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Carbon Emissions Trading and Urban Green Total Factor Productivity Improvement

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Abstract

Based on the urban panel data from 2009 to 2019, this paper uses Difference-in-difference method (DID) to explore the impact of pilot carbon emissions trading policies on the level of regional green development. The study found that the pilot carbon emission trading policy significantly improved the level of urban green development. This conclusion is still valid after multiple robustness tests. The improvement of urban green total factor productivity is directly related to the high-quality development of the manufacturing industry: the 19th National Congress of the Communist Party of China included high-quality development in the national development goals for the first time. Under the current policy background, a thorough explanation of the relationship between the implementation of the "dual carbon" goals and the high-quality development of the manufacturing industry is an inevitable requirement to promote the transformation of China's manufacturing industry and achieve the goal of high-quality development. This article analyzes China's carbon emissions trading policies and high-quality transformation of manufacturing industry development based on literature analysis. It elaborates on the connotation of carbon emissions trading and high-quality development of manufacturing industry, and summarizes the path to achieve high-quality development of manufacturing industry.

Keywords

Carbon Emission Trading; Green Total Factor Productivity; Manufacturing Transformation; DID.

1. Introduction

The comprehensive construction of a socialist modernized country has entered a new stage, and high-quality development has become the primary task at present. High quality development is different from the emphasis on quantity in the early stages of "extensive" development in the past. It pays more attention to achieving effective improvement of "quality" on the basis of maintaining reasonable growth of "quantity", further improving production efficiency, and paying attention to environmental protection during the development process. At the 75th United Nations General Assembly, China solemnly announced that it would strive to reach the peak of carbon dioxide emissions by 2030 and achieve the goal of carbon neutrality by 2060; Since the signing of the United Nations Framework Convention on Climate Change, many countries have chosen to establish carbon emission trading markets to achieve emission reduction goals. In 2013, China also carried out preliminary pilot projects for carbon emission trading in Beijing, Shanghai, Tianjin, Chongqing, Shenzhen, Guangdong, and Hubei to improve green total factor productivity and achieve high-quality development and transformation of the manufacturing industry Building a modern industrial system is a key link in promoting high-quality economic development. The high-quality development of the manufacturing industry requires higher levels of technological innovation, but institutional innovation cannot be ignored. Further improvement of relevant institutional mechanisms is necessary to ensure the

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quality of technological innovation; Build a strong engine for the high-quality development of the manufacturing industry and continue to empower the construction of a modern industrial system.

2. Literature Review

Scholars have long conducted research on innovation driven concepts. Michael E. Porter (2002) divided the stages of national economic development into different factor driven periods in his work, first proposing the concept of innovation driven and clarifying that the fundamental driving force of innovation driven is innovation ability, in order to study the competitive advantages between countries. [1] Subsequent scholars have further explored the essence, focus, and construction of innovation systems of innovation driven industries, emphasizing that technological innovation comes from advanced technology, updates of scientific innovation achievements, and widespread application in society (Hong Yinxing, 2013)[2]. In the process of implementing the innovation driven development strategy, the focus of innovation driven industry development should be on cultivating and enhancing independent innovation capabilities (Zhang Xiaodi, 2008)[3], Constructing a new innovative collaborative system through the path of institutional innovation, providing institutional guarantees for technological innovation (Wang Hugen, 2018[4]; Hu Leming et al., 2022)[5]. The issue of environmental protection in the process of industrial transformation is also a hot topic of scholars' research. The government can choose to enhance the innovation capacity of enterprises through appropriate environmental regulation measures (Ma Hedan et al., 2022)[6]and technological efficiency (Wang Xiaoling, 2021) [7].

In recent years, the rise of digital finance has further boosted the innovation and development of multiple industries (Tian Xiujuan et al., 2022) [8]. There is a clear "structural" innovation driving effect in technological innovation, and it can correct the "mismatch" problem in the development process (Tang Song et al., 2020) [9], making it more targeted in supporting enterprise innovation activities (Shi Dan, 2022)[10]. Under the requirements of high-quality development, we will continue to optimize the innovation driven industrial development strategy, promote industrial integration, further improve the institutional mechanisms conducive to scientific and technological innovation, and empower the construction of a modern industrial system.

3. Research Design

3.1. Model Settings

In order to evaluate the impact of the "quasi natural experiment" of carbon emission trading pilot policy on urban green total factor productivity, the following model is constructed based on Difference-in-difference method (DID) for empirical testing:

$$GTFPit=\theta 0+\theta 1did+\theta 2controlit+\mu i+\gamma t+\varepsilon it \quad (1)$$

Among them, the subscript i represents the city, and t represents the year. The explained variable GTFPit is the natural logarithm of green total factor productivity. According to whether it is a pilot policy for carbon emissions trading, a virtual grouping variable named treated is set for the pilot provinces and cities. The pilot provinces and cities are the experimental group, with a value of 1, and vice versa, the control group, with a value of 0. This article takes 2013 as a policy implementation node and constructs a time dummy variable time. After policy implementation (time ≥ 2013), a value of 1 is assigned, and before policy implementation (time<2013), a value of 0 is assigned. The core independent variable did is the interaction term

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of the two virtual variables mentioned above, did =treated * time. controlit represents a series of urban level control variables. Mi, γt represents regional and temporal effects, respectively, εit represents a random Error term. This article focuses on the value of the core parameter θ1 in equation (1) to characterize the net effect of carbon emission trading pilot policies on urban green total factor productivity.

3.1.1. The Dependent Variable

This paper uses the natural logarithm of urban green total factor productivity (GTFP) as the explained variable. This article uses the widely used DDF-GML index method to calculate green total factor productivity.

3.1.2. Core Independent Variable

The core independent variable of this article is the virtual variable did. Based on the carbon emission trading pilot policy, a total of 7 domestic carbon emission trading pilot regions (Beijing, Tianjin, Chongqing, Shanghai, Shenzhen, and cities under the jurisdiction of Hubei and Guangdong provinces) were established with experimental and control groups. Interaction terms were constructed based on the policy pilot time to obtain the core independent variable did.

3.1.3. Control Variables

Based on existing literature, in order to avoid endogeneity issues that may arise from missing variables, this article selects the following control variables: per capita GDP (perGDP), degree of government intervention (inter), degree of openness to the outside world (open), population density (density), and degree of infrastructure improvement (infra). In order to eliminate heteroscedasticity as much as possible, the selected control variables are all natural logarithm. The specific definitions of variables are shown in Table 1.

Table 1. Variable Definition

Type	Name	Symbol	Definition
Dependent variable	Green Total Factor Productivity	GTFP	Natural logarithm of green total factor productivity
Independent variable	Pilot carbon emission trading	did	If city i is a pilot city for carbon emission trading during period t, the value is 1, otherwise it is 0
	Per Capita GDP	pergdp	Per capita GDP value
	Degree of government intervention	inter	Fiscal expenditure and percentage of GDP
	Extent of openness to the outside world	open	Total imports and exports as a percentage of GDP
Control variables	Population density	density	Population density
	Degree of infrastructure improvement	infra	Per capita urban road area

The initial data used in this article comes from "China Urban Statistical Yearbook", "China Science and Technology Statistical Yearbook", Wind database, China Urban Database, etc. The descriptive statistics of the above variables are shown in the table below.

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Table 2. Descriptive Statistics

Var	Obs	Mean	Std. dev.	Min	Max
GTFP	3091	-0.022	0.099	-0.303	0.922
did	3091	0.083	0.275	0	1
pergdp	3091	10.599	0.620	8.410	13.056
inter	3091	-6.052	1.593	-11.817	4.364
open	3091	-2.557	1.506	-11.210	2.096
density	3091	5.781	0.762	1.569	7.882
infra	3091	-1.094	0.824	-3.996	4.357

4. Analysis of Results

4.1. Parallel Trend Test

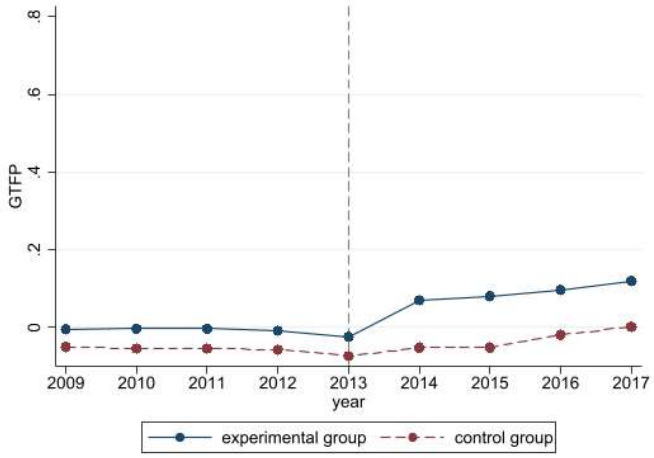

Figure 1. parallel trend test chart

The premise of using the double difference method is that there is no significant difference in the evolution trend of green total factor productivity between the experimental group and the control group before the impact of the policy. Figure 1 is the time trend chart of urban green total factor productivity change. It can be seen that before the year of policy implementation (2013), there is no significant difference in the change trend of urban green total factor productivity between the experimental group and the control group. It can be preliminarily judged that the cities in the experimental group and the control group meet the parallel trend hypothesis before the year of policy implementation, and the difference in the trend of green total factor productivity between the experimental group and the control group after the year of policy implementation is caused by the pilot policy of carbon emissions trading.

4.2. Benchmark Regression Results

This paper establishes a two-way fixed effect model (1) to test the net effect of the pilot policy of carbon emissions trading on urban green total factor productivity. The regression results without adding control variables are shown in Table 3 (1). The impact coefficient of the pilot policy of carbon emissions trading on green total factor productivity is 0.0569, which is significant at the significance level of 1%, It shows that the pilot policy of carbon emission trading can significantly promote the improvement of urban green total factor productivity. Tables (2) to (6) gradually add city level control variables on the basis of column (1) to exclude city level factors that may interfere with green total factor productivity. In the above step-by-step regression process, the impact of the carbon emission trading pilot policy on green total factor productivity is significantly positive, and it is significant at the level of 1%. (6) is the

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regression with all control variables, and the core independent variable coefficient is 0.0568, indicating that the green total factor productivity of the approved carbon emission trading pilot cities is about 5.68% higher than that of the non pilot cities.

The regression results of control variables show that government intervention helps to improve urban green total factor productivity, the impact of opening up and per capita GDP level on urban green total factor productivity is significantly negative, and the impact of population density and infrastructure perfection on urban green total factor productivity is not significant.

Table 3. Baseline regression

var	(1)	(2)	(3)	(4)	(5)	(6)
did	0.0569***	0.0585***	0.0587***	0.0581***	0.0572***	0.0568***
	(3.4267)	(3.4976)	(3.5157)	(3.5191)	(3.5737)	(3.5695)
pergdp		-0.0345***	-0.0291***	-0.0290***	-0.0300***	-0.0285***
		(-4.8155)	(-4.2899)	(-4.2921)	(-4.2368)	(-4.2172)
inter			0.0120***	0.0113***	0.0110***	0.0108***
			(2.8911)	(2.8323)	(2.8728)	(2.8651)
open				-0.0083***	-0.0082***	-0.0082***
				(-2.8248)	(-2.8173)	(-2.8058)
density					-0.0032	-0.0031
					(-0.7194)	(-0.6979)
infra						0.0054
						(0.9790)
City FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
cons	-0.0434***	0.3033***	0.3159***	0.2887***	0.3157***	0.3035***
	(-12.7638)	(4.2190)	(4.3913)	(4.0699)	(3.6578)	(3.6854)
N	3091	3091	3091	3091	3091	3091
adj. R2	0.3108	0.3247	0.3306	0.3335	0.3337	0.3339

4.3. Placebo Test

First, the pilot cities were randomly assigned to form the experimental group cities and the control group cities of the placebo test, and then the sampling estimation was carried out by means of independent repeated experiments. This paper makes 500 random sampling estimates based on samples from randomly assigned pilot cities, and draws Figure 2 based on sampling regression results. It can be found that the estimated coefficient based on random sampling approximately obeys the normal distribution, and the estimated coefficient is concentrated around 0, completely deviating from the real benchmark regression coefficient (0.0568). Most of the P values based on the random sampling estimation coefficient are distributed above the horizontal line of P=0.1 (that is, they are still not significant at the significance level of 10%), which further shows that the estimated results of the policy effect in this paper are unlikely to be obtained by accident. The above test results show that the positive promotion effect of the carbon emission trading pilot policy on urban green total factor productivity is not due to other omitted factors.

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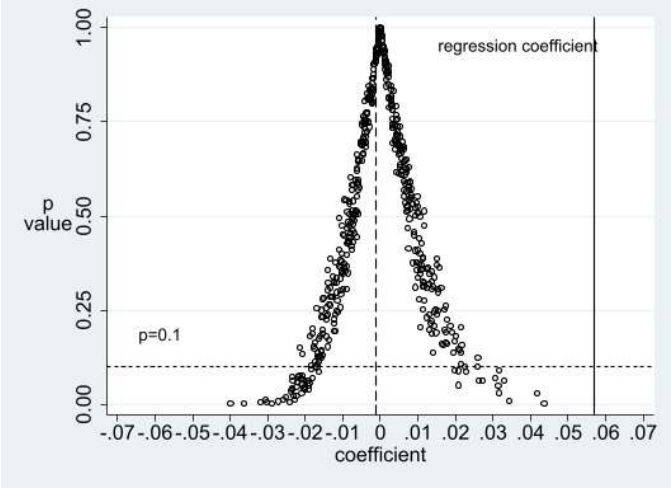

Figure 2. placebo test

5. High-quality Development of Manufacturing Industry and Achievement of "Double Carbon" Goal

At present, the development level of China's manufacturing industry is difficult to match the demand for high-quality industrial development under the background of "double carbon". Most manufacturing industries are still in the middle of the "smile curve" of the industrial chain, mainly in links with low economic added value such as product assembly and OEM of low-tech components. Constrained by factors such as fluctuations in raw material market prices, foreign patent barriers and high-tech blockade, the construction of modern industrial system has encountered many obstacles. The high-quality development of manufacturing industry is the physical cornerstone of improving green total factor productivity and building a green economic system, and is an important guarantee for the goal of comprehensive and high-quality development. To achieve the goal of "double carbon", the high-quality transformation and development of manufacturing industry is not limited to a single level, but a multi-level and overall construction of scientific and technological innovation, system and mechanism innovation, government policy innovation and so on.

The low-quality manufacturing industry with investment and export as the main demand and high pollution and energy consumption as the cost will bring about a relatively rapid development speed in a period of time due to the impact of demographic dividends and economies of scale in the early stage of development[11]. With the continuous development of industry, affected by objective practical factors such as rising labor costs, diminishing economies of scale, lack of resources and environmental constraints, Low tech industries and their corresponding traditional quantitative stacking manufacturing development model are facing the development problems of changes in industrial structure and inefficient resource allocation, which leads to the weakening of the driving role of industrial agglomeration in the initial stage and the bottleneck period of industrial development. The pilot policy of carbon emission trading belongs to a market-oriented environmental regulation means. The government can control the carbon emissions of manufacturing entities through the "carbon trading" market adjustment, and force the manufacturing industry to carry out green technology innovation to achieve energy conservation and emission reduction and eliminate backward production capacity. On the one hand, it is conducive to reducing energy consumption and pollution while increasing production capacity; On the other hand, due to the significant positive externalities of innovation activities, technological progress often radiates to related industries and even the whole society, and green technological innovation of manufacturing industry will further enhance green total factor productivity. Today's world is

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facing a new round of scientific and technological revolution and industrial revolution. China's industrial development needs to seize the opportunity to complete the transformation and upgrading, get rid of the development model mainly based on the simple superposition of production factors and the injection of low-quality human resources, and turn to a new model of innovation driven industrial development. Under the new development pattern with the domestic circulation as the main body, with innovation driven as the development driving force, we should deeply tap the domestic demand market, meet the social requirements for the development of high-quality manufacturing industry, change the driving force of industrial development, improve the efficiency of industrial development, ensure the quality of industrial development, and establish China's modern high-quality industrial system.

5.1. Composition of High-quality Development in the Manufacturing Industry

The high-quality development of the manufacturing industry mainly includes three aspects: industrial development strategy, industrial development process, and industrial development results. The strategic planning for industrial development is the early guide for high-quality industrial development. Only by first formulating planning goals that are correct in direction and in line with the actual situation of China's manufacturing industry development can the overall direction of high-quality industrial development be clearly defined. Strictly controlling the process of industrial development and improving the quality of the entire process of industrial development is a key link in the high-quality development of the manufacturing industry, which will directly affect the high-quality development of the manufacturing industry. The high-quality development of the manufacturing industry is not only the ultimate goal, but also an important basis for testing the rationality of industrial development strategies and the implementation of industrial development processes. The industrial development strategy leads the overall situation and guides the process of industrial development. The step-by-step implementation of the industrial development process determines the final development results, and the summary of the development results is fed back to the formulation of the development strategy and the optimization and adjustment of the development process. The three interact, depend on each other, and coexist in the high-quality development of the manufacturing industry.

5.2. Requirements for High-quality Development of Manufacturing Industry

The real economy is the cornerstone of the national economic system. With the advent of the digital economy era, the high-quality development of the manufacturing industry needs to promote the organic integration of the real economy industry with the financial and digital industries. The high-quality development of the manufacturing industry requires strengthened linkage among various industries to prevent closed door and isolated development. Organic integration and linkage development between industries can help achieve integration and cooperation between traditional and emerging industries. Emerging industries can inject new blood into the development of traditional industries, providing new development ideas and directions; Relatively, emerging industries can rely on the development foundation of traditional industries for secondary development. With the development foundation of traditional industries as the cornerstone, the development of emerging industries will not have a "castle in the air" style development situation.

The global industrial development process has proven that innovation driven strategies have a significant promoting effect on the high-quality development of the manufacturing industry. In the new development pattern, China's manufacturing industry as a whole cannot adhere to the original development concept and continue to follow the "quantity first" development path in order to achieve high-quality development goals. Entering a new era, the development of the manufacturing industry needs to transform its driving force, and innovation is the core driving force for high-quality development. At present, China's manufacturing industry development

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should adhere to the innovation driven strategy and promote development through innovation[12]. The innovation driven strategy can be mainly implemented in the process of high-quality development of the manufacturing industry from the following aspects: first, strengthen innovation at the technical level, adhere to the innovation driven development strategy, give full play to the positive externality of the innovation strategy, radiate outward to related disciplines and industries, accelerate the industrialization process of scientific and technological achievements, and further build an overall high-quality manufacturing system. The second is to optimize industrial service innovation work, strengthen the integration of other industries with the service industry, continuously increase the proportion of the service industry in the industrial structure, and follow the trend of high-quality development. Transforming from only providing specific products or services in the past to an industry chain that can provide "product manufacturing+service support+technology updates+customized solutions" to meet consumers' constantly upgrading needs, adhering to consumer demand orientation, customizing products and services, and meeting consumers' diverse needs. Technological innovation can lead to product quality upgrades, and while carrying out technological innovation, attention should be paid to maintaining and optimizing innovation in manufacturing service related work. The high-quality development of the manufacturing industry not only emphasizes the improvement of the development quality of the industrial chain itself, but also puts forward higher requirements for whether China's manufacturing industry can better meet the diverse needs of consumers. The optimization and innovation of manufacturing services will directly enhance the experience of consumers interacting with various industries, and further improve the optimization and innovation work of related industry services based on consumer feedback to achieve high-quality development of the manufacturing industry. Thirdly, government policy innovation helps promote high-quality development of the manufacturing industry. As policy makers, the government plays a crucial role in promoting high-quality development of the manufacturing industry and building a modern industrial system. Firstly, for some industries related to national security and of significant strategic significance, government policy support is needed to complete the layout of industrial development, fundraising for development funds, and selection of development paths. The formulation and implementation of government policies are of great significance for such industries to achieve high-quality development goals. In the early stages of development, such industries often find it difficult to achieve self-sufficiency in the short term, with a long development cycle and often uncertain development results; In addition, the importance of such industries for the overall national security makes it difficult for the development of such special industries to raise development funds from social capital. How to innovate and formulate the allocation methods and performance evaluation methods of government financial funds has become the key to assisting the development of such special industries[13]. Secondly, in response to the goal of building a modern industrial system in China, the key to achieving high-quality development of innovation driven manufacturing lies in coordinating the relationship between the national innovation system and scientific and technological innovation work, and adapting to the needs of high-quality development. Government policy innovation is of great significance in regulating the relationship between supply and demand in the supply chain, as well as in the process of collaborative innovation, including design, research and development, and mass production.

5.3. Requirements for High-quality Development of Manufacturing Industry

Innovation driven has become the core driving force for the high-quality development of the current manufacturing industry. Breaking away from the excessive reliance on factor driven and investment driven "extensive" manufacturing development, empowering the quality of manufacturing development with innovation, optimizing the development mode of

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manufacturing, and integrating multiple industries is the only way to achieve high-quality development and transformation of the manufacturing industry[14].

5.3.1. Differentiated Development of Homogeneous Industries

The primary problem to be solved for the high-quality development of the manufacturing industry is the improvement of supply quality. Currently, the products and services of various enterprises in the same type of industry are highly homogeneous, and each industry relatively ignores the diverse needs of consumer groups in the development process, often resulting in the continuous repetition of low-quality manufacturing development[15]. The lack of high-quality manufacturing development that can accurately grasp the needs of consumer groups will not only lead to overcapacity in the long run, but also lead to overcapacity, Waste of resources; It may also lead to problems such as the solidification of the development model of the manufacturing industry and the continuous shrinking of profit margins, which is not conducive to the long-term stability and high-quality development of the manufacturing industry. Therefore, the high-quality development of the manufacturing industry places higher demands on enterprises to provide differentiated products and services. Each enterprise should start from consumer needs and guide the quality change of the manufacturing industry based on their actual needs, in order to achieve differentiated development. Adhere to consumer demand as the development direction of the manufacturing industry, and the development of the manufacturing industry cannot be separated from consumer demands. Grasp the basic development principle of "grasping demand", supplement and improve the deficiencies in the development of the manufacturing industry, accelerate the process of adapting the manufacturing industry structure to the demand system, and achieve high-quality industrial supply. To achieve "refined" development, the market is continuously segmented with the advancement of industrial development process. Compared to the rough development stage in the early stages of industrial development, many emerging segmented markets have emerged. After meeting the supply of "quantity", consumer groups have generated more refined demands. Faced with this development background, various industries should seize the opportunity to provide precise products and services to stimulate more demand from consumer entities and unleash development potential[16].

5.3.2. Improve the Collaborative Innovation Model for Inter Industry Development

The most direct and fundamental driving force for the development of the manufacturing industry driven by innovation is to drive industrial technology upgrading and iteration through technological innovation, improve total factor productivity, and ultimately achieve the goal of high-quality development of the manufacturing industry. With the advancement of industrial development and the evolution of innovation forms, the development of technological innovation in the manufacturing industry is no longer an isolated process carried out by a single enterprise. The high-quality development of China's manufacturing industry needs to be based on the actual national conditions of our country, that is, the government, users (consumer entities), enterprises, universities, and research institutions cooperate with each other, and collaborate in different advantageous areas such as policy formulation, demand reflection, production, education, and research, The role of the government in the formulation of innovative development policies and the construction of high-quality development chains in the manufacturing industry is irreplaceable. The importance of feedback information from consumer groups in the innovation process of manufacturing industry development is further highlighted. In the knowledge society environment, strong innovation entities mainly composed of universities and scientific research institutions have become the greenhouse for breeding high-tech. Under the "government industry university research" model, industrial entities belong to the demand side in cooperation with universities and scientific research institutions, Based on the actual needs of manufacturing industry innovation and development,

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technology update needs are proposed to universities and research institutions. As innovative technology supply policies, universities and research institutions conduct technological innovation research on the practical needs of manufacturing industry development, accelerating the effective combination of scientific research innovation achievements and production factors, and promoting the high-quality development process of the manufacturing industry. Relying on the collaborative development model of "government, industry, academia, and research" mentioned above, we aim to achieve a high degree of coupling in the entire process of policy formulation, demand tracking, talent cultivation, technological innovation, and manufacturing production in the upper, middle, and lower reaches of technological innovation, and achieve effective integration at all stages of industrial development. The main body of the government plays a vital role in the coordinated development model of "government, industry, university and research". Starting from the overall development layout, the government can introduce policies to coordinate all parties, establish a comprehensive innovation system in interdisciplinary fields, industrial organizations and technical departments, and promote the positive spillover of innovation externality in all links of the industrial chain. The government will control the overall direction of high-quality development in the manufacturing industry and ensure that the development direction of the manufacturing industry is correct; Continuously improving the task of infrastructure construction, leading the construction of technological innovation platforms, and laying the foundation for high-quality development of the manufacturing industry; Strengthen financial and tax policy support, provide financial incentives or tax incentives to model enterprises that efficiently lead the high-quality development of the manufacturing industry, and further stimulate the enthusiasm of various entities for innovation and development. The feedback information from consumer entities plays an indispensable role in promoting the high-quality development of the manufacturing industry under the innovation driven strategy. Improve the mechanism for collecting consumer feedback information, adjust the development of the manufacturing industry based on actual feedback, and fully leverage the power of the vast consumer group under the collaborative development model. In the current industrial development pattern, the previous model of producers as the main body of innovation is no longer suitable for the high-quality development of the manufacturing industry. Innovation models based on consumer feedback information are emerging, and industrial entities need to fully utilize feedback information for innovative development. Industrial entities should place innovation development strategy at the core of the industrial development process, actively implement innovation driven strategy, regard innovation as the main driving force for the development of the manufacturing industry today, further deepen mutually beneficial cooperation with universities and scientific research institutions, accelerate the integration of scientific and technological innovation results with production factors, and become a new driving force for development. Universities and research institutions should cultivate more talents with professional counterparts based on the actual needs of high-quality development in China's manufacturing industry. The essence of innovation driven high-quality development in the manufacturing industry is talent driven. Establish and improve a talent selection, training, incentive, and evaluation mechanism that integrates interdisciplinary, multi departmental, and whole society collaborative protection, with universities and research institutions as the main body and other industrial development entities as auxiliary. In the training process, incentive measures can be taken for scarcity talents according to the needs of industrial development, so as to enhance the innovation enthusiasm of all kinds of talents and give play to the innovative potential of talents. Organic integration with industrial demand can solve the problem of insufficient driving force for industrial innovation development on the one hand, and help achieve innovation diffusion and enhance the positive external effects of industrial development on the other hand.

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5.3.3. Promote the Integrated Development of Various Industries and Service Industries

The overall trend of upgrading the world's industrial structure is to continuously optimize the proportion of the three major industries, adjust the number and structure of industries, and promote the upgrading and rationalization of industrial structure. In order to achieve the goal of high-quality development of the manufacturing industry in the context of innovation driven strategy, in addition to the requirements for innovation in manufacturing technology, the innovation of manufacturing operation mode is also a powerful means to promote industrial cross integration and achieve high-quality development of the manufacturing industry. The development of various industries should comply with the trend of industrial structure upgrading, accelerate the process of integration with the service industry, and seize the opportunity of integration and progress between various industries and the service industry to create a new industrial development and operation model of "product manufacturing+service support+technology updates+customized solutions"; On the basis of product manufacturing, combined with subsequent service support, abandon the original "single" and "flat" industrial development model, build a multidimensional and three-dimensional industrial development pattern, and promote the organic integration of manufacturing and service industries. Following the trend of industrial structure development helps to effectively improve supply quality and achieve long-term healthy and stable development of the industry, meeting the demand for high-quality development. A single industrial development structure often implies weak risk resistance, and forming an industrial structure that interacts with the service industry can significantly enhance the risk resistance of the industrial chain. Effectively expanding the profit space of enterprises and incorporating the service industry into the overall layout of industrial development have enriched the connotation of industrial development, broadened the channels for industrial profit, and the stable increase in profitability will have a positive feedback effect on industrial technological innovation. Under the dual effect, the goal of high-quality development of the manufacturing industry will be further achieved[17].

In summary, innovating and transforming the development and operation mode of the manufacturing industry and expanding the service field can help further optimize the industrial structure, enhance the ability to resist complex risks, and achieve high-quality development of the manufacturing industry.

6. Conclusion and Outlook

This article takes the carbon emission trading pilot as a quasi natural experiment and constructs a double difference model based on prefecture level city data from 2009 to 2019 for empirical testing. The study found that the carbon emission trading pilot policy can significantly improve the level of green total factor productivity in cities. The achievement of the "dual carbon" goal and the high-quality development of the manufacturing industry are issues of widespread concern to the public. With economic development, when the supply quantity meets consumer needs, the focus of public attention on the development of the manufacturing industry shifts to the supply quality aspect. The primary solution to the high-quality development of the manufacturing industry is to improve the quality of supply and meet diverse needs. In the perspective of innovation driven development, achieving high-quality development of the manufacturing industry first requires a clear understanding that innovation strategies have a significant positive promoting effect on the development of the manufacturing industry, which becomes the fundamental basis for innovation driven manufacturing development strategies[18]. Secondly, the focus on achieving high-quality development of innovation driven manufacturing should be on the following aspects:

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(1) The integration and development process of the service industry with other industries will significantly affect the high-quality development level of the manufacturing industry. Promoting the mutually beneficial integration of industrial development and service industry can help improve the quality of product and service supply, and achieve high-quality development goals.

(2) The serious homogenization of products by similar enterprises will inevitably lead to a lack of vitality in the development of the manufacturing industry. Accurately positioning consumer demand and demand-oriented differentiated upgrading of products and services in the process of manufacturing development can help enrich the industrial development model, enhance industrial profit space, and maintain long-term healthy and stable development of the manufacturing industry.

(3) Deepen cooperation between the government, users (consumer entities), industries, universities, and research institutions, collaborate in different advantageous fields such as policy formulation, demand reflection, production, education, and research, and engage in mutually beneficial cooperation guided by innovation, stimulate the innovation capabilities of all entities, and promote high-quality development of the manufacturing industry through innovative collaborative efforts.

(4) In the process of promoting the "dual carbon" work, we should pay attention to the organic combination of green technology innovation and high-quality development of the manufacturing industry. The government should strengthen the guiding role, play the role of resource allocation through financial and tax policy support and other means, remedy the "market failure" problem, guide the transformation and upgrading of the industrial structure, and promote the improvement of urban green total factor productivity.

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