Can China's Pilot Free Trade Zone Improve New Quality Productive Forces In Pilot Areas?

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【ABSTRACT】
As a new focal point for China's embrace of openness in this new era, the Pilot Free Trade Zone should play a more significant role as a testing ground and provide greater opportunities. The impact and mechanism of establishing free trade zones on the advancement of new quality productive forces in pilot regions based on theoretical analysis. Findings indicate formation can effectively promote improvements forces within pilot regions, with these conclusions remaining robust after conducting various tests. Mechanism analysis reveals that implementing Free Trade Zone policies can drive the advancement of new quality productive forces by promoting scientific and technological innovation, advancing industrial chain modernization processes, and enhancing international trade competitiveness. Furthermore, heterogeneity analysis demonstrates that pilot policies have a more pronounced enabling effect in eastern coastal regions. The research unveils the policy effects of "free trade zones," which hold great significance for expanding high-level openness and accelerating advancements.

【Keywords】
Free Trade Zone; New Quality Productive Forces; Science and Technology Innovation; Modernization of Industrial Chain; International Trade Competitiveness.

JEL codes: F23, O32

I. Introduction

As a specific manifestation of advanced productivity, the core characteristics of new quality productive forces are original and subversive scientific and technological innovations, with a focus on high-quality characteristics. The advancement of new quality productive forces emphasizes fostering new industries, new models, and new momentum, aligning with the new advancement concept of advanced productivity. It is an inevitable choice for all regions and departments to establish new engines of economic advancement and build new advantages in the progress.

Continuously cultivating more dynamic innovative subjects and cutting-edge technologies, accelerating the advancement, strengthening the exploration of rules in emerging fields such as digital trade and green trade, and aggregating global higher-quality resources and elements to accelerate the rise of a vital intersection of the dual cycle, becoming a critical focal point.

To sum up, the research also analyzes the transmission paths between the two from multiple perspectives, aiming to provide a robust reference. Compared to previous research, this study's unique contributions are as follows:

First, regarding the research perspective, the study expands the research framework from the standpoint of high-level extensive engagement with the global community. Additionally, it empirically tests quasi-natural experiments set up within the Pilot Free Trade Zone using the difference-in-differences model, providing new viewpoints and empirical evidence for promoting high-quality development through high-level extensive engagement with the global community.

I. Institutional Background

The Free Trade Zone (FTZ) policy is a trade arrangement in which a country or region implements a special economic management system in its foreign economic activities. To further open up markets, FTZs have gradually eliminated tariff and non-tariff barriers for the majority of goods [1], while improving market access conditions within the services sector, making them specific zones for the liberalization of trade and investment. Within the new period of promoting high-quality economic advancement, China still

faces numerous challenges that hinder the improvement of trade quality, such as the rise of international trade protectionism and the obstruction of the free trade process [2]. This initiative aims to ensure the stability of trade and the economic landscape, thereby promoting a new pattern of comprehensive openness for advancement [3].

The country's pioneering negative list was introduced, along with the launch of its first trade "single window" and the creation of the inaugural free trade account. This series of achievements has contributed numerous "Shanghai experiences" to the thorough intensification. Serving as the "vanguard" of comprehensive reform and a driving force for high-quality advancement.

The following pilot free trade zones were formed in the specified years:

- 2015: The provinces of Guangdong and Fujian, as well as the municipality of Tianjin
- 2017: The provinces for examples as Hubei, Sichuan, and Shaanxi, as well as the municipality of Chongqing, Liaoning, Zhejiang, Henan,
- 2018: The province of Hainan
- 2019: The provinces of Hebei, Yunnan, and Heilongjiang, Shandong, Jiangsu, Guangxi,
- 2020: The municipalities of Beijing and Anhui, as well as the province of Hunani

On November 1, 2023, the Xinjiang Pilot Free Trade Zone was officially unveiled and established in Urumqi, becoming China's 22nd also the first one established in the northwest border region.

According to information from the Ministry of Commerce, in 2022, They contribute over one-sixth of the value. This provides robust support for China in advancement. In summary, the pilot free trade zone not only bears the vital responsibility of further liberalizing and facilitating trade, expanding high-level, as well as promoting high-quality industrial advancement, but it also represents a crucial strategic initiative to drive the region's high-quality development.[20]

II. Theoretical Analysis and Research Assumptions

As a crucial foundation for realizing the Chinese path to modernization. These forces represent the qualitative changes and upgrades of traditional production drivers, with a rich theoretical connotation and distinctive characteristics of the times [4].

They are advanced production drivers spawned by profound industrial transformation and upgrading, innovative distribution of production factors, Such as labor and means of production, along with their combinations. A high level of extensive engagement with the global community. From the perspective that production drivers determine production relations, and production relations react to production drivers under certain conditions, the reform of production relations—such as institutional reform and the allocation of production factors involved in high-level openness—is an inherent requirement and a vital focus for cultivating new drivers for advancing.

As a concrete practice of exploring new modes of institutional openness and building a new system of institutional opening, the pilot free trade zone serves as an "experimental zone" for promoting innovation in economic, scientific, and technological systems and creating cutting-edge industrial clusters. It is an even more vital carrier for promoting extensive engagement with the global community and cultivating dynamic new energy for advancing new quality productive forces.

The exchange and sharing of global knowledge and technology. Adhering to open development helps accelerate the introduction, incubation. Therefore, the advancement is intrinsically aligned with a high level of extensive engagement with the global community.

They have emerged as pivotal forces in China's efforts to attract foreign investment, international advanced technology, and management expertise. Through bold innovations in promoting, these zones have led in enhancing the market competitiveness of export products and services [5].

Additionally, exhibit characteristics of the times, such as innovation, leadership, integration, digitalization, and green development. Benchmarked against international high standards, the

pilot free trade zone takes the lead in piloting and adhering to the core of system innovation [6]. It focuses on leading industries such as integrated circuits, biomedicine, and artificial intelligence while continuously promoting the digitalization and green transformation of traditional industries. The zone is committed to creating world-class industrial clusters. Its advancement concept, construction tasks, and industrial positioning align closely.

H1: The formation of pilot free trade zones could catalyze the advancement of new quality productive forces within the pilot regions.

Boosting the advancement of new quality productive forces could be summarized in three aspects:

(1) As China's economy undergoes a crucial period of transitioning its advancement mode, as well as transforming growth momentum, scientific and technological innovation has become a key driver for improving production efficiency, supply capacity, as well as potential growth rate. Particularly by utilizing disruptive and cutting-edge technologies to give rise to new industries, modes, as well as kinetic energy, thereby developing new quality productive forces. To fully implement the innovation-driven advancement strategy, pilot free trade zones adhere to the dual-wheel drive of system innovation and scientific & technological innovation, aligning with the coordination of the National Innovation Demonstration Zone. Moreover, these zones amplify the integrated effect of policies, accelerating the flow and accumulation of innovation factors while strengthening scientific & technological innovation to cultivate new quality productive forces[7].

The pilot free trade zones establish more open and effective talent introduction policies and cultivation mechanisms, drawing in a substantial number of top-tier talents, stimulating the accumulation effect of talent and innovation factors within the pilot regions[8]. On the other hand, these zones serve as carriers for the high-quality advancement of characteristic industrial clusters, creating better employment environments and attracting talents, especially innovative talents, through their key layouts for emerging industries.

Additionally, Improved trade facilitation within the pilot zones has strengthened domestic and international exchanges and cooperation, contributing to the introduction and optimization of

advanced technologies[9]. There remains a heavy reliance on imports for key regions such as core materials and high-end equipment. To overcome the challenge of dependence on foreign technology, it is imperative to pursue breakthroughs in core technologies through both internal and external means, potentially requiring a strategic shift in approach to "change lanes and overtake" in the pursuit of technological advancement. It could accelerate the aggregation and flow, thus improving the level of technology[10].

H2: The execution of free trade zone policies enhances the advancement level of new quality productive forces within the pilot regions by promoting scientific and technological innovation.

(2) In March 2024, highlighting the Chinese style and consolidating the advancement. Industrial chain modernization involves the transformation, accelerating the cultivation of advanced production drivers, as well as giving rise to new advancement modes by enhancing the innovation capacity, market competitiveness, as well as resilience of industrial chains[11]. pilot free trade zones create a conducive institutional framework for industrial chain modernization, particularly amidst the emerging wave of scientific breakthroughs and industrial transformation, serving as a powerful support for enhancing industrial chain resilience and resolving the risk of industrial chain breakage. As platforms for high value-added industrial clusters, free trade zones leverage the effects of economies of scale, factor allocation, as well as innovation incentives to realize synergistic advancement across entire chains and enhance industrial chain competitiveness. Moreover, regarding regional transformation and upgrading, free trade zones effectively utilize high-end factor agglomeration platforms to accelerate the advancement of future industries[12], specifically focusing on strategic emerging industries such as 5G, artificial intelligence, advanced equipment, bio-medicine, as well as other key sectors. This approach facilitates the practical implementation of decision-making and deployment for modernizing industrial chains. From the standpoint of international cooperation, free trade zones benchmark against advanced international rules, actively explore new modes of international cooperation, as well as deeply utilize high-quality international resources through industry chain integration and business process re-engineering, constantly improving the industrial advancement

potential of pilot regions and realizing the strategic goal of promoting industrial chain modernization through global community.

H3: The execution of free trade zone policies enhances the advancement level of new quality productive forces in the pilot regions by promoting the process of industry chain modernization.

(3) The construction helps to enhance the competitiveness of international trade, thereby promoting the emergence of a new pattern for high-quality advancement of new quality productive forces. As first-class international business platforms, pilot free trade zones are dedicated to creating open environments with broader visions of free-flowing circulation and mutually beneficial cooperation while continuously promoting trade as well as investment to enhance international trade competitiveness. The formation has expanded the degree of economic freedom in pilot regions, promoting product quality upgrading by lowering trade barriers, enhancing the international trade competitiveness of local products. Furthermore, free trade zones actively benchmark against, eliminating institutional differences between foreign investments, forming consensus business environments, as well as thus enhancing the international competitiveness of industries, creating favorable international environments.

H4: Implementing free trade zone policies enhances the advancement level of new quality productive forces in the pilot regions by strengthening international trade competitiveness.

III. Research Design and Data Sources

1. Information Sources

The research utilizes panel information from thirty-one. The dataset comprises a total of 341 sample observations.

2. Model Settings

The pilot FTA is employed to precisely identify the net effect of establishing free trade zones . Considering that the pilot free trade zones were formed in batches across different cities. The specific model is presented in equation (1):

$$NQPF_{i,t} = \beta_0 + \beta_1 DID_{i,t} + \beta_2 Controls_{i,t} + \mu_i + \varphi_t + \varepsilon_{i,t} \quad (1)$$

While the remaining samples are assigned a value of 0. 'β1' is the coefficient to be estimated, representing the marginal effect of establishing a free trade experimental zone on the new production drivers of pilot regions.

Mechanism Model. To clarify whether scientific and technological innovation, industrial chain modernization, as well as international trade competitiveness play mediating roles in new quality productive forces, the following models are constructed:

$$NQPF_{i,t} = \beta_0 + \beta_1 \quad M_{i,\ t} + \beta_2 Controls_{i,t} + \mu_i + \varphi_t + \varepsilon_{i,t} \quad (2)$$

$$M_{i,t} = \beta_0 + \beta_1 DID_{i,t} + \beta_2 Controls_{i,t} + \mu_i + \varphi_t + \varepsilon_{i,t} \quad (3)$$

In these equations, '$M_{i,t}$' represents the mediating variables, including measures, industrial chain modernization, as well as international trade competitiveness. The other variables are described as above.

3. Explanation of Variables

Dependent Variable: advancement level of new quality productive forces in sample cities ($NQPF_{i,t}$). Following the approach of Chinese scholars Lu Jiang et al. (2024).

Table 1. New quality productive forces index evaluation system

Primary Indicator	Secondary Indicators	Level Three Indicators	Explanation	Attributes
Technological productivity	Innovative productivity	Innovative research and development.	Number of Granted Domestic Patents	+
		Innovative industries	Revenue from high-tech industry operations	+
		Innovative product	Funds for industrial innovation in scale-above enterprises.	+
	Technological productivity	Technological efficiency	Labor productivity of industrial enterprises above designated size	+
		Technological production	Installation of the robot at its original density	+

		Energy Intensity	Energy consumption/Gross Domestic Product (GDP)	-
Green Productivity	Resource-efficient productivity	Water Intensity	Industrial water consumption /Gross Domestic Product (GDP)	-
		Waste Utilization	Comprehensive utilization/ generation ratio of industrial solid waste	-
		Wastewater discharge	Industrial wastewater discharge volume/ Gross Domestic Product (GDP)	+
	Environmentally-friendly productivity	Electronic Information Manufacturing	Integrated Circuit Production Volume	-
		Telecommunication Services and Communication	Total volume of telecommunication services	-
		Internet penetration rate	Number of broadband internet access ports	+
Digital productivity	Digital Industry Productivity	Software Services	Software business revenue	+
		Numeric Information	Length of optical cable routes/Area of the region	+
	Industrial digital productivity	E-commerce	E-commerce sales revenue	+

Mediating variables: a) Level of science and technology innovation ($INN_{i,t}$). b) Modernization of the industrial chain ($MIC_{i,t}$), measured using 15 secondary indicators from six dimensions: industrial chain foundation, digitization, innovation, resilience, synergy, as well as sustainability. The international market share index, with logarithmic processing applied.

Table 2. Evaluation Index System for Modernization of Industrial Chain

Primary Indicator	Secondary Indicators	Explanation	Attributes

Industrial Chain Foundation	Circulation Capability	Total road mileage / 100 km^2	+
		Railway operating mileage / 100 km^2	+
		Turnover of goods	+
	Communication support	Number of Web broadband access ports per ten thousand people	+
		Length of long-distance optical cable per unit area per ten thousand people	+
Digitalization of the industrial chain	Enterprise Digitalization	Number of computers used per hundred people	+
		Number of websites owned /100 enterprises	+
		Proportion of enterprises engaged in e-commerce transactions to the total number of enterprises	+
Innovation of the industrial chain	Innovative output	Number of PCT international patent applications	+
		Transaction volume in the technology market	+
		Proportion of sales revenue from new products of industrial	+

		enterprises above designated size to main business income	
Resilience of the industrial chain	Leading the way in high-end sophistication	Fixed asset investment in the productive service industry as a proportion of the total service industry	+
		Main business income of strategic emerging industries	+
		Proportion of main business income of strategic emerging industries to manufacturing industry	+
		Main business income of high-tech manufacturing industry	+
		Proportion of main business income of high-tech manufacturing industry to manufacturing industry	+
		Rationalization of industrial structure	+
		Upgrading of industrial structure	+
	Chain control power	Number of top 100 multinational corporations	+

		Number of top 500 manufacturing enterprises in China	+
		Number of most valuable brands in China	+
Synergistic Industry Chain	Financial Synergy	Outstanding loan balance of banking financial institutions	+
		Proportion of outstanding loans of banking financial institutions to GDP	+
	Innovative Coordination	External expenditure on R&D by industrial enterprises above designated size	+
		Proportion of external expenditure on R&D by industrial enterprises above designated size to GDP	+
	Industrial Synergy	The EG index for the synergistic agglomeration of manufacturing and productive service industries per hundred	+
Sustainability	Energy-efficient	Unit area energy consumption of	-

of the industrial chain	production	gross domestic product	
		Electricity consumption per unit industrial value added	-
	Pollution Index	Carbon dioxide emissions per unit industrial value added	-
	Green Governance	Comprehensive utilization rate of industrial general solid waste	+
		Proportion of investment in industrial pollution control projects completed this year to industrial value added	+

The outcomes indicate that the mean value of NQPF across provinces from 2012 to 2022 is 0.199. The mean value of the FTA dummy variable ($DID_{i,t}$) is 0.334, indicating that the proportion of information in the experimental group within the overall sample is 33.4%. Regarding the control variables, a comparison with previous studies reveals that all variables are distributed within a reasonable range, without any severe left or right bias.

Table 3. descriptive statistics

Symbols	N	Mean	Std.Dev	Min	Max
$NQPF_{i,t}$	341	0.199	0.181	0.030	0.880
$DID_{i,t}$	341	0.334	0.472	0	1
$INN_{i,t}$	341	13.579	1.140	10.637	16.283
$MIC_{i,t}$	341	0.200	0.080	0.040	0.547
$MS_{i,t}$	310	-6.588	1.846	-11.670	-2.900
$INF_{i,t}$	341	11.705	0.841	9.347	12.913

$GDP_{i,t}$	341	10.897	0.445	9.849	12.155
$FTD_{i,t}$	341	0.260	0.266	0.008	1.354
$HC_{i,t}$	341	0.021	0.008	0.006	0.114
$URB_{i,t}$	341	0.598	0.127	0.229	0.896
$INDS_{i,t}$	341	1.305	0.716	0.549	5.297
$FIN_{i,t}$	341	1.520	0.447	0.701	2.996

IV. Empirical Assessment for the Effect of Pilot Free Trade Zones Regarding the Advancement of new quality productive forces in Pilot Cities

1. Baseline Regression outcomes

Column (1) displays the results when individual is not controlled, and no control variables are introduced. Column (2) shows the results when individual is controlled, but no control variables are included. Column (3) presents the results when both individual and time-fixed effects are controlled, and control variables are introduced. Notably, under various combinations of variables, the estimated coefficients of the DIDi,t_{i,t}i,t variables are consistently significant at the 1% level, confirms Hypothesis 1.

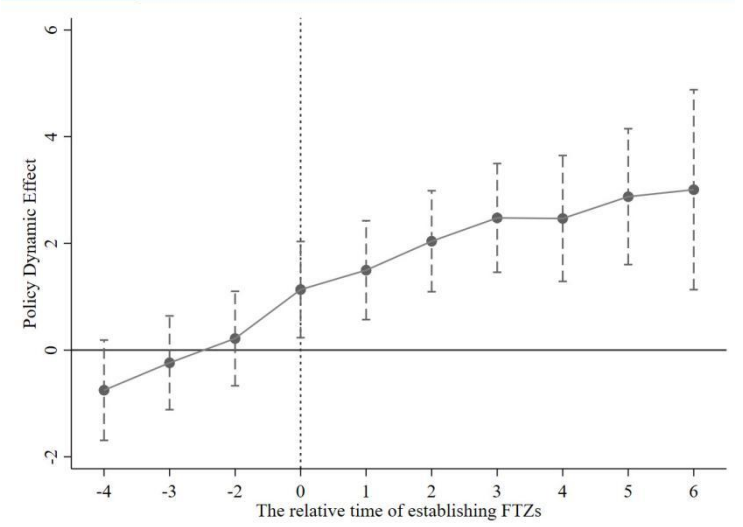
Effectively assist the advancement of regional new quality productive forces by leveraging their role as radiation-driven driving forces.

Table 4 Baseline regression results

	$NQPF_{i,t}$		
	（1）	（2）	（3）
$DID_{i,t}$	0.120***	0.021***	0.025***
	(6.08)	(3.05)	(3.97)
$INF_{i,t}$			-0.015
			(-0.46)
$GDP_{i,t}$			0.156***
			(3.48)
$FTD_{i,t}$			-0.208***

			(-5.30)
$HC_{i,t}$			-0.650*
			(-1.80)
$URB_{i,t}$			0.478**
			(2.48)
$INDS_{i,t}$			0.034**
			(2.58)
$FIN_{i,t}$			0.008
			(0.65)
_cons	0.159***	0.374***	-1.569***
	(13.84)	(31.19)	(-3.10)
Province FE	NO	YES	YES
Year FE	NO	YES	YES
N	341	341	341
R^2	0.096	0.964	0.969

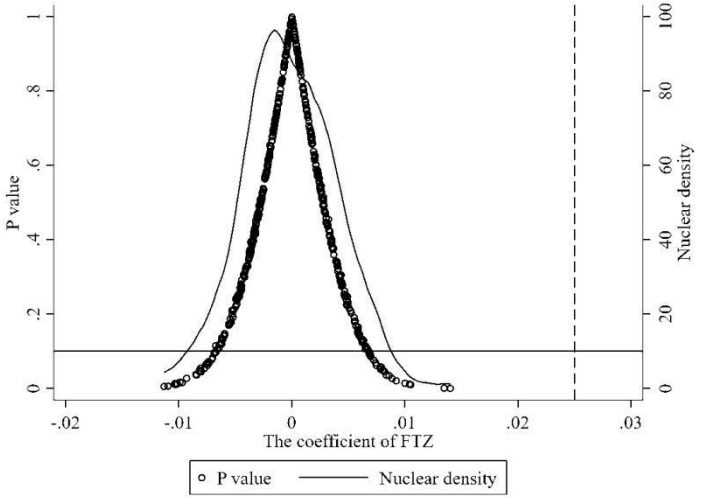
2. Parallel Trend Test



3. Placebo Test

Although the baseline model controls, vital explanatory variables may still be omitted. To test the extent to which the outcomes are affected by omitted variables and random factors (Li P et al., 2016) [15], "pseudo-policy dummy variables" are constructed

through random sampling 500 times for regression analysis and plotted in a scatter plot, as shown in Figure 2. Indicating that the benchmark regression outcomes are not randomly generated, proving the effectiveness of the pilot policy.



4. Robustness Tests

(1) Propensity Score Matching: To eliminate bias caused by sample selection, the research adopts the commonly used radius matching method in propensity score matching, fixing time and individual effects. The outcomes, shown in column (1) of Table 5.

(2) Instrumental-Variable Method: To mitigate endogeneity and ensure the reliability of the study, an interaction term between the average area of economic and technological advancement zones in each province and post in the first five years of the sample period from 2007 to 2011 was employed and incorporated into the two-stage regression model. The outcomes reduce the influence of sample selection bias and strengthening.

(3) Excluding Special Years: To avoid the negative effect of the 2020 epidemic on the advancement in the pilot regions, the research excludes the 2020 samples and conducts the base regression again to test the robustness of the outcomes.

Table 5. Robustness tests results

	$NQPF_{i,t}$		
	(1)PSM	(2)IV-2SLS	(3)Excluding

			special years
$DID_{i,t}$	0.0145***	0.034**	0.0256***
	(2.65)	(2.11)	(3.67)
Controls	Y	Y	Y
Province FE	Y	Y	Y
Year FE	Y	Y	Y
N	276	341	310
R^2	0.983	0.973	0.966

5. Mechanism regression outcomes

The research adopts the aforementioned mechanism model and takes the level of innovation (INNi,t_{i,t}i,t), modernization of the industry chain (MICi,t_{i,t}i,t), and international trade competitiveness (MSi,t_{i,t}i,t) as intermediary variables to conduct regression tests. The test outcomes are presented in Table 6.

First, analyzing from the standpoint, the outcomes in column (1) indicate the validity of the mediating effect test condition. Furthermore, the outcomes in column (2) demonstrate that the coefficient.

Second, from the standpoint of industrial chain modernization, the outcomes in column (3) show that the influence coefficient of industrial chain modernization on new quality productive forces is 0.652, surpassing the significance test at the 1% level, which validates the test condition for the mediating effect of Hypothesis 3. Moreover, the outcomes in column (4) reveal that the coefficient of free trade zone establishment on the level of industry chain modernization is 0.009, surpassing the significance test at the 1% level. This verifies the "free trade zone establishment → industry chain modernization → new quality productive forces" path, confirming Hypothesis 3. Through the open advancement and synergistic layout of featured industries, it enables better linkage and allocation of high-quality resources both internally and externally. Simultaneously, it allows for the forward-looking layout of the modernized industrial system, continuously promoting "new quality production drivers."

Third, analyzing from the standpoint of international trade competitiveness, due to the lack of MSi,t information values in 2022, the benchmark regression is conducted again for the 2012-2021

sample to avoid the effect of sample reduction. The mechanism model outcomes are presented in Columns (6)-(7). The outcomes in Column (6) validate the condition for testing the mediating effect of Hypothesis 4. Furthermore, the outcomes in Column (7) confirm Hypothesis 4. Solidly advancing, continuously pushing forward trade and investment facilitation reforms, and further enhancing the competitiveness of foreign trade in the pilot zones creates a international advancement.

Table 6. Mechanism regression results

	science and technology innovation		industrial chain modernization		International trade competitiveness		
	(1)$NQPF_{i,t}$	(2)$INN_{i,t}$	(3)$NQPF_{i,t}$	(4)$MIC_{i,t}$	(5)$NQPF_{i,t}$	(6)$NQPF_{i,t}$	(7)$MS_{i,t}$
$DID_{i,t}$		0.239***		0.009**	0.023***		0.288***
		(5.38)		(2.52)	(3.33)		(5.77)
$INN_{i,t}$	0.045***						
	(5.72)						
$MIC_{i,t}$			0.652***				
			(6.24)				
$MS_{i,t}$						0.019**	
						(2.35)	
Controls	Y	Y	Y	Y	Y	Y	Y
Province FE	Y	Y	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	YES	YES	YES	YES
N	341	341	341	341	310	310	310
R^2	0.970	0.962	0.971	0.953	0.967	0.966	0.983

6. Heterogeneity Test

Given China's unbalanced regional advancement and large differences in regional advancement, free trade zones under different regions may exhibit significant variations in location conditions, advancement foundations, as well as economic scales. Therefore, building upon the benchmark regression. Specifically, the analysis is conducted in two steps. First, based on geographic regions, the free

trade zones are categorized into eastern and central-western regions, as well as an eastern region dummy variable is constructed. By combining this variable with model (4), the heterogeneity of the pilot free trade zones' impact on the pilot region's new production drivers across different geographic regions is examined. Second, the analysis considers whether the sample city belongs to the cities along the border of the "The Belt and Road Initiative". A dummy variable for "The Belt and Road" border cities is constructed and integrated with model (5) to explore the policy effects of integrating free trade zone policies with the "The Belt and Road Initiative". Simultaneously, a Yangtze River Economic Zone dummy variable is constructed and combined with model (6) to analyze the heterogeneity under such geographical characteristics.

$$NQPF_{i,t} = \beta_0 + \beta_1 DID_{i,t} * Eastern_{i,t} + \beta_2 Controls_{i,t} + \mu_i + \varphi_t + \varepsilon_{i,t} \quad (4)$$

$$NQPF_{i,t} = \beta_0 + \beta_1 DID_{i,t} * B\&R_{i,t} + \beta_2 Controls_{i,t} + \mu_i + \varphi_t + \varepsilon_{i,t} \quad (5)$$

$$NQPF_{i,t} = \beta_0 + \beta_1 DID_{i,t} * YEB_{i,t} + \beta_2 Controls_{i,t} + \mu_i + \varphi_t + \varepsilon_{i,t} \quad (6)$$

In these models, $Eastern_{i,t}$, represents the eastern region dummy variable, taking the value of 1 if city i is located in the eastern region and 0 otherwise.

The eastern region of China possesses certain geographic advantages, a more developed industrial structure, as well as well-established factor markets, which enable it to better harness the benefits. This finding highlights the close complementarity between the FTA and the "The Belt and Road Initiative" regarding their mechanisms of action and policy effects. Actively aligning with the "The Belt and Road" strategy could better leverage the platform role of the pilot free trade zone, injecting powerful kinetic energy into the advancement of new production drivers in the pilot area. The Yangtze River Economic Zone, with its population size and total economic output constituting "half of the country", is China's major urban agglomeration, industrial agglomeration, as well as growth pole agglomeration area. The formation of pilot free trade zones in this region could better exert the role of radiation driving and realize

the resonance between the "golden waterway" and the dividends of opening up.

Table 7. heterogeneity test results

	$NQPF_{i,t}$		
	(1)geographic location	(2)The Belt and Road	(3)the Yangtze River Economic Belt
$DID_{i,t}$*$Eastern_{i,t}$	0.024***		
	(2.94)		
$DID_{i,t}$*$B\&R_{i,t}$		0.023***	
		(2.94)	
$DID_{i,t}$*$YEB_{i,t}$			0.025***
			(3.05)
Controls	Y	Y	Y
Province FE	Y	Y	Y
Year FE	Y	Y	Y
N	341	341	341
R^2	0.968	0.968	0.968

V. Main Conclusions and Policy Implications

The outcomes demonstrate the formation enhances production. The mechanism test reveals that free trade zones promote scientific and technological innovation, modernize industrial chains, as well as enhance international trade competitiveness, thereby driving qualitative leaps and bounds in the productivity of pilot regions.

First, as well as the enabling effect of free trade zone policies on the advancement of new quality productive forces should be continuously strengthened. With institutional innovation at its core, a corresponding institutional system must be established and enhanced.

Second, free trade zones should smooth the channels of empowerment to enhance the construction for the sustained advancement of productivity. This involves strengthening scientific and technological innovation, creating an innovation ecosystem, increasing support for science and technology projects in free trade zones, recruiting, cultivating, as well as retaining innovative talents,

as well as facilitating the reasonable flow of information and technology The conversion and application of scientific and technological achievements should be bolstered, as well as the involvement of diverse entities from surrounding cities should be encouraged. Moreover, a forward-looking layout of a modernized industrial system should be established, accelerating the construction of future industry clusters as well as other sectors. The degree of industrial linkage between free trade zones and surrounding cities should be strengthened to rely on the modernization of the industrial chain to bring sustained impetus to the advancement of regional, new quality productive forces. Additionally, greater efforts should be exerted to create a unified, orderly, as well as fully competitive market environment within free trade zones, facilitating the production factors and further enhancing the competitiveness of foreign trade.

Third, differentiated advancement paths of free trade zones should be explored, . Based on location advantages, industrial foundations, as well as degree of openness, allowing institutional opening potential of each zone should be tapped, carrying out in-depth, differentiated exploration and better demonstrating. Furthermore, free trade zones along the Yangtze River should capitalize on the synergies of the Yangtze River Open Economic Belt to establish a new model of industrial advancement characterized by complementary advantages and synergistic interactions between the upper, middle, as well as lower reaches of the river, serving as a new catalyst for expediting.

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