The Impact of Foreign Direct Investment on Carbon Emissions

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Abstract: Reducing carbon emissions and creating a green, low-carbon economy have emerged as key strategic initiatives for China's green economic transformation against the backdrop of the "dual carbon" agenda. This study uses the two-way fixed effect model to empirically examine the influence of foreign direct investment (FDI) on carbon emissions, using panel data from 30 Chinese provinces between 2000 and 2021. The findings demonstrate that foreign direct investment significantly reduces carbon emissions. The results are still robust after replacing the explained variable, eliminating the municipalities in the sample and considering the lag period. Based on the research of regional heterogeneity, foreign direct investment (FDI) in the western area has a major influence in driving up carbon emissions. Finally, the article offers related recommendations based on the previously mentioned results.

Keywords: Foreign Direct Investment; Carbon Emissions; Dual Carbon Target; Low Carbon Economy; Green Development Model

1. Introduction

With the continuous development of economic globalization, China has gradually become one of the largest recipient countries of foreign direct investment in the world. Foreign direct investment is an essential tool for China to build up foreign exchange reserves and engage in the global value chain, and it will play a major role in driving China's economic growth once it enters the country. Nevertheless, China has emerged as one of the nations with the highest carbon emissions globally, and the conflict between natural environmental preservation and advancement of society and economy has been intensifying. China, a responsible large nation, has proposed the "dual carbon" target, which targets to reach peak carbon dioxide emissions by 2030 and carbon neutrality by 2060, in light of this conflict. Simultaneously, the Chinese government is committed to diminishing carbon emissions by promoting eco-friendly and low-carbon development, as well as shifting from a high-speed growth model to a high-quality growth model in economic and social development. The development of a green and low-carbon economy and the reduction of carbon emissions are pivotal strategic steps for China in overhauling its approach to economic growth and addressing climate change. Therefore, in the process of China's opening up, does FDI inflow increase or decrease carbon emissions? Are FDI's ripple effects on carbon emissions regionally different? Theoretically and practically speaking, the answers to the aforementioned concerns are crucial for advancing China's economic transition to a low-carbon economy.

2. Literature Review

2.1 Investigation Techniques for the Influence of FDI on Carbon Emissions

Currently, in the era of the "dual carbon" goal and economic globalization, the influence of Foreign Direct Investment on carbon emissions has garnered widespread attention. Xu Chunhua et al. [1], Zheng Qiang et al. [2], and Wang Xia et al. [3] have examined the spatial correlation between FDI growth and carbon emissions by utilizing the spatial Durbin model. Additionally, Chang Dunhu et al. [4], Chen Xiaofei [5], and Zhao Jun et al. [6] have delved into the threshold effect of FDI on carbon emissions using the threshold model. Furthermore, Yi et al. [7], Dang et al. [8], and Fan et al. [9] have employed the ARDL model to analyze the impact of FDI inflow on carbon emissions in both the short and long term.

2.2 Study on the Correlation between FDI

and Carbon Emissions

Based on the existing literature, the current research findings regarding the association between foreign direct investment and carbon emissions can be categorized into the following two types:

a. The development of foreign direct investment increases carbon emissions. Yu Dan et al. [10] comprehensively tested the causal relationship among FDI, environmental governance investment and carbon emissions through Johansen cointegration relationship and impulse function response. Sun Jinyan et al. [11] analyzed the positive impact of FDI inflow on urban carbon emissions from four perspectives: trade dependence, trade mode, different sources of FDI and different investment industries. Guo et al. [12] confirmed that FDI enterprises do have the phenomenon of "pollution paradise" by analyzing the positive impact of manufacturing sectors with different factor intensities on carbon emissions.

b. Foreign direct investment has been shown to have a mitigating effect on carbon emissions in the Beijing-Tianjin-Hebei region, according to Wang Xiaoling et al.'s research using the FGLS model. FDI from Southeast Asian countries, European and American countries will promote environmental improvement, while FDI from global offshore financial centers will reduce the local environmental quality [13]. Wang Rong et al. adopted the system GMM method to verify the different impacts of FDI on carbon emissions in the eastern, central and western regions of China from three aspects: scale effect, technology effect and environmental effect [14]. Through the Granger causality test, Wang Liping et al. found that the interaction among China's technological innovation, industrial structure and per capita income level would promote the development of China's low-carbon economy [15].

Based on the above research, this paper selects the data of 30 provinces from 2000 to 2021 to build a two-way fixed effect model. The impact of FDI on carbon emissions is analyzed, and regional heterogeneity is analyzed. Analyzing the impact of FDI on carbon emissions and analyzing regional heterogeneity Finally, according to the research conclusions, the corresponding policy recommendations are put forward.

3. Model Setting and Variable Description

3.1 Model Construction

Based on the relevant panel data of 30 provinces in China from 2000 to 2021, this study explores the impact of FDI on carbon emissions, and constructs the empirical model (1):

$$lnCO2 = \alpha_0 + \alpha_1 lnFDI_{it} + X_{it} + province_i + year_i + \varepsilon_{it} \# \quad (1)$$

Where i represents the province; t represents the year; lnCO2 represents the total carbon emissions; FDI represents the foreign direct investment; X_{it} is the control variable; $province_i$ represents the province fixed effect; $year_i$ represents the year fixed effect; and ε_{it} is the random disturbance term.

3.2 Variable Setting and Data Sources

(1) Variable predicted. Total emissions of carbon dioxide. The apparent emission accounting technique was used in the study's computation, and the data came from China's province carbon dioxide emission inventory.

(2) Variables that explain. Investments made abroad directly. The original statistics, which have been obtained from China Statistical Yearbook and Provincial Statistical Yearbook over the years, are expressed in USD 10,000 units.

Table 1. Basic Meaning and Unit of Variables

Variable type	Variable name	Unit	Mean
Predicted variable	lnco2	Mt	Carbon emissions
Explanatory variable	lnfdi	$10^4 USD$	Foreign direct investment
Controlled variable	lndi	$10^4 CNY$	Per capita disposable income
	lnthird_ind	%	Structure of industry
	lnec_urban	%	Engel coefficient for towns
	lnec_rural	%	Engel coefficient for rural areas
	lnte	%	Level of technology market development
	lnop	%	Level of opening up
	lnlab	%	Level of labor force

(3) Controlling factors. It is thought that provincial-level variables may also have an impact on carbon emissions. The practice of previous literature is cited in this study, which

also modifies the following variables in the benchmark model. The factors that influence a country's economy include per capita disposable income, industrial structure, urban and rural Engel coefficients, technology market development, degree of openness to the outside world, and labor force size. The comprehensive description of each variable is shown in Tables 1 and 2.

Table 2. Description of Variables

Variable	Sign	Data index meaning and calculation
lnco2	Y	The logarithm of total carbon emissions is taken
lnfdi	X1	The logarithm of foreign direct investment is taken
lnec_rural	X2	The logarithm of per capita disposable income is taken
lnec_urban	X3	The ratio of tertiary industry GDP to total provincial GDP is taken as logarithm
lnthird_ind	X4	The logarithm of the ratio of food consumption to total consumption of urban residents was taken
lnop	X5	The ratio of food consumption to total consumption of rural residents was taken as log
lnlab	X6	Logarithm of the ratio of technology market turnover to provincial GDP
lndi	X7	The ratio of total imports and exports to GDP is taken in logarithm
lnte	X8	The ratio of permanent employed population to total population is taken as logarithm

3.3 Data Description

This study selected the panel data of 30 provinces in China from 2000 to 2021. The data are mainly from China Statistical Yearbooks, annual government reports, Provincial Statistical Yearbooks and CEAD database. For some missing data, the 3-year moving average method is used to fill in. In addition, in order to reduce the influence of collinearity and heteroscedasticity, the data are log-transformed. Table 3 shows the descriptive statistics of the variables.

Table 3. Table Example

Variables	N	Mean	Sd	Min	Max
Y	660	5.272	0.987	-0.205	7.650
X1	660	12.18	1.821	5.771	15.09
X2	660	10.04	0.826	7.923	11.83
X3	660	-0.802	0.180	-1.216	-0.178
X4	660	-0.956	0.208	-1.435	-0.467
X5	660	-1.088	0.159	-1.645	-0.707
X6	660	-5.277	1.295	-9.846	-1.739
X7	660	-1.712	0.989	-4.875	0.537
X8	660	2.015	0.112	1.726	2.182

4. Empirical Results and Analysis

4.1 Correlation Analysis and Multicollinearity Diagnosis

Firstly, the correlation analysis between foreign direct investment and other control variables is conducted. The results are shown in Table 4. It can be found that the correlation coefficients between lnfdi and lndi, lnthird_ind, lnec_urban, lnec_rural, lnte, lnop and lnlab are 0.55, 0.19, -0.25, -0.21, 0.33, 0.59 and 0.55, respectively. There is an important association between foreign direct investment and all variables, as shown by the fact that all are significant at the 1% level.

Table 4. Correlation Analysis Table of Variables

Variables	X1	X2	X3	X4	X5	X6	X7	X8
X1	1.000							
X2	0.555***	1.000						
X3	0.191***	0.422***	1.000					
X4	-0.248***	-0.359***	-0.152***	1.000				
X5	-0.213***	-0.375***	-0.269***	0.842***	1.000			
X6	0.327***	0.281***	0.593***	-0.142***	-0.179***	1.000		
X7	0.591***	0.221***	0.321***	-0.086**	-0.042	0.342***	1.000	
X8	0.548***	0.177***	-0.250***	0.013	-0.001	-0.028	0.080**	1.000

In order to avoid the inaccurate regression results caused by multicollinearity, this study adopts the VIF test method to diagnose the multicollinearity of variables. The results are presented in Table 5 below. The results show that the VIF values are all less than 10, and the maximum value is 3.94, which is far less than the warning value of 10. This shows that there is no multicollinearity problem, so the empirical analysis can be carried out.

4.2 Hausman Test and Brensch-Pagan Test

This study makes use of the Hausman test prior to regression to ascertain whether model—the fixed effect model or the random effect model—is chosen. Table 6 presents the results, including a substantial rejection of the null hypothesis (Prob > Chi2=0.0000). As a result, the fixed effect model for regression is selected in this investigation.

Table 5. VIF Test Results

Variable	VIF	1/VIF
X1	3.94	0.253523
X2	3.86	0.258981
X3	3.8	0.262813
X4	2.26	0.442169
X5	2.03	0.491811
X6	2.03	0.493711
X7	2.01	0.498585
X8	1.7	0.589726
Mean VIF	2.7	

Table 6. Hausman Test Results

VARIABLES	(1)	(2)
	RE	FE
X1	0.056**	0.063**
	(0.026)	(0.026)
X2	0.616***	0.632***
	(0.038)	(0.040)
X3	-0.699***	-0.757***
	(0.182)	(0.187)
X4	-0.535***	-0.505***
	(0.163)	(0.162)
X5	0.639***	0.740***
	(0.210)	(0.212)
X6	-0.055***	-0.061***
	(0.021)	(0.022)
X7	-0.096**	-0.104**
	(0.045)	(0.051)
X8	4.083***	4.283***
	(0.599)	(1.127)
Constant	-10.657***	-11.262***
	(1.102)	(2.054)
Observations	660	660
R-squared		0.661
Number of area	30	30
Hausman		42.46
p-value		0.0000

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

To address the problem of regression coefficient overestimation in the t-test value, certain non-significant coefficients tend to exhibit significance. This study employs the Brensch-Pagan test methodology for heteroscedasticity detection. The findings indicate a Chi2 (1) value of 127.10 with a Prob > Chi2=0.0000, thereby strongly rejecting the null hypothesis and confirming the absence of heteroscedasticity.

4.3 Benchmark Regression

This study examines the relationship between FDI and carbon emissions using a two-way fixed effect model of location and time. Table 7 displays the regression results. Table 7's Column (1) displays the estimation results without taking the control variables into account. The findings demonstrate a positive and substantial relationship between FDI and carbon emissions at the 1% level. The estimation results following the incremental addition of the control variables can be observed in columns (2) through (4). It is evident that FDI has a constant positive effect coefficient on carbon emissions, meaning that rising FDI would inevitably lead to rising carbon emissions. Given Column 4's regression results, it can be inferred that, on average, carbon emissions will rise by 0.06% for every 1% increase in FDI. Carbon emissions will rise by 0.09 standard deviations for every standard deviation increase in FDI. Furthermore, it is evident from the control variable regression findings that the labor force level, rural Engel coefficient, and per capita disposable income have positive regression coefficients. It demonstrates that rising per capita disposable income, the labor force participation rate, and the rural Engel coefficient will all result in rising carbon emissions. Industrial structure, urban Engel coefficient, technology market development level, and opening to the outside world are negatively correlated with carbon emissions, indicating that the development of industrial structure, urban Engel coefficient, technology market development level and opening to the outside world are conducive to reducing carbon emissions.

Table 7. Regression Results of the Impact of FDI on Carbon Emissions

VARIABLES	(1)	(2)	(3)	(4)
X1	0.42^{***}	0.07^{***}	0.06^{**}	0.06^{**}
	(21.21)	(2.67)	(2.24)	(2.39)
X2		0.67^{***}	0.66^{***}	0.63^{***}
		(18.09)	(17.26)	(15.69)
X3		-1.06^{***}	-0.90^{***}	-0.76^{***}
		(-5.90)	(-4.82)	(-4.06)

X4			-0.44***	-0.50***
			(-2.75)	(-3.12)
X5			0.47**	0.74***
			(2.28)	(3.49)
X6				-0.06***
				(-2.80)
X7				-0.10**
				(-2.03)
X8				4.28***
				(3.80)
_cons	0.11	-3.14***	-2.68***	-11.26***
	(0.46)	(-8.21)	(-6.47)	(-5.48)
Time Fixed Effects	YES	YES	YES	YES
Area Fixed Effects	YES	YES	YES	YES
N	660	660	660	660
R^2	0.42	0.63	0.64	0.66

t statistics in parentheses, * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

4.4 Regional Heterogeneity Analysis

Affected by factors such as the level of economic development, education, openness and technological R&D in different regions, the impact of FDI on carbon emissions may be different. Therefore, this paper divides the 30 provinces into eastern, central and western regions according to the level of economic development. Sub-samples are used to identify the impact of FDI on carbon emissions, and the results are shown in Table 8.

It is evident from the regression findings in Table 8 above that as foreign direct investment rises, carbon emissions show an upward trend. This may be due to the fact that foreign investors pay more attention to economic benefits and neglect environmental protection in the investment process, or the difference in technology level and management experience leads to the higher carbon emission intensity of foreign firms.

Table 8. Heterogeneity Analysis in Different Regions

VARIABLES	(1) Eastern region	(2) Central region	(3) Western region
X1	-0.04	-0.02	0.20***
	(-0.86)	(-0.84)	(3.75)
X2	0.63***	0.54***	0.58***
	(9.93)	(10.51)	(6.98)
X3	0.44	0.10	-1.89***
	(1.56)	(0.47)	(-3.73)
X4	-0.74***	-0.69***	0.06
	(-3.41)	(-3.05)	(0.17)
X5	0.98***	1.20***	-0.34
	(4.41)	(3.81)	(-0.60)
X6	-0.18***	0.02	-0.01
	(-5.74)	(0.81)	(-0.19)
X7	0.22***	0.10	-0.28***
	(2.82)	(1.31)	(-2.83)
X8	2.23*	18.97***	7.77**
	(1.83)	(8.16)	(2.47)
_cons	-5.05**	-37.56***	-20.68***
	(-2.45)	(-8.52)	(-3.73)
Time Fixed Effects	YES	YES	YES
Area Fixed Effects	YES	YES	YES
N	264	198	198
R^2	0.73	0.85	0.64

t statistics in parentheses, * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

However, when the heterogeneity of different regions is further studied by sub-samples, it is found from the results that the impact of foreign direct investment on carbon emissions is not significant in the eastern and central regions. This may be due to the fact that the eastern and central regions are more economically developed and have a higher level of technology compared to the western regions. Or due to the reasonable structure of foreign investment in the eastern and central regions, more investment is made in clean energy and environmental protection industries, thus reducing the impact on carbon emissions. Yet, in the western region, the impact of foreign direct investment on carbon emissions shows a significantly positive relationship. This may be due to the relative lack of environmental awareness and technical support in attracting foreign investment in the western region, which leads to the greater impact of foreign enterprises on the environment in the production process. In addition, the western region has a relatively single industrial structure and low energy use efficiency, which may also exacerbate the impact of FDI on carbon emissions.

4.5 Robustness Test

In this study, we use the methods of replacing the explained variable, winnow the regression, eliminating the municipalities in the sample and considering the lag period to test the robustness of the regression results.

4.5.1 Replace the explained variable

Regression estimate in the benchmark regression uses the total quantity of carbon emissions as the explanatory variable. For purpose of increasing the robustness of the conclusions of this paper, this study refers to the existing literature and replaces the explained variables with carbon emission intensity [16] and per capita carbon emissions [17], which are obtained by the ratio of the total carbon emissions of each province to the GDP of each province and the resident population of each province respectively. As shown in Table 9's Columns (1) and (2), the coefficient of FDI stayed positive and significant at the 1% level even after the explanatory variable was substituted twice, which is consistent with the results of the benchmark regression. As shown in Table 9's Columns (1) and (2), the coefficient of FDI stayed positive and significant at the 1% level even after the explanatory variable was substituted twice, which is consistent with the results of the benchmark regression. This demonstrates that even with the described factors replaced, the regression findings remain strong.

4.5.2 Following winsorization, regression

This article winsorizes all variables at the 1% level on both sides, and then does regression estimation in an effort to somewhat mitigate the influence of extreme data values on regression outcomes. The predicted conclusion is reinforced by the regression findings of (3) in Table 9, which show that FDI continues to have a considerable beneficial effect on carbon emissions.

4.5.3 Eliminating the municipalities directly under the Central Government in the sample

Compared with prefecture-level cities, municipalities directly under the Central Government have different factor endowments, industrial structure and policy environment, which may affect the generality of regression results. Therefore, in this study, Shanghai, Beijing, Tianjin and Chongqing are excluded from the sample and then regressed. The results are shown in Column (4) of Table 9, which are consistent with the benchmark regression results, again indicating that the regression results are relatively robust.

4.5.4 Consider the lag period

Considering that the carbon emission transfer effect of foreign direct investment may have a certain lag, this study refers to the method of Zhang et al. [18] and regresates foreign direct investment with a lag of one period. Table 9's Column (5) displays the results, and FDI is significant at the 1% level, demonstrating once more how robust the regression results are.

5. Conclusions and Policy Recommendations

5.1 Research Conclusion

In summary, the development of foreign direct investment has a notable beneficial effect on both the overall and the intensity of carbon emissions. The empirical findings indicate that overall carbon emissions will rise by 0.06% for every 1% increase in FDI; For each one standard deviation rise in FDI, carbon emissions will rise by 0.09 standard deviations. Moreover, the empirical results are still robust after replacing the explained variables, regression after winnow processing, eliminating the municipalities in the sample and considering the lag period.

The effect of foreign direct investment on carbon emissions varies significantly among regions, but this heterogeneity will be hidden by the sample as a whole regression. The influence of foreign direct investment on carbon emissions varies by location, corresponding to this study's heterogeneity test, which splits the sample into the eastern, middle, and western regions. The western area has the greatest impact by foreign direct investment on carbon emissions, whilst the middle and eastern regions see less of an influence.

Table 9. Robustness Test Results

VARIABLES	Replace the explained variable		(3) wind-down treatment	(4) eliminate the municipalities in the sample	(5) consider the lag period
	(1) Carbon emission intensity	(2) Carbon emissions per capita			
X1	0.07***	0.07***	0.05**	0.05*	
	(2.68)	(2.64)	(2.44)	(1.89)	
L.X1					0.05**

					(2.02)
X2	-0.40^{***}	0.61^{***}	0.60^{***}	0.60^{***}	0.60***
	(-9.81)	(15.01)	(20.13)	(13.97)	(14.96)
X3	-0.73^{***}	-0.81^{***}	-0.68^{***}	-0.50^{***}	-0.66***
	(-3.84)	(-4.26)	(-4.99)	(-2.59)	(-3.69)
X4	-0.52^{***}	-0.60^{***}	-0.56^{***}	-0.24	-0.51***
	(-3.18)	(-3.68)	(-4.69)	(-1.28)	(-3.33)
X5	0.74^{***}	0.84^{***}	0.74^{***}	0.41	0.72***
	(3.46)	(3.92)	(4.72)	(1.59)	(3.59)
X6	-0.07^{***}	-0.07^{***}	-0.04^{**}	-0.04^{*}	-0.06**
	(-3.15)	(-2.99)	(-2.50)	(-1.89)	(-2.57)
X7	-0.11^{**}	-0.11^{**}	-0.09^{**}	-0.03	-0.06
	(-2.04)	(-2.08)	(-2.34)	(-0.51)	(-1.34)
X8	1.50	1.05	3.35^{***}	11.11^{***}	4.50***
	(1.32)	(0.91)	(4.04)	(7.65)	(4.15)
_cons	-4.57^{**}	-12.87^{***}	-8.76^{***}	-24.31^{***}	-11.08***
	(-2.20)	(-6.18)	(-5.85)	(-9.15)	(-5.58)
Time Fixed Effects	YES	YES	YES	YES	YES
Area Fixed Effects	YES	YES	YES	YES	YES
N	660	660	660	572	660
R^2	0.50	0.61	0.77	0.71	0.66

t statistics in parentheses, * p < 0.1, ** p < 0.05, *** p < 0.01

5.2 Policy Recommendations

(1) Formulate development policies according to local conditions. While attracting foreign direct investment, the Chinese government should pay attention to the differences in development level, industrial structure and resource endowment of different regions, and formulate differentiation strategies based on its own comparative advantages and requirements for environmental protection. Strict control of FDI from different sources will guide foreign investment into industries such as environmental protection and low-carbon development, so as to accelerate the green and low-carbon economic transformation of the provinces and realize the coordinated development of the socio-economy and environmental protection.

(2) Refine and upgrade the environmental control system. The Chinese government has formulated strict environmental standards and set up a sewage and waste discharge licence system to force enterprises to improve their production efficiency and make production cleaner and more environmentally friendly, thus reducing carbon emissions. At the same time, it focuses on attracting high-quality FDI into China, introducing advanced production technology and management experience, and actively giving full play to the environmental benefits of tertiary foreign direct investment, so as to realise the development of a green and low-carbon economy.

(3) Strengthen environmental governance. At present, the degree of opening up of Chinese provinces to the outside world is still uneven. The government should pay attention to optimizing the industrial trade structure, especially in the regions with relatively low openness and backward economic development level. The results of the heterogeneity analysis indicate that the economic development of the western region lags behind, and the energy structure is quite uniform. Hence, it is imperative for the Chinese authorities to prioritize the utilization of fiscal and monetary strategies, curtail the advancement of high-energy consumption and severe pollution, and promote the growth of eco-friendly and low-carbon sectors. At the same time, for the relatively developed regions such as the central and eastern regions, the entry threshold of foreign capital should be raised, so that foreign investment can be transferred to high-end manufacturing and tertiary industries, to mitigate carbon emissions intensity.

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References

[1] Xu Chunhua, Liu Li. FDI government consumption and CO_2 emissions-A spatial Durbin model analysis based on the spatial weight matrix of trade in 36 countries. International Economic and Trade Exploration, 2016, 32(01): 64-78. 2016.01.005.

[2] Zheng Qiang, Gu Haili, Hu Mingxi, et al. Coordinated two-way FDI development and carbon emissions in China: spatial spillover effects. Ecological Economy: 1-11 [2024-05-15].

[3] Wang Xia, Wang Xiaofang. Foreign Direct Investment and Carbon Dioxide Emission in the Context of "Dual Carbon" - An Analysis of the Mediating Effect Based on Industrial Structure. Journal of Xinjiang University (Philosophy and Social Science Edition), 2022, 50(06): 1-14. 2022.06.001.

[4] Chang Dunhu, Miao Qi, Yuan Jiaqian, et al. "Carbon emissions in countries along the Belt and Road: an analysis of the joint impact of foreign direct investment and development factors. Environmental Science Research, 2022, 35(07): 1556-1563.1001-6929.2022.04.08.

[5] Chen Xiaofei. Threshold effect of FDI on carbon dioxide emissions-Evidence from an inter-provincial panel. Journal of Hebei University of Economics and Trade, 2016, 37(05): 91-95. 2016.05.013.

[6] Zhao Jun, Wang Xiaochen. Impact of China's outward foreign direct investment on carbon emissions of countries along the "Belt and Road" - Based on the threshold effect of financial development. Industrial Technology and Economics, 2021, 40(10): 42-51.

[7] Yi Yanchun, Guan Weijun, Gao Yufang. Relationship between foreign direct investment and China's carbon emissions: An empirical study based on ARDL. Journal of Guizhou University of Finance and Economics, 2015(03): 58-65.

[8] Dang Yuting. The impact of trade and foreign direct investment on carbon emissions in China - an empirical test based on the panel ARDL method. China Circulation Economy, 2018, 32(06): 113-121. 2018.06.012.

[9] Fan Huanhuan, Wang Xiangning. The impact of China's outward direct investment on domestic industrial structure. Research on Science and Technology Management, 2006(11): 56-58+62.

[10] Yu Dan, Zhao Lizhou, Wang Bo, et al. Correlation analysis and empirical research on foreign direct investment, environmental governance investment and carbon emission in China. Ecological Economy, 2016, 32(04): 71-74.

[11] Sun Jinyan, Liu Haiyun. Impacts of foreign trade and foreign direct investment on urban carbon emissions-analysis based on Chinese provincial panel data. Urban Issues, 2016(07): 75-80. 160711.

[12] Guo Pei, Zhang Shuxiao. The impact of foreign direct investment on China's carbon emissions: a study based on panel data from 2002-2010. Journal of Northeast Normal University (Philosophy and Social Science Edition), 2013(03): 40-44. 2013.03.001.

[13] Wang Xiaoling, He Feng, Zhu Zhaojun. Research on the impact of FDI on environmental quality in Beijing-Tianjin-Hebei. Research on Financial Issues, 2019(09): 45-52. 2019.09.006.

[14] Wang Rong, Wang Ying. Research on the impact of FDI on carbon emissions in east, middle and west China based on system GMM. Ecological Economy, 2018, 34(10): 24-28+34.

[15] Wang Liping, Li Shuqin. The impact of FDI on China's low carbon economy based on - China's data test from 1992-2016. Resource Development and Market, 2018, 34(10): 1438-1443.

[16] Shan Haiyan, Gu Mengjie. Digital Finance, Green Technology Innovation and Carbon Emission-An Empirical Analysis Based on Provincial Panel Data. Decision-making Consultation, 2024(02): 77-87.

[17] Tian Weiteng. Fiscal decentralization, urban sprawl and carbon emission intensity in China. East China Economic Management, 2024, 38(04): 72-82.

[18] Zhang Yun, FANG Xia, YANG Zhenyu. Carbon emission effect and influence mechanism of foreign direct investment. Shanghai Economic Research, 2023(08): 70-84. 2023.08.002.