



The Impact of Establishing Free Trade Zones on Green Development

Jing Cheng¹, Hu Sheng², Lili Ma^{3*}

School of Economics and Management, Northwest University, Xi'an China

E-mail: ¹nwu_jing@163.com

²1242071513@qq.com

³*nihaolili@sina.com

Abstract. The implementation of pilot Free Trade Zones (FTZs) is crucial for China's high-level opening up and high-quality development, emphasizing green growth and ecological protection. This study examines the impact of FTZs policy experiments on regional green development since 2013, revealing that FTZs significantly enhances green total factor productivity (GTFP) over time. The construction of FTZs improves green development by boosting green finance, service industries, and foreign investment, validating effective policy implementation and the government-market synergy. Economically backward regions can expedite green development by learning from advanced regions and leveraging latecomer advantages. Inland FTZs have a greater potential to drive policy effects and promote regional green development compared to coastal FTZs.

Keywords: Free Trade Zone; Green development; Policy evaluation; Difference-in-difference

1 Introduction

The pilot Free Trade Zones (FTZ) play a vital role in China's high-level opening up and low-carbon development. FTZs aim to be pioneers in green development, shifting from extensive factor-driven growth to intensive growth with high total factor productivity and environmental sustainability. Governments at all levels continuously make breakthroughs in governance, tariffs, and negative-list approach, establishing reproducible experiences for green development. FTZs drive regional economic growth, lead national ecological civilization construction, and foster high-quality regional development.

Existing studies has verified the positive promoting effect of the construction of free trade zones on economic growth (Tan et al., 2015¹; Wang et al., 2015²; Huang, 2018³; Ying et al., 2018⁴), but there is still some controversy in the academic community about whether the construction of free trade zones can promote green development of regional economy. Grossman et al., ⁵(1993) found through their research on NAFTA

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L. Moutinho et al. (eds.), *Proceedings of the 2023 International Conference on Management Innovation and Economy Development (MIED 2023)*, Advances in Economics, Business and Management Research 260, https://doi.org/10.2991/978-94-6463-260-6_42

that establishing FTZs promoted foreign inflows and economic growth, but also exacerbated environmental pollution in Mexico. The research findings of Copeland et al.,⁶(2004) are on the contrary. In economies with international factor mobility, the welfare benefits of reforming pollution policies are greater than those without international factor mobility.

There are also literatures surrounding the linkage between economic and environmental effects (Cai et al., 2008⁷; Lu , 2000⁸), laying the foundation for this study. Zhu et al.,⁹ (2021) conducted a study using the Guangdong FTZ as a case study and found that FTZ is forming a "policy trap" and has not significantly improved regional environmental welfare. However, Jiang et al.¹⁰(2020) found that Shanghai FTZ promoted the improvement of Shanghai's GTFP through technological progress effects. An et al.,¹¹ (2020) believed that it will continue to inject new impetus into the green sustainable development.

This paper focuses on the impact of FTZs on regional green development. It explores whether the establishment of FTZs effectively promotes balanced regional development and green development in economically underdeveloped areas. The research also investigates the mechanisms that facilitate regional green development.

2 Theoretical Mechanism

The establishment of FTZ actively participate in building an open world economic system continuously improves the level of openness. FTZ will increase the quantity and types of trade goods within the zone, generate economies of scale, promote capital formation within FTZ, and promote green coordinated development of the regional economy. Furthermore, FTZs are a policy pilot field for China's new round of reform and opening up, which absorbs advanced technology from large enterprises before other regions, improves regional pollution management capacity, and ultimately improves regional green development level.

H1: The establishment of FTZs can promote regional green development, that is, enhance regional GTFP.

First, FTZ is China's financial opening pilot field and the pioneer of Finance innovation development. The continuous development and application of green finance in FTZs reduces the financing costs of enterprises and institutions, improv investment. Also, they optimize the regional industrial structure, promote the development and expansion of green industries, and thus improve GTFP. Second, FTZ emphasizes taking the lead in exploring the openness and agglomeration of the service industry. The agglomeration development of the service industry can improve the green innovation ability and technological progress level of enterprises in the zone, reduce the overall level of environmental pollution, and ultimately achieve the goal of promoting regional green development and establishing a green FTZ. Third, the construction of FTZs places greater emphasis on the opening up of investment fields, which to some extent enhances the competitive advantage of regional trade and provides favorable conditions for attracting green foreign direct investment. While actively promoting the liberalization

and facilitation of foreign investment, the free trade zone has increased and strengthened the environmental review mechanism for foreign investment, reduced the entry of polluting foreign investment into the zone, and introduced more low-carbon and environmentally friendly high-quality foreign investment. Based on this, a hypothesis is proposed:

H2: FTZs promote green development by green finance, service industry agglomeration and foreign direct investment.

3 Methodology and data

3.1 Difference-in-difference Model

In the evaluation process of the impact of FTZ on the improvement of green total factor productivity (*GTFP*), in order to evaluate this effect, we first compare the changes in the research group provinces before and after establishing FTZs. This article introduces a difference-in-difference (DID) model to evaluate the policy effect, and the baseline econometric model is set as follows:

$$GTFP_{c,t} = \beta_0 + \beta_1 FTZ_{c,t} + \beta_2 X_{c,t} + \gamma_c + v_t + \varepsilon_{c,t} \quad (1)$$

$$FTZ_{c,t} = treat_c \times post_{c,t} \quad (2)$$

In equation(1), the dependent variable $GTFP_{c,t}$ is the *GTFP* of province c in year t . Equation(2) explains the $FTZ_{c,t}$ in equation(1). $treat_c$ as a policy dummy variable, the value for the province in the processing group is set to 1, while the value for the province in the control group is set to 0; $post_{c,t}$ as a dummy variable of time, the values of provinces setting up FTZs and subsequent years are taken as 1, and the values of other years are taken as 0; $X_{c,t}$ is a series of control variables; γ_c and v_t fixed effects for provinces and years respectively; $\varepsilon_{c,t}$ is the random perturbation term of the model.

3.2 Variables Description

Explained variable.

This article uses SBM direction distance function and the Malmquist Index model to measure *GTFP* from 2005 to 2019. Among them, input includes labor input, capital input, and resource input, measured by the number of employed people, total fixed capital formation, and energy consumption. The undesirable output is measured by SO₂ emissions and COD emission.

Core explanatory variables.

This article will set FTZ as dummy variables. If the province has already established a free trade zone in that year, the pilot year and subsequent years will be set to 1, and other years will be set to 0.

Core mechanism variables.

The level of green finance (*GFL*) is measured by the level of green credit. The Agglomeration level of service industry (*SAL*) is measured by the location entropy of the service industry. The level of foreign direct investment (*FDI*) is measured by the ratio of actual utilized foreign investment to gross domestic product.

Control variables.

We introduce a series of control variables in the model, mainly including: (1) The level of regional economic development. (2) The level of human capital. (3) The level of information infrastructure. (4) For the level of transport infrastructure. (5) Policy support intensity.

3.3 Data Source

The relevant data for this article comes from the "*China Statistical Yearbook*", "*China Energy Statistical Yearbook*", "*China Environmental Statistical Yearbook*", and data published on the official websites of various provincial and municipal statistical bureaus.

4 Results and Discussion

4.1 Baseline regression model.

The empirical results are shown in columns (1) - (4) of Table 1, with explanatory variables *FTZ* the coefficients of have always been positive and have reached statistical significance (significant at a 1% confidence level), which is basically consistent with existing relevant research. This means that under the conditions of introducing control variables, controlling for individual fixed effects, time fixed effects, and interactive fixed effects, the establishment of FTZ has a significant improvement effect on *GTFP*.

Table 1. Baseline Regression Model Results

Variables	(1) <i>GTFP</i>	(2) <i>GTFP</i>	(3) <i>GTFP</i>	(4) <i>GTFP</i>
<i>FTZ</i>	0.688 *** (6.33)	0.403 *** (3.76)	0.184 *** (3.22)	0.161 *** (3.20)
X	control	control	control	control
<i>cons</i>		-3.134 *** (-4.15)	-1.726 *** (3.20)	-0.372 *** (-1.93)
Provincial FE	YES	YES	YES	YES
Year FE	NO	NO	YES	YES
R^2	0.318	0.555	0.622	0.391
<i>N</i>	465	465	465	465

4.2 Parallel Trends and Placebo Testing

Parallel trend testing.

The premise of using the double difference method is to meet the parallel trend assumption, which means that the changing trends of green total factor productivity in the treatment group and control group provinces should remain parallel before the establishment of the free trade zone. The test results are shown in Fig. 1, and the estimated values of the $t < 0$ interval coefficient are not significant within the bilateral 95% confidence interval. The estimated coefficient of the interval $t > 0$ is significantly positive, consistent with the baseline regression results, and the coefficient value continues to rise, indicating that the establishment of free trade zones has a positive impact on green total factor productivity, meeting the parallel trend hypothesis.

Placebo test.

We construct a new treatment group with random provinces and policy times. Based on this new treatment group, the baseline regression model is re-estimated, and 500 simulation experiments are randomly repeated. The kernel density and its P-value distribution of 500 coefficient simulation results are presented in the graph. The placebo test results are shown in Fig. 2. This indicates that after the double randomized experiment, the policy effect has been significantly weakened in both the effect intensity and significance, indirectly confirming the robustness of the original conclusions.

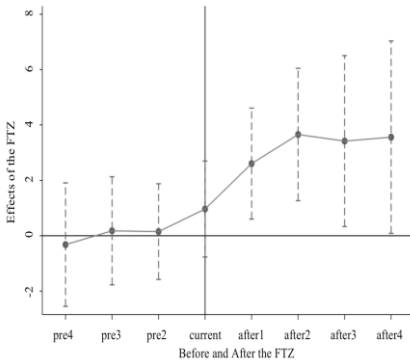


Fig. 1. Parallel Trend Test

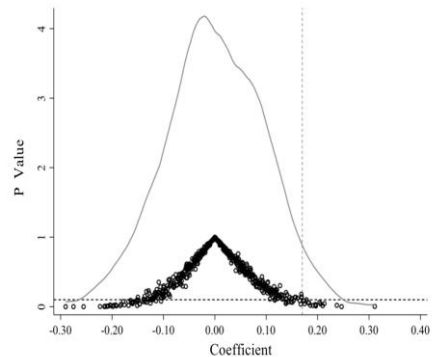


Fig. 2. Placebo Test

4.3 Heterogeneity analysis

This section first conducted data screening and grouping based on geographical location and export trade location. The empirical results are shown in Table 2.

The columns (1) - (3) of Table 2 show the results of heterogeneity testing based on geographical location, with the eastern and central regions passing the 5% significance level test and the western region passing the 1% significance level test. In addition, the regression coefficient for the eastern region is 0.128, the regression coefficient for the

central region is 0.158, and the regression coefficient for the western region is 0.190. This indicates that the establishment of free trade zones has the greatest impact on the western region and the least impact on the eastern region. The main reason may be that environmental regulatory standards in different regions may lead to different impacts on GTFP. The columns (4) - (5) of Table 2 show the results based on export trade location. The coefficient for coastal areas is 0.102, while the regression coefficient for inland areas is 0.146. The establishment of FTZs in inland areas has had a more significant driving effect. The main reason may be that compared to coastal areas, the level of economic green development in inland areas is relatively low, and the lack of technology and funds is an important factor restricting their economic green development.

Table 2. The Impact of FTZ on GTFP: Heterogeneity Analysis Results

Variable	(1)	(2)	(3)	(4)	(5)
	Eastern	Middle	Western	Coastal	Inland
<i>FTZ</i>	0.128** (2.11)	0.158** (2.32)	0.190*** (3.79)	0.102** (1.90)	0.146*** (3.07)
Control Variables	control	control	control	control	control
Provincial FE	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES
R ²	0.31	0.37	0.39	0.32	0.32
N	465	465	465	465	465

4.4 Mechanism analysis

Based on Hypothesis 2 proposed in this paper, that is, FTZ can exert a positive impact on *GTFP* by green finance, service industry agglomeration and foreign investment. Since other articles have verified their positive effects on GTFP, we constructed a model as follows:

$$IM_{c,t} = \beta_0 + \beta_1 FTZ_{c,t} + \beta_2 X_{c,t} + \gamma_c + v_t + \varepsilon_{c,t} \quad (3)$$

The regression results of model (3) are shown in Table 3. The coefficient of the policy variables in columns (1) - (3) is significantly positive, indicating that the establishment of FTZ has significantly promoted green finance, service industry agglomeration and foreign direct investment. Therefore, the hypothesis 2 was verified.

Table 3. The Impact of FTZs on GTFP: Mechanism Analysis Result

Variable	(1)	(3)	(5)
	<i>GFL</i>	<i>SIA</i>	<i>FDI</i>
<i>FTZ</i>	0.106** (2.30)	0.051** (1.97)	0.019* (1.35)
Control Variables	YES	YES	YES

<i>Province FE</i>	YES	YES	YES
<i>Year FE</i>	YES	YES	YES
R^2	0.30	0.40	0.37
N	465	465	465

5 Conclusions

This paper constructs a multiple DID model to empirically analyze the promotion effect of establishing FTZs on regional green development, using the panel data of 31 provinces in China from 2005 to 2019. The results are as follows: (1) The establishment of FTZ has a significant effect on the green development of the region. (2) This effect conforms to the law of diminishing marginal effects. Regions with poorer initial economic levels are more likely to upgrade their green development levels by setting up free trade zone. Inland areas have more room for policy dividends than coastal areas. (3) The FTZs is a new round of reform and opening up highland in China, emphasizing the innovation and development of the green financial system in the field of policy pilot and institutional innovation, taking the lead in exploring the opening up of the service industry, service trade and investment, and producing green finance effect, service industry agglomeration effect and foreign direct investment effect in each area, significantly promoting the rise of regional GTFP and positive promotion of regional green development.

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