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The impact of carbon trading pilot policy on employment

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Abstract:

This paper investigates the impact of carbon trading pilot policies on employment in China. Using a multi-phase Difference-in-Differences (DID) model, the analysis reveals that these policies have significantly increased employment rates in pilot areas. The improvement is mainly attributed to environmental enhancements and an increase in foreign direct investment. Meanwhile, carbon trading policies promote technological progress and industrial structure adjustments. Their comprehensive impact on employment is nuanced, with both positive and negative effects observed. This research contributes to understanding how market-based environmental regulations can influence economic and employment dynamics, providing insights for policy implementation in regions with similar industrial structures.

Keywords: carbon trading pilot policy; employment;-multi-phase DID model

1. Introduction

Carbon trading is an important market-based environmental regulatory policy, and its general practice is that the competent government departments evaluate specific regions and sectors to determine the carbon intensity that the environment can absorb and convert it into a share of each release. The government uses bids and auctions in the primary market to shift payments for CO2 emissions. At the same time, energy-intensive companies can either buy carbon credits or sell them on the secondary market.

In 2013, Shenzhen first established a carbon trading market, which marked the official implementation of China's carbon trading policy. Subsequently, from 2014 to 2016, China gradually set up carbon trading markets in Chongqing, Fujian, Beijing, Shanghai, Guangdong, Tianjin and Hubei provinces.

Recently, China's employment situation is still grim at the present stage because of the coronavirus and the imbalance between the supply and demand of the labor force [1].

So, this article aims to determine the impact of the carbon trading pilot policy on employment. Meanwhile, this paper refers to the existing research and adjusts the variables, choosing the variables that are more directly affected by the policy to get closer to the real impact of the policy on employment. Ultimately, this paper uses the multi-phase DID model to analyze provincial data and find out that the carbon trading pilot policy has a positive impact on employment. Therefore, research on this aspect is necessary, and it is believed that it will be helpful to the subsequent development of the carbon emission market.

Compared with existing research, the selection of

influencing factors on employment is different, and few papers take wages, GDP, and fixed asset investment as influencing factors at the same time. What's more, few studies used the multi-phase DID model though the policy was introduced in different years in different provinces.

2. Data

In this paper, employment, GDP, PM2.5 concentration, foreign direct investment, fixed asset investment, number of patent grants, and value-added of the secondary industry are obtained from China Statistical Yearbook, cities' China Statistical Yearbook, China Industrial Statistics Yearbook, etc., and wage data are obtained from CSMAR. This paper will use the data from 2005 to 2021 at the provincial level, among which Hong Kong, Macao, and Taiwan will not be included in the data due to the missing data. At the same time, since some influencing factors are difficult to measure directly, this paper will use proxy variables for explanation.

3. Mechanism

According to existing research, the carbon emission trading policy successfully reduces greenhouse gas emissions [2] and improves environmental quality. Additionally, green innovation in companies is promoted to reduce production costs so that companies won't have to buy discharge permits at high prices [3,4]. They can reduce emissions during production. This paper analyzes the policy's impact on employment through labor market equilibrium.

In the labor market, labor supply typically increases with higher wages, but poor environmental conditions can decrease it by increasing the disutility of work. Conversely, improved environmental quality from the policy can boost labor supply. On the demand side, firms may increase labor demand for high-skilled jobs due to the need for innovation, while demand for low-skilled jobs may decline. The policy also influences employment through changes in foreign and fixed asset investments, as well as technological progress.

4. Methods

Due to the different implementation years of policies in different pilot provinces, this paper will use the multi-period DID model regression to analyze the impact of carbon emission trading pilot policies on employment in pilot provinces. In addition, the parallel trend hypothesis test will be used to confirm whether the trend is consistent between the treatment group and the control group before policy implementation to ensure that the observed effect is indeed attributable to the policy. The robustness of the causal effect was verified by the placebo test. This paper will postpone the policy implementation time for five years and randomize the selection of pilot cities.

Variables are as follows.

The explained variable is employment figures given by the statistical yearbook of each city in China. This paper will use them to represent it.

Dummy variables:

In 2013, China gradually established carbon trading markets in Beijing, Shanghai, Guangdong, and Tianjin provinces. However, in Chongqing and Hubei provinces, the policy was carried out in 2014. For Fujian province, the policy started in 2016.

Thus, treat=1 if it's in the experimental group; otherwise, treat=0. The experimental group contains Beijing, Shanghai, Fujian, Chongqing, Hubei, Guangdong, and Tianjin. For Hubei and Chongqing provinces, post=1 if the year is greater than 2013; otherwise, post=0.For Fujian province, post=1 if the year is greater than 2015; otherwise, post=0. For the rest of the province, post=1 if the year is greater than 2012; otherwise, post=0.Then, did=treat*post

Control variables:

According to Wu Xiangli et al., PM2.5 contribution's correlation coefficient with other pollutants in the air is large and it's hard to measure the level of the environment [5]. So this paper will use PM2.5 contribution as the environment's proxy variable. What's more, the level of technology is also hard to measure, but Zvi Griliches mentioned that it's reasonable to use the number of patents granted as the level of technology's proxy variable (Table 1) [6].

Table 1 Control variables

	(1)	(2)
CONTROL VARIABLES	meaning	Proxy variable
lnfi	Fixed investment	
PM	Level of Environment	PM2.5 contribution
ln2i	Added value of the secondary industry	

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lnwage	wage	
lnfdi	Foreign direct investment	
lntech	Level of Technology	Number of patents granted
lngdp	Nominal GDP	

Regression equation:

$$\ln em_{it} = \alpha + did_{it}\beta + X_{it}\gamma + u_{it} + v_{it} + \epsilon_{it}$$

u_{it} is urban fixed effect, v_{it} is year fixed effect, ϵ_{it} is stochastic disturbance, X_{it} are control variables.

5. Results

Table 2 Summary statistics

	(1)	(2)	(3)	(4)	(5)
VARIABLES	N	mean	sd	min	max
lnem	527	7.496	0.891	4.970	8.864
lngdp	527	9.413	1.083	5.493	11.73
PM	527	39.13	15.66	4.392	85.65
lnfdi	527	14.34	1.826	7.636	18.59
lnfi	527	8.984	1.148	5.232	11.04
lntech	527	9.445	1.827	3.784	13.68
lnwage	527	10.74	0.574	9.524	12.18
ln2i	527	8.536	1.133	4.103	10.87

Table 3 Baseline regression result

	(1)
VARIABLES	lnem
did	0.0940**
	(0.0411)
lngdp	0.0975
	(0.213)
PM	0.00489**
	(0.00204)
lnfdi	0.0255***
	(0.00713)
lnfi	-0.00926
	(0.0140)
lntech	-0.0584*
	(0.0297)
lnwage	0.0315

	(0.139)
ln2i	-0.0451
	(0.144)
Constant	6.591***
	(1.752)
Observations	527
R-squared	0.357
Number of code	31

Table 2 and 3 shows that the policy has a positive effect on employment and the policy can influence employment mainly by environment improvement, foreign direct investment, and technology innovation.

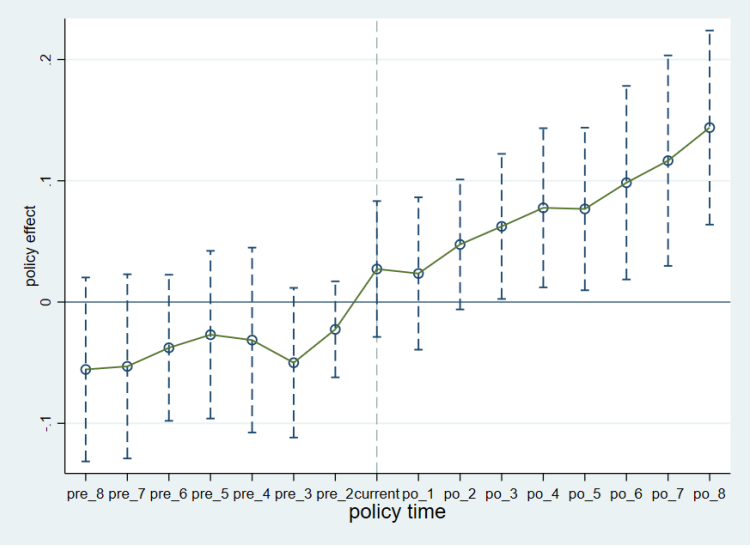
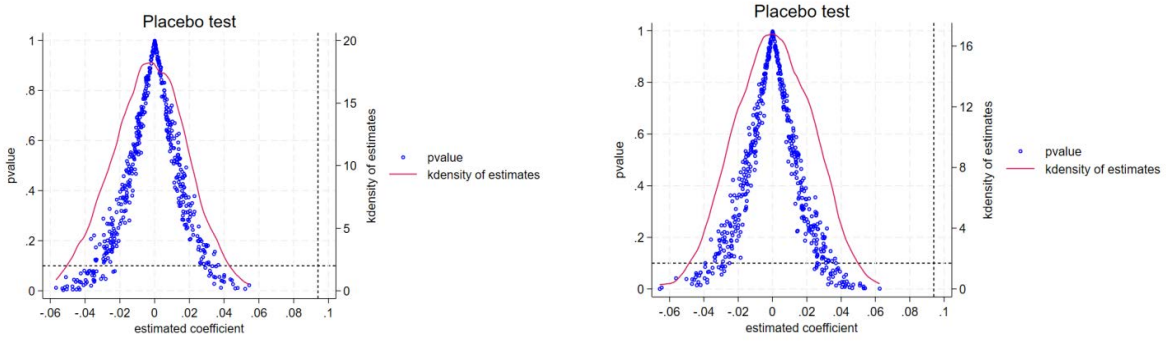


Fig.1 Parallel trend hypothesis testing results

It shows that from the third year after the implementation of the policy, the impact of the policy has become significant and increased year by year in Fig.1, so the parallel trend hypothesis test passes.



(a)Randomize the policy pilot area **(b) The policy was postponed for five years**

Fig.2 Placebo test results

Fig.2 shows that the mean values of the estimated coefficients are close to 0 under both stochastic processes, and most of the P-values are above 0.1. At the same time, the actual estimated coefficient of policy implementation (0.094) is within the range of small probability events in the kernel density plot of the placebo test above. In other

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words, the effect of carbon emission trading policy on employment promotion is not an accidental event, and the research conclusions of this paper are reliable and robust.

6. Conclusion

Based on analyzing the theoretical mechanism of the impact of carbon emission reduction policies on employment, this paper evaluates the impact of carbon trading policies on employment by using a multi-period differential model. The main research conclusions include: First, carbon trading policy can significantly increase the employment rate of pilot areas; Second, from the decomposition results of labor sources, the improvement of employment in pilot areas mainly stems from three aspects, namely, the improvement of environment, the increase of foreign direct investment and the innovation of technology.

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