

The Impact of Foreign Direct Investment on China's Carbon Targets

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Abstract

Since the reform and opening up, China's economy has developed rapidly, and at the same time, many problems have gradually emerged. In order to achieve high-quality economic development, we will accelerate the transformation of a green and low-carbon production structure. Based on the perspective of regional development, a simple linear regression between FDI and carbon emissions in 2019 is examined. The model results show that the relationship between FDI and carbon emission is not a simple linear regression relationship, which needs further discussion. Second is the influence between the two. The impact of FDI on achieving "double-carbon" goals varies locally and requires heterogeneity testing in subsequent studies. Based on this, starting from the concept of sustainable development, we will put forward corresponding policy suggestions for carbon emission reduction, promote the transformation and adjustment of local industrial structure, and implement the strategy of carbon neutrality and carbon peak reaching.

Keywords

FDI; Sustainable Development; Carbon Neutral; Carbon Peak.

1. Introduction

Since the reform and opening up, China's economic strength and international status have been significantly improved. For decades, from joining the WTO in 2000, to advocating "Belt and Road", to taking COVID-19 actions, China has proved its strength and capabilities to the world. With the rapid development of the Internet and the advent of the digital economy era, the connection between countries is becoming increasingly close, and the trend of world diversification is obvious. In order to strengthen the exchanges between countries and better realize the integration of the global economy, bilateral direct investment plays an important role. Although the introduction of foreign investment and foreign investment can drive the economic development of China and other countries, it will also have a certain impact on the implementation of China's carbon neutral and carbon peak strategy. Despite the economic development has been significantly improved, but the carbon dioxide emissions are increasing year by year, global warming, animal and plant habitat has been affected, and human production and life has also been disturbed. We cannot meet our own needs at the expense of the environment. Every country is making efforts to achieve the goals of sustainable development and the community of mankind. In September 2020, China announced at the UN General Assembly that it aims to reach a peak by 2030 and achieve carbon neutrality by 2060. The dual-carbon strategy gradually enters people's vision, and countries are also paying more attention to and supporting the "dual-carbon action". Studying carbon emissions is already a topic of heated discussion.

For a long time, many scholars have chosen the factors affecting carbon emissions as their research direction and conduct in-depth analysis. Among them, the impact of OFDI and

bidirectional FDI on carbon emissions is more favored by scholars. However, compared with China's foreign investment, the relationship between foreign domestic investment and carbon emissions should become the direction of our research at present. The existence of IFDI has more of an impact on the environmental problems of the invested countries. Since the reform and opening up, China has introduced a large number of foreign enterprises to invest internally, and when the industrial production will inevitably make China's environmental problems more severe. Among them, the problem of carbon emissions is an important factor causing environmental problems. As an active practitioner of the Paris Agreement, China should take some measures for carbon emissions under the two-carbon target to solve the problem of carbon emissions.

To sum up, how to balance the relationship between the natural environment and economic development is the current top priority. From the perspective of FDI, carbon emissions and foreign direct investment are analyzed through relevant measurement means and empirical methods. In the existing literature, two-way FDI is more favored by most scholars, but the ecological problems caused by unilateral investment are also urgent. Moreover, although many literatures focus on bilateral investment issues, it is more focused on the relationship between OFDI and carbon emissions, and there is still relatively few research on the relationship between FDI and carbon emissions. This paper combines the significance of China's carbon neutral and carbon peak target (hereinafter referred to as "double carbon") strategy, as well as the difficulties faced, and discusses the relationship between FDI and carbon emissions, to further understand the impact of unilateral investment on China's economy, and how to solve the resulting carbon dioxide problem and find a way out.

2. Literature Review

The analysis of the relationship between foreign direct investment and carbon emissions has been long studied at home and abroad. Through the literature search, it was found that domestic and foreign scholars have different focuses and views on FDI and carbon emissions. For example, Naughton (2014) through research found that the host country environmental control policy will fall on OCED currency return on capital, leading to the part of the capital from the area of high environmental standards to the low environmental standards, so that foreign take part of the capital, and the domestic economic development will be affected. On the other hand, some scholars believe that the investment of the countries with high environmental policy requirements is not sensitive to the environmental policy requirements of the host countries, and even the countries with high environmental policy requirements have more investment tendencies and ideas, so as to gain benefits from the environmental perspective. For example, Muhammad and Khan (2019) believe that strengthening the environmental policies of the host country can promote the internal investment of new energy enterprises, drive the development of new energy enterprises, and thus promote the overall economic development.

Since its reform and opening up, China has encountered many opportunities and challenges. Joining the WTO, building the Belt and Road, the trade war between China and the United States and the COVID-19 pandemic, every opportunity and challenge coexist. China has faced the challenges and difficulties, seized every opportunity, and its economy has been rapidly improved. While meeting the development opportunities and introducing the international advanced technology, the domestic ecological environment, especially the current carbon emissions and carbon emission intensity, have been greatly affected. Han-bin wang, Huang Baoshan through the analysis, Granger causality test and VAR model, explain the relationship between FDI, environmental regulation and carbon emissions, the results show that there are long-term stable balance between the three, the FDI and environmental regulation plays an

important role in the carbon emissions related index calculation, and the FDI and carbon emissions exist causal relationship. Liu Yufei, Wang Xuying and others, from the perspective of the industry, use the total factor productivity decomposition items in the manufacturing industry to judge the technology spillover effect of FDI. Through the GMM method, it is found that the spillover effect of FDI technology in different industries on the total factor productivity decomposition items of domestic enterprises is different. By establishing equations for 34 industrial sectors in China and combining with the GMM method estimation model, Li Sihui found that FDI Hui increased carbon emissions and intensity through two channels of economic scale and industry structure, which could slow down with the help of technology level channels. Fu Yuanhai has found that developed countries have introduced high-carbon emission industries to China, which causes great obstacles to ecological and environmental protection and tends to cause malignant environmental pollution. Therefore, China urgently needs to introduce high-quality foreign enterprises to complete the optimization and upgrading of industrial structure. Ji Shengbao and other researchers studied the corresponding environmental pollution measures of different foreign investment in China, and used bilateral stochastic frontier model analysis to learn that with the increase of FDI level, the degree of environmental pollution is also increasing.

To sum up, both domestic and foreign scholars have their own unique views on the safety relationship between FDI and carbon emissions, but the final results show that FDI will have different degrees of impact on the environmental changes of the host countries. At present, the total amount of relevant literature is small, and although the topic heat is very high, the overall research is still in the initial stage. Based on this, this paper uses a measurement model to analyze the relationship between FDI and carbon emissions, and how to affect carbon emissions through FDI.

3. Model Setting and Data Description

3.1. Data Source and Indicator Description

In this paper, 30 provinces, municipalities and autonomous regions except Tibet were selected as samples in 2019 for simple linear regression. The data sources are National Statistical Yearbook, Energy Statistical Yearbook and provincial statistical Yearbook. The selected index data are the total investment of provincial foreign enterprises (us \$100 million) and carbon dioxide emissions, among which foreign enterprises 'investment represents unilateral FDI, and carbon dioxide emissions represent the implementation degree of China's carbon targets.

3.2. Theoretical Model

To examine the relationship between FDI and carbon emissions, the measurement model is designed as follows:

$$y_i = \beta_0 + \beta_1 x_i + \mu_i$$

The above formula represents the real relationship between the variables y and x , which represents the carbon emissions of each province, represents the foreign direct investment of each province, and represents the random error term.

3.3. Model Analysis

(1) Draw the scatter map of the FDI and carbon dioxide emissions, as shown in Fig.

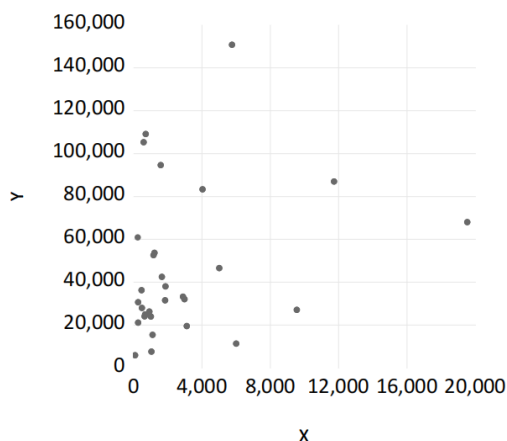


Figure 1. Scatter plots of the FDI and carbon dioxide emissions

According to the scatter chart, the overall distribution of FDI and carbon emissions is concentrated, and roughly shows a linear change with high slope. In 2019, most FDI of all provinces was concentrated in 0 to 4000, while carbon emissions were concentrated in 2000 to 6000. Therefore, the overall model can be set to:

$$y_i = \beta_0 + \beta_1 x_i + \mu_i$$

in the formula, y_i , x_i respectively said i provinces, municipalities directly under the central government or autonomous regions of carbon emissions and foreign direct investment, μ_i represent random error items, β_0 , β_1 to estimate parameters, in the model reflects the spontaneous basic foreign direct investment. When carbon emissions are zero, β_1 is a constant greater than 0, for carbon emissions of marginal foreign direct investment, namely in increasing the proportion of foreign direct investment, the value range is $0 < \beta_1 < 1$.

(2) The OLS estimation model was used, as shown in Fig.

Table 1. Model estimation results

Variable	Coefficient	Std. Error	t-Statistic	Prob.
x	40350.36	7656.876	5.269821	0
c	2.052772	1.512165	1.357506	0.1855
R-squared	0.061751	Mean dependent var		46397.39
Adjusted R-squared	0.028242	S.D.dependent var		34603
S.E.of regression	34110.87	Akaike info criterion		23.77696
Sum squared resid	3.26E+10	Schwarz criterion		23.87037
Log likelihood	-354.6544	Hannan-Quinn criter.		23.80684
F-statistic	1.842822	Durbin-Watson stat		1.260111
Prob(F-statistic)	0.185462			

According to the figure, the regression function of the sample is:

$$\hat{y}_i = 40350.36x + 2.052772$$

$$S=(1.512)(7656.876)$$

$$t=(1.358)(5.270)$$

$$R^2 = 0.062 \quad \bar{R}^2 = 0.0282$$

$$F=1.843 \quad DW=1.2601$$

After estimating the model, view the resulting regression diagram by means of the "Resids" of Eviews 11.0, listing the actual value (actual), fit value (fitted), and residual item (residual) of the explained variable in order order from left to right. As can be seen from the figure, the change of the fitting value is gentler, while the actual value and residual items show an approximate fluctuation trend, which is more violent, indicating that there are differences in foreign direct investment in different provinces, and the impact of direct investment on carbon emissions is also different. It shows that in the impact of unilateral direct investment on the carbon emissions of each province, the direct effect is not enough to explain the relationship between the two, and further control variables are needed to analyze the relationship between the two.

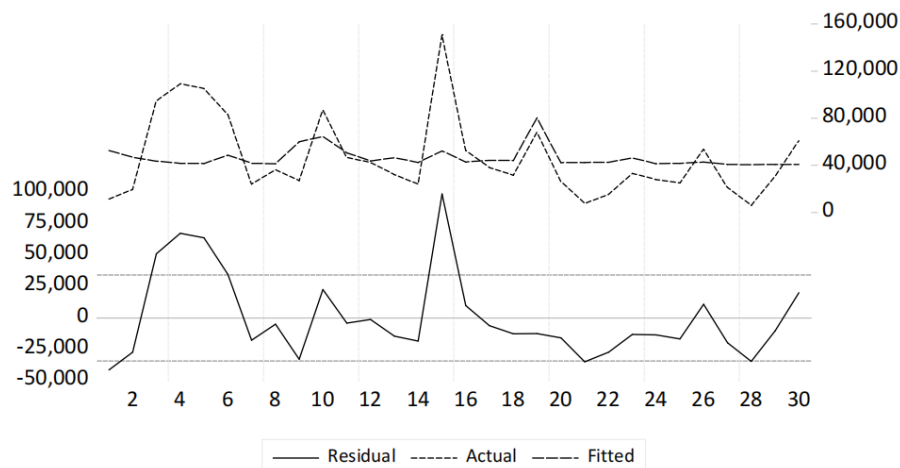


Figure 2. Regression results figure

3.4. Model test

3.4.1. Economic Significance Test

According to the sample estimates, $\beta_0 = 2.052772$ $\hat{\beta}_1 = 40350.36$ It shows that the foreign direct investment of each province, that is, the basic foreign direct investment is US \$205.277.2 million, which is in line with the symbol expectation; the slope coefficient, that is, the marginal FDI tendency is RMB 4,035.036 billion, which is not in line with the expectation, and may be due to the impact of international fluctuations. For example, the aftermath of the trade war between China and the US in 2018, and the disruption of the COVID-19 outbreak that began in 2019.

3.4.2. The Goodness of Fit

The feasibility coefficient is 0.0618, indicating that the change of FDI in the sample explains the carbon emissions of each province, possibly due to the impact of potential factors such as industrial structure and technological innovation, and the direct impact of FDI on provincial carbon emissions is less than the indirect impact. Although the determinability coefficient indicates that the sample regression model is not very ideal for fitting the sample data, it provides ideas and reference for our further study.

4. Conclusion and Recommendations

This paper preliminarily explores the influence of FDI on carbon emissions, mainly in the following two aspects: through the provincial index data in 2019, the simple regression analysis, and the economic significance and goodness of fit model test, trying to further investigate the influence of FDI for carbon emissions mechanism, do reference for follow-up research. For this study, regarding the relationship between FDI and carbon emissions, we tried to analyze the direct impact relationship between the two, and to guide the subsequent research. In the model results of this paper, we look from the following two perspectives: first, between FDI and

carbon emissions at the national level, combined with the existing literature, the relationship between the two is largely U-shaped, and the second perspective, the relationship between FDI and carbon emissions in the eastern, central and western regions may be different, with different directions of U opening in the three regions. The effect of FDI on carbon emissions, after a simple regression model, found that the two is not a simple linear relationship. Therefore, we can think about the following three aspects in the following research. First, Based to the regression outcome plot, In addition to the relatively stationary fit-value fluctuations, The actual value and the residual items fluctuate more violently, It shows that the economic development is different in different regions, To this end, we may use tests such as regional heterogeneity tests and economic heterogeneity tests in our follow-up studies, To ensure that the impact of foreign direct investment on carbon emissions in all provinces is measured and judged under a unified standard; next, Since provincial FDI and carbon emissions are not simply a uninary linear regression relationship, Remeans that the effect between the two has indirect effects besides the direct effect, So we will put the new variables in the follow-up studies, In order to better explain the relationship between FDI and carbon emissions. Finally, we also need to base ourselves on a certain perspective, through other scholars' literature reference, we will try to intervene in the influence of the industrial structure in the following research, and use the FDI to adjust the industrial structure to affect the local carbon emissions.

To sum up, we can draw the following policy suggestions: First, continue and improve the openness of local governments, attract more foreign investors and capital inflows, and inject new vitality into local economic development by enhancing large-scale FDI. The entry of foreign investors will bring capital, technology and management methods to the local governments. In addition to energy abuse and transition exploitation, the increase in carbon emissions is also due to the inefficient use of resources. Advanced technologies can improve energy efficiency and reduce increased carbon emissions to some extent. Second, the development mode and concept of low-carbon and environmental protection are still popular in the international community. Combined with the domestic "dual-carbon" strategy and green development concept, we will ensure that China's dual-carbon strategy is further deployed on the basis of sustainable development, so as to provide help and help to achieve the goal of carbon neutrality and carbon peak as soon as possible. Third, adjust the local industrial structure, from the primary and secondary industries to the tertiary industry transition, industry is the pillar of the economy, but today's economic form and technological progress, not with the secondary industry as the leading local development model, but need to focus on the development of the tertiary industry, to ensure the rational utilization of natural resources and environmental protection. The first productive force of science and technology is also the guarantee of the environment-friendly economic development model. The development of the tertiary industry will promote technological progress. Although the current green ecological concept and technical means are still in the development stage, in addition to policy guidance, it is also necessary to expand the application scale of FDI in related fields in China, and accelerate the research of new energy utilization technology and green development means. Through the above methods, the residents can achieve a green and low-carbon lifestyle, and help the country and the region to achieve the strategic goals of "carbon neutrality" and "carbon peak" ahead of schedule.

Acknowledgments

This work is supported by the 2022 Key Research Fund of the School of Economics, Anhui University of Finance and Economics, project number: ACJJXYZD2220. This paper is the phased outcome of the project.

References

- [1] Wang Hanbin, Huang Baoshan. Research on the Interactive influence of FDI, Environmental Regulation and Carbon emission under the New Normal [J]. *China Coal*, 2017,43 (07): 147-152.
- [2] Liu Yufei, Wang Xuying, Liu Xiaofeng. FDI Technology spillover Effect on the Heterogeneity of Manufacturing Industry in China [J]. *Scientific Decision-making*, 2019 (04): 23-40.
- [3] Li Sihui. Impact of FDI on industrial carbon emissions in China [J]. *North China Finance*, 2018 (02): 20-24.
- [4] Naughton, H. T. To Shut Down or to Shift: Multinationals and Environmental Regulation. *Ecological Economics*, 2014, 102: 113-117
- [5] Muhammad, B., and S. Khan. Effect of Bilateral FDI, Energy Consumption, CO₂ Emission and Capital on Economic Growth of Asia Countries. *Energy Reports*, 2019, 5: 1305-1315.
- [6] MICHAEL Hübler. Energy saving technology diffusion via FDI and trade using CGE model of China [J]. Kiel working paper, 2009, 1491.
- [7] SHAO Shuai, LUAN Ranran, YANG Zhenbing, et al. Does directed technological change get greener: empirical evidence from Shanghai's industrial green development transformation [J]. *Ecological indicators*, 2016 (69): 758-770.
- [8] DESAI M A, FOLEY C F, HINES J R. Foreign Direct Investment and the Domestic Capital Stock [J]. *American Economic Review*, 2005, 95 (2): 33-38.
- [9] GHODESWAR B, VAIDYANATHAN J. Business Process Outsourcing: An Approach to Gain Access to Worldclass Capabilities [J]. *Business Process Management Journal*, 2008, 14(1): 23-38.
- [10] Muller, Dominique, Charles M. Judd, and Vincent Y. Yzerbyt. "When moderation is mediated and mediation is moderated." *Journal of personality and social psychology* 89.6 (2005): 852.
- [11] Yang Z B, Shao S, Yang L L, et al. Differentiated Effects of Diversified Technological Sources on Energy-saving Technological Progress: Empirical Evidence from China's Industrial Sectors [J]. *Renewable and Sustainable Energy Reviews*, 2017, 72: 1379-1388.
- [12] Bai Y, Qian Q Q, Jiao J L, et al. Can Environmental Innovation Benefit from Outward Foreign Direct Investment to Developed Countries? Evidence from Chinese Manufacturing Enterprises [J]. *Environmental Science and Pollution Research*, 2020, 27: 13790-13808.