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Outward Foreign Direct Investment and Industrial Structure Upgrading: The Mediating Role of Reverse Green Technology Innovation, the Moderating Role of R&D Investment and Environmental Regulation

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Abstract: Based on the provincial panel data from 2004 to 2019, this paper constructs a more comprehensive industrial structure upgrading coefficient and uses a moderated mediation model to verify the mechanism of OFDI reverse green innovation technology on industrial upgrading. It is found that OFDI has a reverse green technology innovation effect, which can positively promote China's industrial upgrading. From the perspective of a moderated mediating effect, the increase of domestic R&D investment is conducive to shortening the technological gap with developed countries, and the enhancement of domestic environmental regulation also encourages multinational enterprises to implement green technology cooperation. Both of them strengthen the reverse green technology innovation effect of OFDI, and correspondingly have a greater promoting effect on the upgrading of industrial structure. The reverse green technology innovation of OFDI mainly promotes strategic green innovation of noninvention types, but the enhancement of R&D capability and the improvement of environmental regulation can strengthen the reverse substantive green innovation of OFDI. After endogenous processing and replacing the core explanatory variables, the results are still significant.

Keywords: foreign direct investment; industrial structure upgrading; green technology innovation; moderated mediation

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1. Introduction

As global problems such as resource depletion and environmental deterioration become more severe, the majority of developing countries are actively exploring ways to achieve a green economic transformation [1]. Green development, as a mode of development that achieves a harmonious balance between economy, society, and ecology, is centered on recycling, low-carbon emissions, and sustainability, and the key to it is increasing the efficiency of green development [2]. In addition, China's 14th Five-Year Plan clearly states that "we should focus on high-quality development, coordinate development with green and low-carbon transformation as the main theme, accelerate the optimization and upgrading of industrial structure, and support the timely achievement of the goal of achieving peak carbon and carbon neutrality". Nowadays, outward foreign direct investment (OFDI) is one of the many influential factors that cannot be ignored for green development. As a significant source of international capital flow, it has a substantial impact on China's economic development and has emerged as a new force for sustainable economic growth in the new era [3,4]. According to the data of the Ministry of Commerce, China's industry-wide OFDI increased 109-fold from 2003 to 2021, reaching USD 145.19 billion, with a 9.2% increase annually. Undoubtedly, China has become one of the world's leading powers of OFDI, with both flows and stocks consistently placing in the top three worldwide.

The essence of green technology innovation is to form a green economic growth mode, whose structural dividend is manifested primarily in the continuous optimization of the industrial structure towards low energy consumption and low pollution [5]. According to the concept of green technology innovation, promoting industrial structure modernization and achieving a balance between economic and environmental sustainability are prerequisites for green technology innovation. Historical evidence demonstrates that industrial structure upgrading is primarily dependent on the cross-border flow of resources and the operation of global industrial transfer in addition to relying on the mechanism of technological advancement in a country, and OFDI is essentially a global transfer of capital, technology, management experience, and human capital [6]. As a significant channel for acquiring advanced foreign technology, OFDI is also a considerable incentive for the ongoing industrial structure upgrading. Thus, promoting industrial structure upgrading through OFDI is likely to become a crucial means of achieving sustainable, high-quality economic development.

There is a large literature on green innovation for our reference, but most of the research focuses on green technology or process innovation-related fields [7]. Awan et al. (2021) believed that it is essential to better understand the key dimensions of green innovation, namely green product and process innovation [8]. According to existing studies, technological innovation is usually carried out from top to bottom, and the top management team is the most important decision-making driving body in the process of technological innovation [8,9]. These studies explore the impact of digital green-related innovation from the perspectives of leadership style, leadership gender, leadership culture and leadership political background [10]. Guo et al. (2018) pointed out that the environmental pollution-economic development cycle is a problem in the process of national sustainable development [11]. As a complex concept of environmental protection and technological innovation, green technology innovation is the key to breaking this vicious circle [12]. Wicki and Hansen (2019) delved into the process of green technology exploration and the learning patterns and outcomes associated with these processes [13]. The research found that the development of green technology involves a long-term exploration process, which cannot guarantee success (fast). Therefore, in order to make a qualitative leap in green innovation, we must pay attention to the innovation of green technology. Huan et al. (2022) put forward that the innovation activities of enterprises to achieve the dual goals of economic performance and environmental performance are called green innovation through innovative technologies and means [14]. Huan et al. (2022) pointed out that for an economy to perform well in growth, it usually needs to make a tradeoff between financial development and environmental degradation. Taking Singapore as an example, Huan et al. (2022) demonstrated the importance of green technological innovation in the pursuit of economic excellence with as little environmental cost as possible. Existing scholars in the field of green technology innovation have engaged in a detailed discussion [15]. This provides a relatively comprehensive theory for us to better understand green innovation. However, a literature review of many studies reveals that few scholars have studied the concept of deep integration of digital technology and green innovation, which is a key research gap.

The relationship between OFDI and economic transformation, as well as the relationship between industrial structure and green technology innovation, have been covered in many studies. As one of the important paths to improve production efficiency and high-quality economic development, OFDI is conducive to promoting the mobility of resources, and the diffusion of experience and knowledge and may gradually influence the adjustment process of industrial structure through marginal industrial transfer and technological progress. Moreover, a high degree of optimization of industrial structures in a country or region is also an essential requirement for economic transformation as well as an important manifestation of a green and low-carbon economy. Although it is believed that OFDI, green technology innovation, and industrial structure are closely related to one another, few studies comprise all of them in one research framework. Therefore, it will be of great significance to explore a comprehensive interaction mechanism and test the effects.

Based on the above theoretical and practical background, this paper seeks to: i. propose the mechanism underlying the effects of OFDI and green technology innovation on industrial structure upgrading; ii. measure the level of industrial structure upgrading and green technology innovation of China and analyze their mediating and moderating relationship; and iii. examine the heterogeneity of their effects while taking into account green technology innovation.

The following parts of the paper are arranged as follows: The second part is the theoretical background and hypotheses development; the third part presents the methodology; the fourth part presents the results; the fifth part is the discussion; and the sixth part is the conclusion.

2. Theoretical Background and Hypotheses Development

2.1. OFDI, Reverse Green Technology Innovation, and Industrial Structure Upgrading

Under the realistic background of the declining demographic dividend and an increasingly severe resource environment, the key to high-quality economic development has become to lead scientific and technological innovation to green technology innovation with ecological environment protection as the starting point [16]. With the awakening of the host country's awareness of environmental protection and the improvement of the system in recent years, multinational enterprises pay more and more attention to the cleanliness and greening of reverse spillover technology when conducting technical exchanges with the host country, strengthen the development of their own green technology innovation capabilities, and guide the transfer of innovative resources to high-end green industries. OFDI is an important channel to obtain foreign advanced green clean technology and innovative resources. Through this reverse spillover effect, it can improve the production equipment of the home country, improve the efficiency of energy use, promote the development of domestic green technology innovation [17], and then become the driving force for the upgrading of the industrial structure, achieving a win–win situation of economic benefits and environmental effects. Therefore, through this 'inverse gradient' OFDI activity, we can obtain clean technology from developed countries, and this clean technology plays a positive role in industrial segmentation and division of labor, further catalyzes the birth of emerging industries, and promotes the development of high-end industries. Therefore, this paper puts forward the following hypotheses:

H1a. *OFDI reverse technology spillover has a positive impact on industrial structure upgrading.*

H1b. *OFDI reverse technology spillover has a positive impact on domestic green technology innovation.*

H1c. *Domestic green technology innovation has a positive impact on industrial structure upgrading.*

2.2. The Moderating Effect of Independent R&D Level

The level of reverse green technology spillover obtained by OFDI will be greatly affected by the technology research and development factors of the home country, making the relationship between OFDI and industrial structure upgrading complicated [18]. According to technology gap theory, the absorption, imitation, and reinnovation of foreign advanced technology and R&D capabilities depend on the domestic technology level. The higher the domestic technology level, the stronger the absorption capacity of foreign technology and machinery [19]. In contrast, if the domestic technology level does not match the advanced technology obtained by OFDI, it is difficult to digest and imitate in the short term, and the promotion effect on the upgrading of the industrial structure of the home country will not be significant. Therefore, combined with Hypothesis 1, it is inferred that when OFDI reverse technology spillover promotes the upgrading of the industrial structure of the home country through green technology innovation, it is also related to domestic technology catch-up behavior, which may be an important adjustment variable behind the green spillover effect. The level of independent R&D investment in the home country is an important manifestation and measurement of technological catch-up behavior. It can produce positive interaction effects with foreign R&D technology spillover [20], improve the matching of domestic and foreign technology, accelerate the digestion and absorption of foreign green environmental protection technology, clean process equipment, and green R&D knowledge spillover, promote the construction of the green industry chain, and promote the transformation and upgrading of traditional industries in the home country. Therefore, this paper puts forward the following hypotheses:

H2a. *The level of independent R&D investment moderates the relationship between OFDI reverse technology spillover and industrial structure upgrading.*

H2b. *The level of independent R&D investment moderates the relationship between OFDI reverse technology spillover and domestic green technology innovation.*

2.3. The Moderating Effect of Environmental Regulation

The reverse technology spillover obtained by OFDI is also related to the intensity of domestic environmental regulations. The Porter Hypothesis holds that environmental regulations can increase the pollution cost of enterprises and stimulate the innovation behavior of enterprises [21]. In an open economic environment, this innovative behavior will be manifested as international innovation cooperation and become the primary motivation for OFDI activities in emerging countries. In order to adapt to domestic environmental regulation policies, enterprises will focus on absorbing foreign green technologies when conducting OFDI activities, promote green process innovation in the upstream and downstream of the industrial chain through the international division of labor, and promote industrial structure upgrading through imitation, learning, and absorption by domestic enterprises. On the other hand, some scholars believe that strict domestic environmental regulation will produce a pollution haven effect, and domestic enterprises will transfer polluting industries to countries with loose environmental regulation. Such foreign investment activities cannot obtain green technology spillover effects, which are not conducive to the upgrading of industrial structures in the home country [22]. The reverse green technology innovation spillover obtained by China's OFDI activities mainly comes from developed countries and developed countries have long had clear environmental protection rules in controlling investment activities. For example, the United States developed the "National Environmental Policy Law" in the 1970s, yet the pollution shelter effect is not obvious. In addition, developing countries' investment in developed countries can obtain green spillover effects, and home country environmental regulations have a significant role in promoting green technology progress, thereby promoting home country industrial development [23]. Therefore, this paper puts forward the following hypotheses:

H3a. *Environmental regulation moderates the relationship between OFDI reverse technology spillover and industrial structure upgrading.*

H3b. *Environmental regulation moderates the relationship between OFDI reverse technology spillover and domestic green technology innovation.*

The research model is shown in Figure 1.

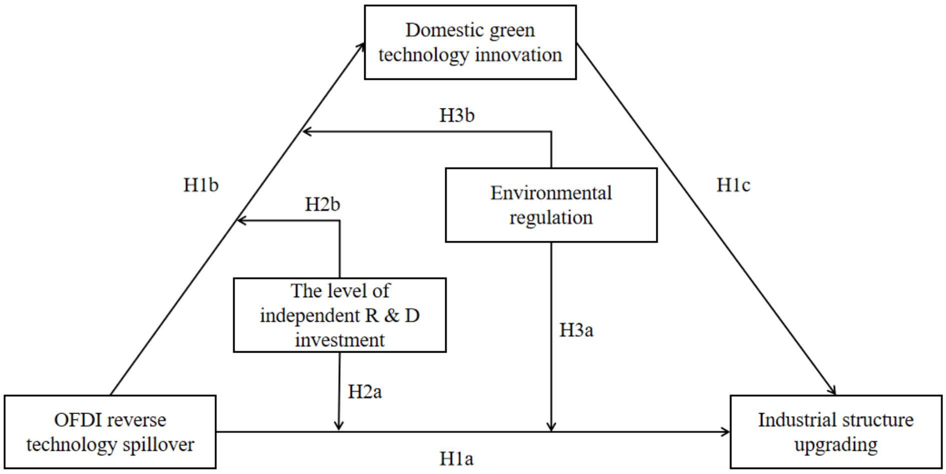

Figure 1. Research Model.

3. Research and Data Methodology

The Cobb–Douglas production function was originally created by American mathematician C. W. Cobb and economist Paul H. Douglas when they discussed the relationship between input and output. It improves the general form of the production function by introducing the factor of technical resources. It is an economic mathematical model used to predict the production of national or regional industrial systems or large enterprises and to analyze the way to develop production. It is the most widely used form of production function in economics. It plays an important role in the research and application of mathematical economics and econometrics. Based on the Cobb–Douglas production function (C-D) model, this paper analyzed the direct relationship between OFDI reverse technology spillover and industrial upgrading and added other control variables that can affect industrial upgrading.

3.1. Data Sources and Descriptive Statistics

According to data continuity, the latest available data of 30 provinces in China from 2004 to 2019 were selected as samples (excluding Hong Kong, Macao, Taiwan and Tibet with more missing data). Most of the data were from the EPS China macroeconomic database, the China science and technology database, the China regional economy database, and the China labor economy database. The models were calculated using Stata16.0 software. All the variable data were logarithmically processed, and the descriptive statistical analysis of the data is shown in Table 1.

Table 1. Sample characteristics.

Variable	Mean	Std. Dev	Min	Max
lnInd	1.892	0.325	0.986	2.715
lnS^f	2.246	2.292	−4.717	7.096
lnofdi	13.618	2.272	6.738	18.703
lnginnov	6.640	1.691	1.098	10.363
lnrd	−4.443	0.647	−6.329	−2.602
lner	2.549	1.038	−1.649	4.953
lnfdi	−4.166	1.054	−7.859	−2.502
lnpeduc	2.164	0.113	1.852	2.548
lngov	−1.598	0.408	−2.566	−0.464
lnlroad	−0.435	0.809	−3.248	0.750
lngdpr	0.113	0.078	−0.327	0.474

3.2. Model

Based on the Cobb–Douglas production function (C-D) model, this paper analyzed the direct relationship between OFDI reverse technology spillover and industrial upgrading and added other control variables that can affect industrial upgrading. The basic Equation (1) is as follows:

$$\mathrm{lnInd_{it}} = \alpha_0 + \alpha_1 \ln S^f_{it} + \alpha_j \ln X_{it} + \mu_i + \varepsilon_{it} \quad (1)$$

In Equation (1), i and t are the provinces and years, respectively. $\ln Ind_{it}$ is the logarithm of the industrial structure upgrading coefficient. $\ln S^f_{it}$ is the reverse technology spillover effect obtained by the logarithm of OFDI. α_0 is the intercept term of the Equation. α_1 is the elasticity coefficient of the reverse technology spillover effect obtained by OFDI to the upgrading of industrial structure. α_j is the elasticity coefficient of the control variable. $\ln X_{it}$ is a series of control variables after taking the logarithm. μ_i is an unobservable individual fixed effect. ε_{it} is a random disturbance term.

In order to investigate the possible transmission mechanism of OFDI reverse green technology innovation on industrial structure upgrading, based on the OFDI reverse green technology innovation spillover method of Cheng et al. (2018), the OFDI intermediary effect Equation was constructed [24]. On the basis of Equation (1), this paper analyzed the impact of OFDI reverse technology spillover on green technology innovation, and then verified the impact of green technology innovation on industrial upgrading. The mediating effect refers to the practice of Yousef et al. (2008) to test the mediating effect of green technology innovation [25]. The test steps were as follows: on the basis of Equation (1), if α_1 is significant, it shows that OFDI reverse technology spillover and industrial structure upgrading have a direct effect. In order to further test the mechanism relationship between them, the regression Equation (2) of $\ln S^f$ to $\ln C_{it}$ was constructed. If β_1 is significant, it shows that OFDI has a reverse green technology innovation effect, and further constructs Equation (3). If γ_2 is significant, it shows that OFDI has a reverse green technology innovation effect, and then promotes the upgrading of industrial structure. The Equations were set as follows:

$$\mathrm{lnginnov_{it}} = \beta_0 + \beta_1 \ln S^f_{it} + \beta_j \ln X_{it} + \mu_i + \varepsilon_{it} \quad (2)$$

$$\mathrm{lnInd_{it}} = \gamma_0 + \gamma_1 \ln S^f_{it} + \gamma_2 \ln C_{it} + \gamma_j \ln X_{it} + \mu_i + \varepsilon_{it} \quad (3)$$

In Equation (2), $\ln ginnov$ is green technology innovation, representing the intermediary variable, which is measured by the number of green patent authorizations ($\ln ginnov1$), the number of green invention patent authorizations ($\ln ginnov2$), and the number of green utility Equation patent authorizations ($\ln ginnov3$).

Furthermore, we verified whether the level of independent research and development has an impact on the absorptive capacity of reverse green technology innovation brought by OFDI. Referring to the moderated mediating effect method proposed by Wu et al. (2019), a Equation was constructed to verify the moderating effect of domestic independent R&D capability and environmental regulation intensity [26]. Equations (4)–(6) are as follows:

$$\ln Ind_{it} = a_0 + a_1 \ln S^f_{it} + a_2 \ln M_{it} + a_3 \ln S^f_{it} \times \ln M_{it} + a_j \ln X_{it} + \mu_i + \varepsilon_{it} \quad (4)$$

$$\ln ginnov_{it} = b_0 + b_1 \ln S^f_{it} + b_2 \ln M_{it} + b_3 \ln S^f_{it} \times \ln M_{it} + b_j \ln X_{it} + \mu_i + \varepsilon_{it} \quad (5)$$

$$\ln Ind_{it} = c_0 + c_1 \ln S^f_{it} + c_2 \ln M_{it} + c_3 \ln S^f_{it} \times \ln M_{it} + c_j \ln ginnov_{it} + a_j \ln X_{it} + \mu_i + \varepsilon_{it} \quad (6)$$

In Equation (5), $\ln M$ is the moderating variable of independent R&D level and environmental regulation, which is expressed by R&D investment intensity ($\ln rd$) and environmental regulation intensity ($\ln er$). $\ln S^f \times \ln M$ is the cross term of OFDI reverse technology spillover and independent R&D level, and a, b, and c are regression coefficients.

The first step was to test the coefficient a_3 in Equation (4) to test whether the direct effect of OFDI reverse technology spillover and industrial structure upgrading is affected by the moderating variables when green technology innovation is not considered. If significant, it is proved that OFDI reverse technology spillover and industrial structure upgrading are affected by the level of domestic independent research and development and the intensity of environmental regulation. The second step was to verify whether the coefficient b_3 in Equation (5) and the coefficient c_4 of Equation (6) were significant. If significant, it proves that the moderated mediating effect (the first half of the path and the direct path) is established.

3.3. Measures

For the reproducibility of the study, a scale that has been verified before was selected for measurement. The details are as follows:

(1) First, we introduced a measure of industrial structure upgrading (Ind) in Equation (1). Zhou et al. (2013)'s measurement of the upgrading of traditional industrial structure was based on Clark–Petty's law to assign weights to the three industries and add them up, but this measurement method does not take into account the production efficiency of each industry [27]. Han et al. (2018) used the product of the proportion of the output value of the three industries to the total output value and the corresponding labor productivity to construct the industrial structure quality coefficient, but it does not reflect the Clark–Petty law of industrial progression [28]. The upgrading of the industrial structure not only reflects the advanced evolution of the industrial structure, but also means the improvement of productivity within the industry. Based on the practice of two scholars, this paper combined Petty–Clark's law with the quality of industrial structure to construct a new industrial structure upgrading coefficient with richer connotations. Compared with the focus of this paper, it can fully reflect the structural evolution and productivity improvement effect brought by green technology innovation. Its form is:

$$Ind = \sum_{n=1}^{3} P_n \times \sqrt{L_n} \times k_n (n = 1, 2, 3) \quad (7)$$

In Equation (7), ind is the upgrading coefficient of industrial structure, n is the Nth industry, k_n is the weight of each output value in the upgrading of industrial structure, the three industries are weighted by 1,2, and 3, respectively, P_n is the proportion of the output value of the three industries to the total output value, L_n is the labor productivity of the three industries, and the output value of each industry is divided by the number of employees in the corresponding industry.

(2) Second, we introduced a measure of reverse technology spillover of OFDI in Equation (8). Using two measurement methods, the international R&D capital spillover obtained by OFDI was used as the evaluation index of OFDI reverse technology spillover effect. The calculation equation refers to the calculation method of Falvey et al.'s (2004) foreign knowledge spillover [29] and combines Chen et al.'s (2014) method to construct the reverse technology spillover capital stock equation of OFDI [30]:

$$S_{it}^{f} = \sum_{i \neq j} \frac{OFDI_{jt}}{Y_{jt}} S_{jt} \times \frac{OFDI_{it}}{\sum_{\neq i} OFDI_{it}} \quad (8)$$

In Equation (8), S_{it}^{f} is the reverse technology spillover obtained by China's provinces through OFDI. $OFDI_{jt}$ represents China's OFDI stock in country j at time t, Y_{jt} is the gross domestic product (GDP) of country j at time t, $OFDI_{it}$ is the OFDI stock of province i at time t, and S_{jt} is the R&D capital stock of country j at time t. The perpetual inventory method was adopted, and the depreciation rate is 5%. According to Dong et al.'s (2021) method, the OFDI stock of China to 14 countries, such as South Korea, Japan, Singapore, Britain, Germany, France, Italy, Netherlands, Denmark, Sweden, Spain, the United States, Canada and Australia, were selected [31].

In addition, referring to Hu et al.'s (2018) approach, the OFDI stock was used to measure the reverse green technology innovation spillover level of provinces and cities [32], and the nonfinancial OFDI stock was converted into RMB by using the current exchange rate. The OFDI measure was used for the robustness test.

(3) Third, we introduced a measure of Green technology innovation (ginnov) in Equation (2). Green technology innovation is usually measured by green patents. General invention patents are regarded as breakthrough technological progress, while utility Equation patents are regarded as progressive technological progress. The number of green invention patents (ginnov1) and green utility model patents (ginnov2) were selected as the evaluation index of green technology innovation (ginnov), and the total green technology innovation index was obtained by adding the two.

(4) Fourth, we introduced a measure of independent R&D level (rd) in Equation (5). Referring to Wakelin's (2001) approach, the ratio of R&D expenditure to GDP in the current year is used to represent the R&D investment intensity (rd) of each province [33].

(5) Fifth, we introduced a measure of environmental regulation (er) in Equation (5). Referring to Zhang et al.'s (2003) approach, the amount of investment in industrial pollution control was used to measure environmental regulation (er) [34].

The following control variables were selected: foreign direct investment level (open), per capita education years (peduc), government expenditure level (gov), infrastructure level (lroad), and economic development level (gdpr).

4. Result

4.1. Mediating Effect Analysis

Through robust standard error regression, it was found that the VIF value (1.92) of the multicollinearity test is less than 10, indicating that there is no serious multicollinearity relationship [35]. After the Hausman test (p = 0.000), it was found that the fixed effect was more appropriate, and the regression analysis was performed on Models (1–3). The results are shown in Table 2.

According to the empirical results of Model (1), the influence coefficient of OFDI reverse technology spillover on industrial structure upgrading is 0.093 and significant at the level of 1%, indicating that OFDI reverse technology spillover has a significant role in promoting industrial structure upgrading. The coefficient is relatively small compared with other variable coefficients. It may be that although China's OFDI is large in scale, it started late and grew fast, but the investment structure and investment location are unreasonable, which inhibits the impact of OFDI reverse technology spillover on the industrial structure [36].

The results of Models (2) and (3) show that China's OFDI activities can significantly improve the level of domestic green technology innovation, which has a significant positive impact on the upgrading of the industrial structure, which verifies the green technology innovation mechanism of OFDI reverse technology spillover affecting the upgrading of the industrial structure in Hypothesis 1. Among them, the mediating effect of green invention accounted for 31.23% of the total effect ($\beta_1 \times \gamma_2/\alpha_1$), the mediating effect of green utility model patents accounted for 39.06% of the total effect, and the mediating effect of total green patents accounted for 44.35% of the total effect. The mediating effect of green invention patents is lower than that of green utility model patents. From the perspective of OFDI reverse green innovation effect, the OFDI reverse green invention effect coefficient is 0.312, while the reverse green utility model patent effect coefficient is 0.367, indicating that China's OFDI reverse green utility model innovation effect is higher [37].

Table 2. The mediating effect of OFDI reverse technology spillover on industrial upgrading through green technology innovation.

Variable	Model (1)	Model (2)	Model (3)	Model (2)	Model (3)	Model (2)	Model (3)
	lnInd	lnginnov1	lnInd	lnginnov2	lnInd	lnginnov3	lnInd
$\ln S^f$	0.093 *** (8.70)	0.355 *** (9.70)	0.052 *** (5.05)	0.312 *** (8.77)	0.064 *** (7.27)	0.367 *** (8.98)	0.056 *** (5.46)
lnginnov1	-	-	0.114 *** (6.57)	-	-	-	-
lnginnov2	-	-	-	-	0.093 *** (5.69)	-	-
lnginnov3	-	-	-	-	-	-	0.099 *** (6.48)
lnfdi	−0.126 (−0.81)	−0.152 ** (−2.37)	0.004 (0.33)	−0.085 (−1.13)	−0.004 (−0.33)	−0.160 ** (−2.66)	0.003 (0.23)
lnpeduc	0.970 (4.56)	4.756 *** (5.47)	0.424 ** (2.25)	6.060 *** (6.49)	0.403 ** (2.31)	4.577 *** (4.70)	0.515 ** (2.54)
lngov	−0.090 (−1.32)	0.726 *** (3.36)	−0.173 ** (−2.55)	0.726 *** (3.25)	−0.158 ** (−2.31)	0.711 *** (3.08)	−0.160 ** (−2.36)
lnlroad	0.151 *** (4.46)	0.193 (1.69)	0.129 *** (4.41)	0.116 (0.83)	0.140 *** (4.99)	0.203 (1.68)	0.131 *** (4.20)
lngdpr	0.013 (0.16)	−0.397 (−1.58)	0.059 (0.75)	−0.724 * (−2.04)	0.081 (1.06)	−0.309 (−1.18)	0.044 (0.54)
Cons	−0.550 (−1.19)	−3.794 * (−1.95)	−0.114 (−0.29)	−7.71 *** (−3.80)	0.171 (0.47)	−3.785 * (−1.73)	−0.174 (−0.42)
R^2	0.913	0.935	0.930	0.914	0.928	0.928	0.928
N	480	480	480	480	480	480	480

Note: (1) ***, ** and * were expressed as significant at the 1%, 5% and 10% significance levels, respectively; (2) The parentheses are *t* statistics.

4.2. Moderated Mediation Effect Analysis

In order to test how domestic technology catch-up behavior and environmental regulation intensity regulate the mediating effect between OFDI reverse green innovation and industrial structure upgrading (first half of the path and direct path), a regression analysis was carried out on Models (4–6). The results are shown in Table 3.

The coefficient of the interaction term ($\ln S^f \times \ln rd$) between OFDI reverse technology spillover and R&D intensity is 0.141, and it is significant at the level of 1%, indicating that the direct effect of OFDI reverse technology spillover on industrial structure upgrading is regulated by R&D intensity. In the intermediary mechanism, the coefficient of the interaction term ($\ln S^f \times \ln rd$) between OFDI reverse technology spillover and R&D intensity is 0.073, and the coefficient of green technology innovation ($\ln ginnov$) in the total effect is 0.101, which is significant at the 1% level, proving that the moderated intermediary effect is established, and the first half of the path and the direct path are regulated. Similarly, the intensity of environmental regulation not only has a regulatory role in the direct effect, but also has a regulatory role in the intermediary mechanism of OFDI reverse technology spillover and industrial structure upgrading, regulating the first half of the path and the direct path. Therefore, it can be seen that the increase of domestic independent technological catch-up behavior and environmental regulation can improve the absorptive capacity of OFDI of foreign advanced technology, and the greater the role of reverse green innovation, the greater the promotion effect on the upgrading of industrial structure; thus, Hypotheses 2 and 3 have been verified.

Table 3. Moderated mediating effect.

Variable	First Half Path			Direct Path		
	Model (4)	Model (5)	Model (6)	Model (4)	Model (5)	Model (6)
	lnInd	lnginnov	lnInd	lnInd	lnginnov	lnInd
$\ln S^f$	0.143 *** (5.70)	0.588 *** (8.28)	0.072 *** (2.95)	0.089 *** (7.63)	0.313 *** (9.43)	0.054 *** (4.79)
lnginnov	-	-	0.119 *** (5.45)	-	-	0.111 *** (5.99)
lnrd	0.014 (0.30)	0.643 *** (3.97)	−0.062 (−1.13)	-	-	-
$\ln S^f \times$ lnrd	0.011 ** (2.26)	0.060 *** (4.57)	0.004 (0.95)	-	-	-
lner	-	-	-	−0.026 *** (−4.01)	−0.092 ** (−2.08)	−0.016 ** (−2.49)
$\ln S^f \times$ lner	-	-	-	0.003 * (1.73)	0.023 *** (2.82)	0.001 (0.40)
Control variable	Yes	Yes	Yes	Yes	Yes	Yes
Cons	−0.266 (−0.57)	0.122 (0.07)	−0.281 (−0.68)	−0.390 (−0.83)	−3.057 (−1.59)	−0.050 (−0.13)
R^2	0.917	0.947	0.932	0.916	0.938	0.931
N	480	480	480	480	480	480

Note: (1) ***, ** and * were expressed as significant at the 1%, 5% and 10% significance levels, respectively.

4.3. Robustness Test

The research aim is to explore the impact of OFDI reverse technology spillover on industrial structure upgrading, but industrial structure upgrading will further promote OFDI level. For example, technology-seeking OFDI precisely reflects the need to upgrade the domestic industrial structure and invest in factories in developed countries to obtain advanced R&D equipment and innovative technologies in developed countries. In addition, the upgrading of industrial structure can also play a role in economic growth. In view of the interaction between OFDI, economic development level, and industrial structure upgrading, Model (1) may have endogenous problems and needs to be endogenous. First, the regression of the industrial structure upgrading coefficient of the current period is carried out for all explanatory variables. Second, referring to Stoian (2013), OFDI and economic development variables are selected as instrumental variables [38]. This paper takes the first-order lag period of OFDI as its instrumental variable, and the first-order and second-order lag periods of economic development level as its instrumental variables. Finally, two-stage least squares (2SLS) and generalized moment estimation (GMM) are used for instrumental variable regression. In addition, the replacement variable method is used for the robustness test. The OFDI reverse green innovation index refers to the Zhang et al. (2022) practice [39], and the OFDI stock of each province is used as the measure of OFDI green technology reverse spillover. The industrial structure upgrading index refers to Wang et al. (2013)'s equation algorithm to replace the empirical process [40]. The empirical results show that both the explanatory variable lags one period, 2SLS, and GMM regression and the variable replacement method show that OFDI reverse technology spillover has a significant positive effect on industrial structure upgrading. It shows that the promotion effect of OFDI reverse technology spillover on industrial structure upgrading is robust, and after replacing the industrial structure variable, the effect of OFDI reverse green innovation on industrial structure upgrading is also significant. From the test results of the regulated intermediary mechanism, after replacing the OFDI measurement index, whether it is the improvement of R&D intensity or the enhancement of environmental regulation, it also has a positive adjustment effect in the direct effect and intermediary mechanism of OFDI and industrial structure upgrading.

The motivation of enterprise innovation can be divided into substantive innovation and strategic innovation. Invention patents are substantive innovation, and noninvention patents are strategic innovation [41]. In view of the fact that industrial policy belongs to the macro category, the regional technological catch-up behavior and environmental regulation are derived as macro strategic variables that affect regional innovation. Then, whether different macrostrategic environments have heterogeneous effects on OFDI reverse green innovation spillover effects and whether this effect has differences in industrial structure upgrading are determined. Therefore, green invention patents are divided into substantive innovation, green noninvention patents are listed as strategic innovation, and a moderated mediation model is estimated. The results are shown in Tables 4 and 5.

Table 4. R&D investment intensity-moderated mediating effect.

Variable	First Half Path			Direct Path	
	Model (4)	Model (5)	Model (6)	Model (5)	Model (6)
	lnInd	lnginnov2	lnInd	lnginnov3	lnInd
lnginnov2	-	-	0.094 ***	-	-
			(4.76)		
lnginnov3	-	-	-	-	0.099 ***
					(5.28)
$lnS^f \times lnrd$	0.011 **	0.062 ***	0.005	0.061 ***	0.005
	(2.26)	(3.10)	(1.35)	(4.43)	(1.13)
Control variable	Yes	Yes	Yes	Yes	Yes
Cons	−0.266	−3.514 *	0.066	0.072	−0.273
	(−0.57)	(−1.96)	(0.18)	(0.04)	(−0.62)
R^2	0.917	0.928	0.929	0.940	0.929
N	480	480	480	480	480

Note: (1) ***, ** and * were expressed as significant at the 1%, 5% and 10% significance levels, respectively.

Table 5. Environmental regulation-moderated mediating effect.

Variable	First Half Path			Direct Path	
	Model (4)	Model (5)	Model (6)	Model (5)	Model (6)
	lnInd	lnginnov2	lnInd	lnginnov3	lnInd
lnginnov2	-	-	0.093 ***	-	-
			(5.22)		
lnginnov3	-	-	-	-	0.094 ***
					(5.04)
$lnS^f \times lner$	0.089 ***	0.028 ***	0.001	0.023 **	0.001
	(7.63)	(3.01)	(0.34)	(2.70)	(0.66)
Control variable	Yes	Yes	Yes	Yes	Yes
Cons	−0.390	−7.112 ***	0.273	−2.930	−0.112
	(−0.83)	(−3.40)	(0.79)	(−1.35)	(−0.27)
R^2	0.916	0.918	0.930	0.932	0.929
N	480	480	480	480	480

Note: (1) *** and ** were expressed as significant at the 1% and 5% significance levels, respectively.

According to the results of comprehensive Tables 4 and 5, OFDI reverse green innovation is a positive relationship, whether it is the adjustment effect of R&D investment intensity or environmental regulation. That is, the increase of R&D investment intensity and the enhancement of environmental regulation in both home countries can promote OFDI reverse substantive green innovation and strategic green innovation and the upgrading of the industrial structure. From the perspective of the mediating effect value, there are differences between the two. If we do not consider the moderating effect of R&D investment intensity and environmental regulation quality on OFDI reverse technology spillover, OFDI has a stronger absorptive capacity for green utility model patents (strategic green innovation). However, considering the regulatory effect of R&D investment intensity and environmental regulation of OFDI reverse technology spillover, OFDI has a stronger absorptive capacity for green invention patents (substantive green innovation), with coefficients of 0.062 and 0.028, respectively. This is higher than the utility model patents of 0.061 and 0.023, indicating that R&D investment intensity and environmental regulation can significantly improve OFDI's absorptive capacity for green invention patents, which is more conducive to the upgrading and sustainable development of the industrial structure of the home country. In addition, the coefficients of the synergistic effect of R&D investment intensity and environmental regulation on OFDI reverse technology spillover on green invention patents are 0.062 and 0.028, respectively. It can be seen that the adjustment of R&D investment intensity has a greater impact on the mediating effect of green innovation, while environmental regulation has a smaller impact on the mediating effect of green invention patents. The intensity of environmental regulation measured by the amount of investment in environmental pollution control is generally regarded as formal environmental regulation, and the increase in the intensity of R&D investment will improve the efficiency of resource use and unconsciously improve the ability of environmental governance. From this perspective, the intensity of R&D investment is approximately equal to the role of informal environmental regulation. Therefore, it is more important for regional internal factors such as R&D capabilities to achieve green development when conducting overseas investment activities.

5. Discussion

First, Chinese enterprises should continue to be encouraged to go out and actively play the reverse role of OFDI in green technology innovation. The 'new infrastructure' to improve the hard conditions such as transportation and information and communication facilities will strengthen the development of interconnections at home and abroad, and further expand the level of opening up [42]. At the same time, relevant policies should be developed, such as participating in the establishment of green international rules, optimizing soft conditions such as OFDI protection framework [43], building green overseas economic and trade cooperation zones, and combining the "Belt and Road" initiative to provide a friendly investment environment and corresponding policy support for Chinese multinational investment enterprises.

Second, Chinese enterprises should improve their ability to adapt to the technology of cooperative countries in OFDI activities [44]. When conducting strategic asset-seeking OFDI, Chinese enterprises must first adhere to the development strategy of "iron-making needs its own hard", continuously accumulate human capital and R&D capital stock, improve the level of technology R&D, strengthen the absorption capacity of green technology brought by OFDI, promote domestic substantive green innovation, and promote the transformation and upgrading of regional industrial structure.

Third, the opening-up strategy should be combined with the green development strategy [45]. Government departments should flexibly use environmental protection policy tools, actively use environmental regulation to guide overseas investment enterprises to optimize OFDI structure, encourage enterprises to learn green technology from developed countries, promote the development of China's green economy, and achieve high-quality economic development goals.

Fourth, when conducting OFDI activities, we should deeply understand the industrial policy of the host country, actively guide the flow of innovative elements such as knowledge technology, green talent and R&D capital to the field of green innovation, and create a green economy international cooperation and development model [46]. In-depth analysis of the host country's environmental policy and early technology accumulation can strengthen cooperation with foreign advanced green technology. For example, we should implement the cooperation mode with excellent universities and scientific research institutions in the host country, and further consolidate the green R&D cooperation mode through industrial linkage and industrial chain correlation with excellent enterprises in the host country, promote the establishment of substantive green innovation system, and promote the advanced development of China's industry.

6. Conclusions

Under the background of "double circulation", whether a large number of OFDI activities of enterprises can obtain the reverse technology spillover effect of foreign advanced green technology to promote domestic industrial upgrading and promote high-quality economic development while obtaining overseas markets and resources is one of the important criteria for judging whether China's OFDI strategy is effective. It is also an important basis for examining whether the external circulation promotes the benign interaction of the domestic circulation. This paper proposes that the two key points of OFDI to promote the high-quality development of the domestic economy are industrial structure upgrading and green technology innovation capability. The findings are as follows:

First, the reverse technology spillover obtained by OFDI not only promotes the upgrading of China's industrial structure in general, but also has an intermediary influence mechanism on green technology innovation.

Second, green technology innovation is not only conducive to promoting the extension of the industrial value chain, but also can promote the improvement of industrial labor productivity.

Third, the improvement of domestic R&D capacity and the enhancement of environmental regulation not only play a strengthening role in the direct effect of OFDI reverse technology spillover and industrial structure upgrading, but also play a strengthening role in the mediating effect of OFDI reverse green technology innovation. Although OFDI reverse green innovation mainly promotes the development of strategic green innovation, the improvement of domestic R&D capabilities and the enhancement of environmental regulation can significantly improve the mediating effect of substantive green innovation and strengthen the role of OFDI reverse green technology innovation in promoting industrial structure upgrading. R&D investment intensity has a greater effect on OFDI reverse substantive green innovation. It shows that in the green cooperation of foreign investment, the level of R&D capability is more important. After robustness processing, such as the endogenous test and replacement variable and replacement of the core explanatory variable measurement method, the hypothesis is still verified.

7. Limitations and Future Research Directions

The limitation of this paper is that it mainly discusses the influence of foreign investment on industrial structure upgrading under the regulation of R&D investment and environmental regulation. The data come from developing countries, and data from developed countries will be used for comparison in the future. At the same time, the impact of digital technology on industrial structure upgrading is also the main direction of further research, which also points out the direction for China to achieve the strategic goal of "carbon neutrality and carbon peak" and the strategic goal of becoming a digital power.

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