 1% significance tests, respectively, confirming the sustained contribution of logistics efficiency; The direction of the EDL coefficient remains unchanged, but the significance of the annual regression weakens to the 10% level; DGI is significantly positive in the lagged model, but fails to pass the significance test after excluding pandemic data, suggesting that its effects may depend on a special policy environment.

Robustness tests using dual methodological cross-validation have strengthened the causal inference efficacy of Technology-Driven New Quality Productive Forces driving the High-Quality Development of China's Foreign Trade.

### 4.3 Heterogeneity Test

From the perspective of regional differences, this paper conducts group regression analysis on the three major regions of eastern, central, and western China (Table 5). The empirical results show that there is significant heterogeneity in the impact of Technology-Driven New Quality Productive Forces and control variables on the High-Quality Development of China's Foreign Trade. This heterogeneity is not simply caused by differences in the degree of technology application, but is deeply rooted in the systemic differentiation between regions in terms of industrial structure characteristics, innovation factor endowments, and institutional environment coordination. This is particularly evident in the depth of computer technology application and its actual effectiveness.

**Table 5.** Results of regional heterogeneity tests.

Variable	Eastern Region	Central Region	Western Region
TNQPF	0.6458***(0.0918)	0.2242***(0.0452)	0.0151(0.0450)
DGI	1.0273***(0.1515)	-0.1148*(0.0642)	0.0358(0.0243)
LED	0.2631***(0.0238)	-0.0215(0.0163)	0.0678***(0.0086)
TI	0.0607***(0.0086)	-0.0080**(0.0031)	-0.0129***(0.0049)
RDI	-0.6032(0.4920)	0.9795**(0.3748)	0.9532***(0.1993)
_cons	-3.7572***(0.3343)	0.4038*(0.2132)	-0.5231***(0.0803)
N	132	96	132
adj. R2	0.7830	0.8102	0.9572

Note: \* $p < 0.1$ , \*\* $p < 0.05$ , \*\*\* $p < 0.01$

The results of the regional grouping regression analysis indicate that the impact of Technology-Driven New Quality Productive Forces (TNQPF) on High-Quality Development of Foreign Trade (HDFT) exhibits significant gradient differences. The TNQPF coefficient for the eastern region reaches 0.6485 and is statistically significant at the 1% level, indicating that its first-mover advantage in the commercialization of AI technology has been efficiently converted into trade competitiveness. This powerful enabling effect stems from a three-pronged synergy mechanism involving "demand, supply, and institutional frameworks." From the perspective of industrial demand, as the core hub of China's foreign trade, the eastern region has a huge cross-border e-commerce transaction volume. The high frequency and complexity of trade scenarios drive the iteration of AI technology. From the innovation supply side, the eastern region accounts for 65% of the nation's AI-related patents and 70% of AI-listed companies, forming a collaborative innovation chain of "research institutions - technology companies - foreign trade enterprises"; From the institutional side, the policy advantages of pilot free trade zones have broken through key bottlenecks, while the central and western regions, due to lagging data security policies, have seen many foreign trade enterprises' AI models suffer from significant prediction errors due to insufficient training data.

The coefficient for the central region (0.2242) also passed the 1% significance test, but the shortage of AI talent resulted in a technology conversion efficiency of only 34.7%. The core constraints stem from the dual pressures of lagging traditional industrial transformation and the loss of innovative elements: on the one hand, foreign trade in central China is dominated by traditional manufacturing industries such as steel and machinery, with rigid industrial production processes and severely aging equipment. Most of the old equipment lacks sensor interfaces, resulting in a data coverage rate of less than 20% for equipment fault warning algorithms based on random forests. On the other hand, the density of AI R&D personnel in central China is low, and the shortage of talent has led to a breakdown in the "last mile" of technology implementation.

The coefficient for the western region is 0.0151, which did not pass the significance test. The fundamental reason lies in the systemic mismatch between the economic struc-

ture and digital infrastructure: first, resource-based products such as energy and minerals account for over 75% of the western region's foreign trade, and the production and trade processes of these products have minimal demand for AI technology; second, digital infrastructure suffers from a "shortage in both quantity and quality," with low 5G base station density in the western region, and most base stations concentrated in provincial capital cities; third, the western region lacks industrial clusters, making it difficult for AI technology applications to achieve economies of scale.

The mechanism of control variables also exhibits systematic regional differentiation. Government intervention in the eastern region exhibits a strong positive effect (1.0273,  $p < 0.01$ ), stemming from a policy combination of "institutional innovation + market orientation." In contrast, the coefficient for the central region (-0.1148) is significantly negative at the 10% level, reflecting the inhibitory effect of administrative intervention on market vitality. The western region, however, did not exhibit a significant effect due to inadequate policy implementation. Transport infrastructure significantly promotes trade development in the eastern region (0.0607,  $p < 0.01$ ), benefiting from the deep application of path optimization algorithms in smart logistics hubs, while both the central and western regions exhibit inhibitory effects (central -0.0080, western -0.0129), exposing a structural mismatch between infrastructure investment and the demand for AI technology application. Research and development intensity exhibits a prominent innovation catch-up effect in the central and western regions (central: 0.9795, western: 0.9532), with marginal benefits exceeding 1.5 times those of the eastern region. However, due to talent shortages, the technology transfer rate of R&D outcomes in these regions is only half that of the eastern region. The eastern region, where innovation resources are nearing marginal saturation, does not exhibit significant effects.

The significant differences in model fit further corroborate the existence of regional systemic heterogeneity. The western region's model achieved a fitting degree as high as 0.9572, significantly outperforming the eastern and central regions, strongly indicating that exogenous factors such as policy interventions and resource reallocation have a stronger explanatory power for the improvement of foreign trade quality in the western region. In contrast, the relatively lower fitting degree in the eastern region suggests that its foreign trade development is influenced by a more complex and diverse array of global factors, such as international competition and technological barriers.

In summary, the empirical results of this study clearly depict the regional gradient differences in Technology-Driven New Quality Productive Forces driving High-Quality Development of Foreign Trade and reveal the systematic regional differentiation of the control variable mechanism. The differences in the depth, breadth, and effectiveness of computer technology application are the core microfoundation explaining this heterogeneity.

## 5 Conclusions and Policy Recommendations

### 5.1 Research Conclusions

This study empirically examines the impact mechanism of Technology-Driven New Quality Productive Forces on the High-Quality Development of China's Foreign Trade

based on panel data from 30 provinces in China from 2011 to 2022. The research confirms that the enhancement of Technology-Driven New Quality Productive Forces has a significant positive promotional effect on the High-Quality Development of China's Foreign Trade. Among these, the penetration of AI technologies such as machine learning algorithm optimization, computer vision quality inspection upgrades, and NLP cross-border service enhancements are the core drivers, highlighting that technology-driven productivity is the core momentum for breaking through the traditional bottlenecks in China's foreign trade development.

Heterogeneity analysis reveals regional gradient differences: The eastern region has the strongest marginal effect on AI technology commercialization efficiency, benefiting from the deep application of deep learning models and intelligent algorithms; the central region lags behind in industrial Internet applications, particularly in terms of low coverage of predictive maintenance algorithms; the western region is constrained by weak digital infrastructure, insufficient edge computing and real-time data processing capabilities, and has not yet formed a significant impact.

Among the control variables, a 1-unit increase in RDI drives a 0.6385-unit increase in the quality of China's foreign trade, confirming the critical role of innovation investment; improved TI significantly enhances trade upgrading by reducing logistics costs; DGI exhibits regional differentiation effects, leveraging institutional supply advantages in the eastern regions, while the central regions face suppression due to insufficient policy-market coordination.

## 5.2 Policy Recommendations

Based on the findings of this empirical study, which reveal significant regional heterogeneity and differentiated control variable mechanisms in the role of Technology-Driven New Quality Productive Forces in empowering high-quality foreign trade development, the following three-dimensional policy recommendation system is proposed to promote the transformation and upgrading of foreign trade in line with regional coordinated development:

### 5.2.1 Macro Level: Building a Technology Gradient Support System.

In response to differences in regional innovation momentum, targeted policy interventions are needed<sup>[5]</sup>. The eastern region should focus on cutting-edge fields such as AI large models, using tax credits to incentivize basic research into Transformer models, knowledge graphs, and other technologies. It should leverage free trade pilot zones to establish cross-border data compliance platforms and strengthen technology spillover effects; Central and western regions should strengthen AI computing infrastructure development, deploying supercomputing center nodes in hub cities like Chengdu-Chongqing and Wuhan. They should utilize R&D expense super-deduction incentives and targeted support from the National New Quality Productivity Special Fund to advance core technology breakthroughs in areas like industrial quality inspection CNN models and logistics route optimization algorithms<sup>[6]</sup>.

### 5.2.2 Meso Level: Optimizing the Synergy Between the Digital Industry and Infrastructure.

To resolve the regional mismatch in transportation infrastructure, it is necessary to promote synergy between industrial layout and infrastructure upgrades<sup>[7]</sup>. The eastern region can leverage its existing industrial foundation to establish an innovation corridor, consolidate its advantages in the iterative development of technologies such as federated learning and digital twins, and strengthen the competitiveness of its high-end industrial chain segments. The central and western regions should focus on manufacturing, forming a supply chain gradient of "eastern R&D (algorithm design) — central and western conversion (model application)." At the same time, the central and western regions need to shift to efficiency-oriented infrastructure, building smart logistics hubs in hub cities such as Xi'an and Zhengzhou, deploying edge computing nodes to support real-time data processing for AIoT devices, and piloting data circulation mechanisms.

### 5.2.3 Micro Level: Activating Corporate Technological Innovation and risk Response Capabilities.

To address the regional disparities in R&D capacity and digitalization levels among small and medium-sized enterprises, it is necessary to improve the ecosystem for cultivating corporate capabilities<sup>[8]</sup>. The "cross-provincial innovation voucher" system can be implemented to cover the AI model pilot testing phase, thereby reducing corporate innovation costs and promoting the commercialization of technological achievements. A flexible talent mobility system should be established to focus on attracting machine learning engineers and NLP algorithm experts, promoting deep collaboration between industry, academia, and research, and injecting innovative vitality into enterprises. The scope of intellectual property pledge financing should be expanded to include AI algorithm patents and computer software copyrights as pledge collateral, alleviating corporate financial pressure. At the same time, legal assistance for cross-border disputes should be provided to reduce innovation risks.

## References

1. Liu Y ,Duan D ,Feng Z .The Impact of New Quality Productive Forces on the High-Quality Development of China's Foreign Trade[J].Systems,2025,13(5):367-367.
2. Liang M ,Chen H .Digital economy development, regional openness, and high-quality foreign trade[J].Finance Research Letters,2025,81107469-107469.
3. Zhang L, Wang H. Computer Vision-Based Quality Inspection for Export Products: A Case Study in Guangdong Province [J]. IEEE Transactions on Industrial Informatics, 2023, 19 (7): 7890-7898
4. Porter, M. E. (1990). *The Competitive Advantage of Nations*. Free Press.
5. Cipollina M., Demaria F., Pietrovito F. Deter-minants of trade: The role of innovation in presence of quality standards[J]. Journal of Industry, Competition and Trade, 2016(16): 455-475.
6. Zhou, S., Wang J., & Lin X. (2023)."Artificial Intelligence, Manufacturing Innovation Chain, and High-Quality Economic Development." *Science and Technology Management Research*, 43(7), 171–181.

7. Gereffi, G. (2019). \*Global value chains and development: Redefining the contours of 21st century capitalism\*. Cambridge University Press. <https://doi.org/10.1017/9781108559417>.
8. Pan K., He F., Liu R. Does high-tech industry agglomeration promote its export product upgrading:Based on the perspective of innovation and openness[J].Sustainability, 2022(13): 8148.

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