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The Impact of Low-carbon City Pilot Policies on Enterprise Performance

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Abstract

Since the reform and opening up, with the rapid development of the economy, China's environmental problems have become increasingly prominent, air pollution has become increasingly serious, and carbon dioxide emissions have gradually increased. In order to properly respond to climate change, effectively control greenhouse gas emissions, and promote green and sustainable development, the National Development and Reform Commission (NDRC) has issued three notices on the construction of low-carbon city pilot projects since 2010, and the scope of the pilot projects has been gradually expanded from five provinces and eight municipalities in the first batch to 45 cities in the third batch. The expansion of the pilot scope of low-carbon cities plays an increasingly important role in China's energy conservation and emission reduction work. Through the construction of low-carbon pilot cities, the implementation of low-carbon economy in cities, the establishment of a resource-saving and environment-friendly society, the construction of a benign and sustainable energy ecosystem. For enterprises, the construction of low-carbon city pilots requires enterprises to respond to low-carbon policies, increase investment in green technology innovation, reduce carbon emissions, and achieve low-carbon transformation. Based on the micro data of A-share listed companies in Shanghai and Shenzhen from 2005 to 2019, this paper uses the difference-in-difference method to analyze the impact of low-carbon city pilot policies on firm performance. Research shows that low-carbon city pilot policies can improve the performance of manufacturing firms.

Keywords

Corporate Performance; Low-carbon City Pilot Policies; Difference-in-difference.

1. Introduction

Climate change has a profound impact on the survival and development of mankind and is a huge challenge faced by people all over the world. According to the 2020 Greenhouse Gas Bulletin, global carbon dioxide concentrations reached a new high in 2019, and the global warming trend is still intensifying. How to properly respond to climate change and effectively control greenhouse gas emissions is a new problem faced by the world.

Since 2010, when China announced the first batch of low-carbon provinces and low-carbon city pilots, the exploration of green and low-carbon transformation in China's cities has been carried out for more than ten years. In July 2010, the National Development and Reform Commission (NDRC) identified five provinces and eight municipalities as the first low-carbon pilot projects for the first time. In 2012, 29 cities and provinces including Beijing, Shanghai and Hainan became the second batch of low-carbon pilot provinces and cities in China. In 2017, 45 cities, including Nanjing, Hefei and Jinan, were listed as the third batch of low-carbon city pilots. The establishment of low-carbon city pilot projects is a major measure for China to respond to climate change, explore the transformation of economic development mode and economic

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restructuring, which means that China attaches great importance to climate warming and strengthens environmental regulations. The expansion of the pilot scope of low-carbon cities plays an increasingly important role in China's energy conservation and emission reduction work. For enterprises, the implementation effect of low-carbon pilot policies will have a series of impacts on enterprises, and how to improve corporate performance while fulfilling environmental responsibilities is a difficult problem for enterprises. Therefore, exploring the impact of low-carbon city pilot policies on corporate performance can help policymakers better understand the implementation effect of the policies to a certain extent, and contribute to the realization of the dual carbon goals. At the same time, it deepens the understanding of enterprise managers on the importance of green development, helps enterprises adjust their business strategies in a timely manner, increases environmental protection income, promotes enterprises to carry out green innovation, and finds a balance between fulfilling environmental protection responsibilities and improving corporate performance, so as to achieve sustainable development of enterprises.

2. Literature Review

2.1. Current Status of Foreign Research

There are many studies on enterprise performance abroad, but there is little literature on the impact of low-carbon city pilot on enterprise performance. Šlogar Helena (2020) studied the relationship between firms' innovation capabilities and business performance and found that there was a positive correlation between firms' innovation capabilities and business performance. Ferrat Yann (2021) studied the moderating role of corporate financial performance level, carbon emission performance importance and regional attributes, and re-examined the impact of carbon emission performance on corporate financial performance, and the results showed that short-term corporate financial performance was affected by carbon emission performance. Yoshikuni Adilson Carlos et al. (2022) studied the impact of IS-innovation strategy alignment on firm performance, and all methods of alignment between IS strategy and innovation have a strong impact on firm performance.

2.2. Current Status of Domestic Research

At present, most of the literature explores the relationship between low-carbon pilot policies and corporate green innovation based on low-carbon city pilot policies. Xu Jia and Cui Jingbo (2020) explored the relationship between low-carbon city pilot policies and enterprise green technology innovation, and found that low-carbon city pilot policies can promote green technology innovation at the enterprise level to a certain extent, which is mainly reflected in the application of two types of patents: energy conservation and alternative energy production. At the same time, the policy has a more obvious effect on the inducement of green technology innovation for high-carbon enterprises and non-state-owned enterprises. Deng Siyuan et al. (2022) studied the impact of low-carbon city pilot policies on enterprise technological innovation based on the data of A-share listed companies in Shanghai and Shenzhen, and found that the low-carbon city pilot policies have a significant positive impact on enterprise technological innovation, especially for non-state-owned enterprises, enterprises in large cities and enterprises in non-resource-based cities.

Secondly, some scholars have studied the relationship between low-carbon city pilot policies and the total factor productivity of enterprises. Zhao Zhenzhi et al. (2021) studied the impact of the national low-carbon strategy on the total factor productivity of enterprises, and found that the pilot policy of low-carbon cities can improve the total factor productivity of enterprises and reduce the total factor productivity of enterprises in high-carbon emission industries, but it is conducive to improving the total factor productivity of non-state-owned enterprises. Guo

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Bingnan et al. (2022) studied the impact of low-carbon city pilot on the total factor productivity of manufacturing enterprises, and found that the low-carbon city pilot policy can significantly improve the total factor productivity of manufacturing enterprises, and the improvement effect shows the phenomenon of diminishing marginal returns. At the same time, the pilot of low-carbon cities can significantly improve the total factor productivity of state-owned manufacturing enterprises, and has a stronger effect on the total factor productivity of heavily polluting manufacturing enterprises.

In summary, there are few studies on low-carbon city pilot policies and firm performance, and this paper will construct a difference-in-difference model to conduct research in this context.

3. Study Design

3.1. Sample Selection and Data Sources

Based on the data of A-share listed companies in Shanghai and Shenzhen, this paper uses a difference-in-difference model to investigate the impact of low-carbon city pilot policies on the performance of industrial enterprises. So far, the National Development and Reform Commission (NDRC) has issued three notices since 2010 on the construction of low-carbon city pilot projects. Since the first batch of low-carbon pilot provinces and cities only includes five provinces and eight cities, the scope of the pilot projects is small, so the policy effect is relatively limited. Therefore, drawing on the research results of Xu Jia and Cui Jingbo, this project expands the scope of the pilot to the second batch of low-carbon city pilots to examine the impact of low-carbon policies on corporate performance.

This paper selects the micro data of listed companies in China's Shanghai and Shenzhen A-share industrial enterprises from 2005 to 2019, and finally obtains the data of 125 A-share listed companies in the industrial industry for a total of 15 years after excluding all companies with serious lack of ST, ST* and financial data. Among them, there are 56 enterprises in the pilot areas of low-carbon cities and 69 enterprises in the non-low-carbon pilot areas.

The sample data in this paper are mainly derived from the Guotaian database.

3.2. Indicator Construction and Variable Definition

The explanatory variable of this paper is enterprise performance, and scholars agree that the net profit rate (ROA) of total assets can reflect the ability of enterprises to obtain profits from operating assets, so this paper uses ROA to measure corporate performance as the explanatory variable of this paper. The explanatory variable in this paper is the intersection and multiplier of the group dummy variable (treated) and the time dummy variable (time), which is denoted by treated×time. The dummy variable is used to determine the grouping of enterprises, when the city where the enterprise is located belongs to the pilot city, the enterprise belongs to the experimental group and is denoted as treated=1, and when the city where the enterprise is located belongs to the non-pilot city, the enterprise belongs to the control group and is denoted as treated=0. If the first batch is in 2010 and after 2010, it is time=1, before 2010, it is time=0, and if the second batch is in 2012 and after 2012, it is time=1, and before 2012, it is time=0.

In order to more accurately evaluate the impact of low-carbon city pilot policies on firm performance, this paper selects the following control variables to introduce into the model with reference to the relevant research of some scholars. The control variables in this paper are the asset-liability ratio, the size of the company, the operating income, the proportion of independent directors, the growth of the company, and the age of the company.

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Table 1. Variable definitions

Variable type	The name of the variable	Description of the variable
Explanatory variables	Net profit margin on total assets	Net Profit/Average Total Assets
Explanatory variables	Low-carbon city pilots	Measure the effectiveness of low-carbon city policy implementation
Control variables	Debt-to-asset ratio	Total liabilities of the enterprise/total assets of the enterprise
	The size of the enterprise	Total assets of the enterprise
	Operating income	Business revenue
	Proportion of independent directors	Number of independent directors/number of directors
	Enterprise growth	Growth rate of operating income
	The age of the business	The age of the business

The purpose of this paper is to study whether the pilot policies of low-carbon cities affect the performance of industrial enterprises, and the effective method to evaluate the effect of the policies is the difference-in-difference method. In this paper, the first two batches of provinces and cities included in the pilot scope of low-carbon cities are taken as the experimental group, and the other provinces and cities are used as the control group, to explore the effectiveness of the low-carbon city pilot policy from the perspective of enterprise performance. The specific model is as follows.

$$ROA_{it} = \beta_0 + \beta_1 treat_r \times time_t + X_{it} + \gamma_t + \alpha_i + \mu_{irt} \quad (1)$$

Where, ROA_{it} represents the performance of listed company i in year t; The treat _r is a dummy variable for low-carbon pilot cities, when the city where the enterprise is located belongs to the pilot city, the enterprise belongs to the experimental group and is denoted as treated=1, and when the city where the enterprise is located belongs to the non-pilot city, the enterprise belongs to the control group and is denoted as treated=0. If the first batch is in 2010 and after 2010, it is time=1, before 2010, it is time=0, and if the second batch is in 2012 and after 2012, it is time=1, and before 2012, it is time=0. X_{it} is the matrix of control variables. γ_t control the fixed effect of the region with time, α_i control the individual effect of the firm, which is μirt the random perturbation term. β_1 reflects the net effect of low-carbon policies before and after the impact of low-carbon policies, and after the difference between low-carbon pilot cities and non-low-carbon pilot cities. If β_1 is significantly positive, it indicates that low-carbon policies can promote the performance of enterprises in low-carbon pilot areas. If β_1 is significantly negative, it indicates that the performance of the enterprise in the pilot area is suppressed.

4. Analysis of Empirical Results

4.1. Descriptive Statistics

Table 2 shows the full-sample descriptive statistics for the main variables. In this paper, a total of 125 industrial enterprises and non-pilot urban industrial enterprises located in the pilot areas of the first two batches of low-carbon cities were selected. As can be seen from Table 2, the average net profit rate of total assets of 125 industrial enterprises from 2005 to 2019 was 0.03856%, the minimum was -0.88691%, the maximum was 0.55803%, and the standard deviation was 0.08442. It shows that the difference between the net profit margin of total assets of industrial enterprises is small, and there will be profit losses in some years.

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Table 2. Descriptive statistics

Variable	Sample size	Min	Max	mean	SD
The age of the business	1875	0.00000	37.0000	14.5200	6.82600
The size of the enterprise	1875	2.93093	3.35468	3.13252	0.08032
Debt-to-asset ratio	1875	-3.05473	0.41381	-0.85371	0.49451
Operating income	1875	16.0000	29.0000	22.2900	2.16900
Proportion of independent directors	1875	0.00000	12.0000	1.19135	1.73821
Net profit margin on total assets	1875	-0.88691	0.55803	0.03856	0.08442
Growth rate of operating income	1875	-11.5494	2.72256	0.03003	0.65146

4.2. Benchmark Regression Result Analysis

As can be seen from Table 3, after adding a series of control variables of firm characteristics, such as asset-liability ratio, enterprise age, and chance meeting size, and controlling for time and individual fixed effects, the cross-term Treated×time is positive, and the net profit rate of total assets of industrial enterprises has been positive. The coefficient for the difference-in-difference item in column (3) is also significantly positive at the 5% level, but the effect is slightly less than that of the former. This suggests that there are other factors that affect business performance at the temporal level and at the enterprise level. From the perspective of control variables, the growth rate of operating income and the asset-liability ratio have a positive impact on corporate performance to a certain extent, while the age of the enterprise and the proportion of independent directors are not conducive to the improvement of corporate performance. The coefficients of the other control variables do not reflect stable significance, indicating that they are not the core factors affecting firm performance.

Table 3. Regression results

Variable	(1)ROA	(2)ROA	(3)ROA
Treated×time	0.0300 (0.0219)	0.0213** (0.0095)	0.0208** (0.0091)
The age of the business		-0.177*** (-11.574)	-0.194*** (-12.635)
The size of the enterprise		0.0482*** (0.0119)	0.0499*** (0.0119)
Debt-to-asset ratio		0.0246 (0.0159)	0.0246 (0.0159)
Operating income		-0.0012 (0.0060)	-0.0131* (0.0069
Proportion of independent directors		- 0.1030 (0.0675)	-0.1100* (0.0657)
Net profit margin on total assets		0.0004* (0.0002)	0.0004* (0.0002)
Growth rate of operating income		0.005 (1.142)	0.005 (1.145)
Time fixation effect	not	not	yes
Individual fixed effects	not	not	yes
Sample size	1875	1875	1875
Adjust R^2	0.036	0.120	0.089

5. Conclusions and Recommendations

To achieve the "dual carbon" goal, we need to rely on the joint efforts of the government, enterprises and the public. Green and low-carbon transformation is an important development model with the close participation of the government, enterprises and the public, and an

important way to achieve the "dual carbon" goal of industrial enterprises. Based on the data of A-share listed companies in Shanghai and Shenzhen, this paper uses a difference-in-difference model to investigate the impact of low-carbon city pilot policies on the performance of industrial enterprises. The results show that the implementation of low-carbon policies can improve the level of enterprise performance.

Based on this, this paper puts forward the following policy recommendations: Further expand the scope of low-carbon policy pilots and strengthen the policy effect. Compared with environmental regulatory measures such as carbon tax and carbon emission trading, the "low-carbon city" pilot policy is a weakly binding policy, which allows each pilot city to formulate its own low-carbon development implementation plan based on its own development foundation and resource endowment, but it is a comprehensive environmental control policy, which can effectively promote the improvement of enterprise performance. Secondly, for enterprises, they should enhance their awareness of environmental protection responsibilities and take the initiative to adjust their development strategies. Low-carbon policies should not be blindly excluded, but should focus on the overall situation and not only focus on immediate interests.

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