Study on the Impact of Green Investment on Industrial Transformation in China

Xiaosu Yuan[1a], Lei Yao[2b*]

Yxx1318803483@163.com [a]
Corresponding author's email: 1318803483@qq.com[b]

[1]Beijing Institute of Fashion Technology, Yinghuayuan, Beijing,100105, China
[2]Beijing Institute of Fashion Technology, Research Base of Capital Clothing Culture and Clothing Industry, Beijing, 100105, China

Abstract: This paper takes the level of green investment and the level of industrial green transformation in China as the research object, and analyzes its status quo, and the results show that the status quo of both is not optimistic. Then, by constructing a mixed effect model, the influence of green investment level on China's industrial green transformation in 29 provinces and cities (except Tibet, Xinjiang, Hong Kong, Macao and Taiwan) from 2010 to 2020 is analyzed. The results show that green investment plays a significant role in promoting the green transformation of China's industry.

Keywords: green investment; industrial green transformation; Mixed-effects models

1 Introduction

Since the reform and opening up, China's economy has been developing rapidly with an average annual growth rate of nearly 10%. With the expansion of industrial scale year by year, the excessive economic growth and unreasonable production mode have spawned a series of environmental problems. With the promotion of the Chinese government, "green development" has gradually become a social consensus, and green investment as a key part of green development has also received great attention[1]. Therefore, improving environmental quality and promoting high-quality economic development through green investment is an important issue that needs to be solved urgently and has practical significance.

The theoretical researches on the definition of green investment are mainly divided into two aspects: the narrow sense and the broad sense. The measurement methods for China's industrial green transformation are mainly divided into the measurement of green total factor productivity. (Yan Yafen, 2021; Jiang Yao.2022;[2] And construction of comprehensive evaluation indicators (Zhu Dongbo 2017; Hu Anjun 2019) two major categories[3]. When studying the relationship between green investment and industrial structure, it can be proved that there is a close relationship between environmental protection investment and industrial structure, but most of them ignore the problem of industrial green industry transformation[4].

ICPDI 2023, September 01-03, Chongqing, People's Republic of China

DOI 10.4108/eai.1-9-2023.2338746

2 Analysis of the Current Situation

2.1 Development of Green Investment in China

In the 1970s, the government began to gradually increase investment in environmental protection. In 2014, the total investment in China's industrial environmental pollution control reached the highest level in history of 99.77 billion yuan, an increase of 80.6% compared with 2007, accounting for 0.43% of GDP. From 2007 to 2014, China's green investment has fluctuated and increased. However, it showed a weakening trend after 2014, and did not increase with China's industrial development. As shown in Table 1.

Table 1 China's green investment level over the years

Period (t)	Green Investment Level (100 million yuan)	Proportion of green investment in industrial GDP
2007	552.4	0.49%
2008	542.6	0.41%
2009	442.6	0.32%
2010	397	0.24%
2011	444.4	0.23%
2012	500.5	0.24%
2013	849.7	0.38%
2014	997.7	0.43%
2015	773.7	0.33%
2016	819	0.33%
2017	681.5	0.25%
2018	621.3	0.21%

Data source: China Statistical Yearbook, compiled by the authors.

2.2 Development of Industrial Green Transformation in China:

Based on the SBM-GML model[5], this paper selects the data of 29 provinces in China from 2010 to 2020 to calculate China's industrial green total factor productivity. Among them, the input factors are capital input, labor input and energy input, which are respectively measured by fixed asset investment of industrial enterprises above designated scale, employees of industrial enterprises above designated scale and total industrial energy consumption[6]. In the output factors, the main business income of industrial enterprises is taken as the index to measure the expected output, and the industrial "three wastes" of each province is selected to measure the non-expected output[7]. The results are as follows as Table 2:

Table 2. China Industry 2010-2020 GTFP and its decomposition table

Period (t)	GTFP (t）	GML (t-1, t)	TC (t-1, t)	EC (t-1, t)
2010	0.6157448722	0.010744	7.924826	0.0000***
2011	0.6160301437	1.248053398	1.320415653	0.949941349
2012	0.6160731656	1.765232223	0.677051598	1.143831098

2013	0.6161567667	1.02000116	1.047324274	0.994986047
2014	0.6162263224	1.066040791	1.06720284	1.000557783
2015	0.6163379678	1.041492988	1.084958767	0.962321308
2016	0.6164552664	1.051985713	1.00874256	0.978264654
2017	0.6164739173	1.099671846	1.024136772	1.10039223
2018	0.6165299215	1.0675187	1.08939981	0.989337697
2019	0.6185012908	1.11875974	1.125211945	1.008249596
2020	0.6188294378	1.912098102	1.941607353	0.97804542
Mean value	0.616669007	1.053680725	1.016653669	1.046023345

Data sources: EPS database, provincial statistical Yearbook, compiled by the author.

The results show that China's industrial green total factor productivity is on the rise from 2010 to 2020. In 2011-2012, with the decline of the GML index, industrial green total factor productivity growth slowed down. In 2011-2019, green GTFP was dominated by industrial green technology progress, but in 2019-2020, industrial green technology efficiency is the leading force of industrial green total factor productivity.

3 Variable Selection and Model Assumptions

3.1 variable selection and model assumptions

The explained variable of this paper is the level of industrial green transformation (GTFP) in each province. The explanatory variable is the green investment level (LN_GREENINV), which is expressed by the ratio of industrial environmental pollution control investment and total industrial product of each province[8]. The control variables were human capital level (HUM), economic development level (RGDP) and opening degree (OPEN), which were respectively measured by the ratio of the number of R&D personnel in industrial enterprises to the number of employees in industrial enterprises[9], the per capita GDP of industrial enterprises, and the ratio of the total import and export volume of industrial enterprises to the gross industrial product[10].

Green investment can provide companies with the necessary financial support to guide them to adopt more environmentally friendly technologies and processes that promote environmental hygiene while improving corporate productivity[11]. A high level of human capital can promote green technology innovation, drive the popularization of environmental protection technology and green products, and effectively achieve energy conservation and emission reduction. The improvement of the level of economic development leads the government to invest more in environmental protection. Opening to the outside world not only brings advanced technology into our country, but also helps attract foreign investment.

Based on the above theoretical basis, the following hypothesis is proposed:

(1) The level of green investment promotes the level of green transformation of China's industrial industry.

(2) The level of human capital promotes the level of China's industrial green transformation.

(3) The level of economic development promotes the level of green transformation of China's industry.

(4) The degree of opening to the outside world promotes the level of green transformation of China's industry.

3.2 Model Results and Analysis

In this paper, panel data from 29 provinces in China (except Tibet, Xinjiang, Hong Kong, Macao and Taiwan) from 2010 to 2020 are selected as research samples to establish a static panel data model. The formula is as follows as (1):

$$lnGTFP_{it} = a_1 lnLN\_GREENINV_{it} + a_2 lnHUM_{it} + a_3 lnRGDP_{it} + a_4 lnFDI_{it} + \varepsilon \quad (1)$$

Where i represents the province of the cross-section (i=1,2,3,4... N), t stands for time (t=1,2,3,4... T), a_t(i = 1、2、3、4) are the parameters to be estimated.

Excluding inflation, White test passed. Compared various models, the best fitting result was the mixed-effect model, and the results were as follows as (2):

$$lnGTFP_{it} = 0.09 * lnLN\_GREENINV_{it} + 0.08 * lnHUM_{it} + 0.10 * lnOPEN_{it} + \varepsilon \quad (2)$$

Table 3. Regression result

lnGTFP	Coef.	Std.Err	t	P>|t|
lnLN_GREENINV	0.085143	0.010744	7.924826	0.0000***
lnHUM	0.081951	0.011273	7.269467	0.0000***
lnOPEN	0.096497	0.007595	12.70475	0.0000***

Data sources: China Provincial Statistical Yearbook, calculated by Eviews13.

By analyzing the above regression results, we can draw the following conclusions, as shown in Table 3.

(1) The regression coefficient of green investment level (LN_GREENINV) is 0.085143, which is significantly positive at 1% level, indicating that when other conditions remain unchanged, every 1% increase in green investment level will increase the level of industrial green transformation in China by 0.085143%. It shows that the level of green investment will have a very important and positive impact on the degree of green transformation of China's industrial green, and hypothesis (1) is verified.

(2) The regression coefficient of human capital level (HUM) is 0.081951, which is significantly positive at 1% level, indicating that if other conditions remain unchanged, the level of industrial green transformation in China will increase by 0.081951% with every 1% increase in human capital level, that is, with the increase of human capital level, the level of industrial green transformation will increase by 0.081951%. China's industrial green transformation level will also be improved to a certain extent. Hypothesis (2) is verified

(3) The regression coefficient of the degree of openness is 0.096497, which is significantly

positive at the 1% level, indicating that other conditions remain unchanged. When the degree of openness to the outside world increases by 1%, the level of China's industrial green transformation will increase by 0.096497%, that is, with the increase of the degree of openness to the outside world, the level of China's industrial green transformation will also increase. Hypothesis (4) is verified.

4 Conclusion and Recommendations

4.1 the conclusion of the model

This thesis mainly draws the following conclusions.

(1) China has begun to pay attention to green investment and industrial environmental protection, but the proportion of green investment in GDP is less than 1%, compared with Europe and the United States and other countries there is still a big gap, in order to achieve the benefit of the entire industrial ecological environment and sustainable development goals, there are still many challenges and problems.

(2) The overall scale and level of the industry continue to improve, the total industrial output value and added value maintain a relatively stable growth trend, but the level of China's industrial green transformation is still lagging behind, guess the reason has a lot to do with the lag of green technology progress.

(3) Green investment is one of the necessary means for enterprises to promote industrial green transformation. Only by actively and long-term investment in green resources can we truly achieve the goals of energy saving, emission reduction, low-carbon clean production and sustainable development.[12]

(4) Human capital level is one of the core competitiveness of sustainable development of enterprises, enterprises need to improve human capital level in order to better master environmental protection technology and environmental management methods, and lead and drive enterprises to innovate and transform. Improving the level of human capital can not only improve the core competitiveness and production efficiency of enterprises, but also promote the green transformation of industry.

(5) Enterprises need to bring more information, technology and market opportunities to enterprises through opening up, reduce industrial chain costs and environmental risks, improve the competitiveness of enterprises and innovation ability, so as to promote industrial green transformation. The more open enterprises are to the outside world, the more likely they are to access more production factors and market opportunities on a global scale, thus promoting the green transformation of industry.

4.2 Policy Suggestions

As shown in Figure 1, the following measures can be taken to increase the level of green investment of enterprises to promote the green transformation of industry.

China should take positive measures to encourage enterprises to make green investment, increase the publicity of green investment, provide fiscal and tax incentives, provide relevant

professional knowledge training, and establish a green financial mechanism to attract funds to the environmental protection field. The government and enterprises should improve the level of human capital, carry out green training programs to meet the needs of enterprises for green talents, and can also establish cooperative relationships with scientific research institutions to promote the development and transformation of green technologies. The government and enterprises should open up more to the outside world, actively promote trade liberalization, attract foreign investment into green industries, and strengthen international cooperation. In addition, it can also strengthen the exchange of international green certification and improve the international competitiveness of China's green product[13].

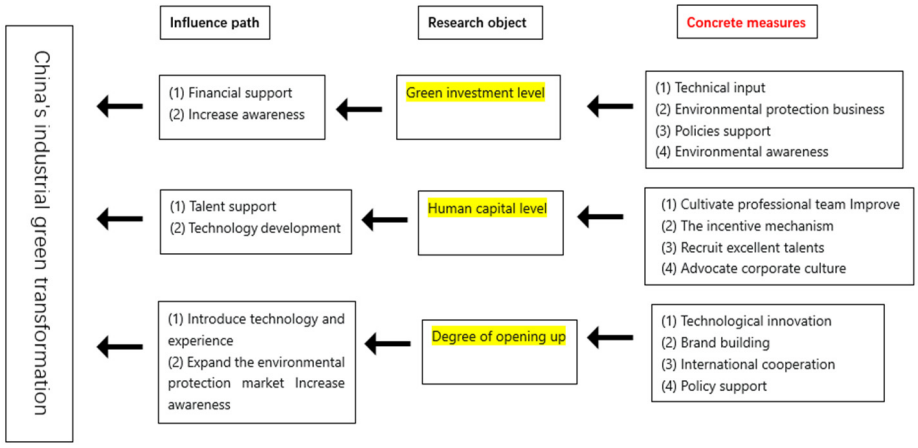

Fig. 1. Transmission path and policy recommendations

Reference

[1] Zu Ying silver. The empirical study of green tax to promote manufacturing green transformation [D]. Chengdu: southwest university of finance and economics, 2021. DOI:10.27412/d.cnki.gxncu.2021.002477.

[2] Lian Mengmeng. The impact of two-way OPEN on the green transformation of China's manufacturing industry [D]. Lanzhou: lanzhou university of technology, 2022. DOI: 10.27206 /, dc nki. Ggsgu. 2022.000986.

[3] Yuanzhen Xiao. Study on the impact mechanism of green taxation on the green transformation of China's manufacturing industry [D]. Business tianjin: tianjin university, 2022. DOI: 10.27362 /, dc nki. Gtsxy. 2022.000428.

[4] Yao Meng. Research on Green investment [D]. Dalian: Dongbei University of Finance and Economics,2006.
https://kns.cnki.net/KCMS/detail/detail.aspx?dbname=CDFD9908&filename=2008037631.nh

[5] Yahong Ma. Study on the impact of China's financial Development on Industrial Green Transformation [D]. Lanzhou University,

[6] BeiBei Gu. Analysis of efficiency and influencing factors of green finance in promoting industrial transformation and upgrading [D]. Changsha: central south forestry university of science and technology, 2022. The DOI: 10.27662 /, dc nki. GZNLC. 2022.000655.

[7] Lusha Cui. Research on the spatial effect of low-carbon technology innovation on the green transformation of manufacturing industry [D]. Hohhot, Inner Mongolia university of finance and economics, 2022. DOI: 10.27797 /, dc nki. GNMGC. 2022.000443.
[8] Guoqiang Liu. Analysis on the influence of green investment on the development level of green economy. [D]. Jinan: Shandong University,2020. DOI:10.27272/d.cnki.gshdu.2020.000757.
[9] Yafen Yan. Research on the effect and path of technological innovation on industrial green transformation [D]. Beijing: University of Science and Technology Beijing, 2021. DOI:10.26945/d.cnki.gbjku.2021.000272.
[10] Yuyu Sun. Study on the influence of Green Investment on optimization of industrial Structure in our country [D]. Xuzhou: China mining university, 2018.
https://kns.cnki.net/KCMS/detail/detail.aspx?dbname=CMFD201901&filename=1018827147.nh
[11] Zhang Youtang, Berhe Hagos Mesfin. The Impact of Green Investment and Green Marketing on Business Performance: The Mediation Role of Corporate Social Responsibility in Ethiopia's Chinese Textile Companies[J]. Sustainability, 2022, 14(7):7-24.
[12] Belaïd Fateh, Al-Sarihi Aisha, Al-Mestneer Raed. Balancing climate mitigation and energy security goals amid converging global energy crises: The role of green investments[J]. Renewable Energy,2023,205:534-542.
[13] Fateh B,Aisha A,Raed A. Balancing climate mitigation and energy security goals amid converging global energy crises: The role of green investments[J]. Renewable Energy,2023,205.