Environmental Regulations and Outward Foreign Direct Investment—Empirical Evidence from Chinese Enterprises

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Abstract

In the context of the new economic normal, environmental protection and economic growth have become the focus of academic attention. This paper explores the effect and impact mechanism of environmental regulations on the outward foreign direct investment (OFDI) of enterprises by using data from the China Industrial Enterprise Database and the Directory of Overseas Investment Enterprises (Institutions) for years 2004 to 2010. The findings are summarised as follows. Firstly, environmental regulations have a significant positive effect on the OFDI of Chinese enterprises, and this result remains robust after considering the outcomes of robustness tests and endogeneity issues. Secondly, the promotion effect of environmental regulations on the OFDI of Chinese enterprises obviously differs across investment motivations and industry characteristics. Thirdly, productivity gains are important channels through which environmental regulations promote the OFDI of enterprises. These findings have great significance for the effective formulation of environmental regulatory policies and the stable development of the OFDI of Chinese enterprises.

1. Introduction

Since 2001 after the Chinese government proposed the “going out” strategy, local governments in China have successively introduced relevant policies and measures to encourage enterprises to make outward foreign direct investments (OFDI). Under the guidance of China's “going out” strategy, the quantity and scale of China's OFDI have rapidly increased. According to statistical data from the Ministry of Commerce, China set up 6,349 overseas enterprises in 166 countries and regions around the world in 2021, representing a year-on-year increase of 3.2%. Meanwhile, China's outward FDI reached US$145.19 billion in the same year, representing a 9.2% year-on-year increase. Therefore, OFDI has become an important driver of China's economic growth. However, in sharp contrast to its fast-growing OFDI, the environmental quality in China is rapidly deteriorating (Ouyang et al. 2020). Serious environmental pollution not only disrupts and destroys the ecosystem but also affects normal production and operation activities and reduces the social welfare of the people. In this context, environmental pollution introduces a serious challenge to sustainable economic development. Therefore, how to improve the quality of the ecological environment has become a key task of the Chinese government. In recent years, the Chinese government has introduced a series of strict pollution control measures to enhance the intensity of its environmental regulations and improve environmental quality (Gong et al. 2020; Yang and Wang 2022). To meet the environmental regulatory standards stipulated by the government, Chinese enterprises have gradually increased their investment in R&D on green technologies and upgraded their existing environmental performance and technological processes. Enhancing R&D capabilities can also improve the competitive advantage of enterprises in the international market (Cai et al. 2020). In this case, are there significant economic links between the strengthening of environmental regulations and China's fast-growing OFDI? If so, what about its influence mechanism? Answering these questions presents great theoretical and practical significance.

The literature on the impact of environmental regulations on foreign investment has mainly focused on the field of foreign capital inflows. Mcguire (1982) proposed the “pollution haven effect” when discussing the impact of environmental regulations on the production costs of firms. He mentioned that strengthening

environmental regulations will facilitate the transfer of enterprises to countries or regions with low levels of environmental regulations. In addition, Manderson and Kneller (2012) integrated environmental regulation into heterogeneous firm models and empirically found that the environmental regulation of the host country is a key factor that influences the OFDI of polluting-intensive firms in the UK. Using data on Korean companies, Yoon and Heshmati (2021) found that host countries with loose environmental regulations attract large amounts of direct investment from highly polluting firms. These studies further justify the existence of the “pollution haven effect”. With the increasing seriousness of China's environmental problems and the unevenness of its economic development, scholars have started to investigate the relationship between China's environmental regulations and FDI. For instance, based on Chinese panel data, Dong et al. (2021) found that environmental regulations inhibit FDI inflows and argued that such inhibition varies across regions and industries. In other words, strengthened environmental regulations will improve FDI quality and help China avoid turning into a “pollution haven” (Huang et al. 2017; Yu and Li 2020; Xu et al. 2021).

With the annual expansion of China's OFDI scale and the gradual strengthening of its environmental regulations, the impact of environmental regulations on China's OFDI warrants investigation. In recent years, scholars have begun to explore the impact of home country environmental regulations on OFDI and obtained contrasting findings. On the one hand, enterprises prefer OFDI to avoid the higher pollution control costs caused by environmental regulations (Gong et al. 2020; Cole et al. 2004). On the other hand, other scholars argue that strict environmental regulations will reduce the willingness of companies to operate across borders (Markusen 1997). In addition, Eskeland and Harrison (2003) found that environmental regulations have failed to develop a clear facilitative or inhibitory effect on OFDI. On this basis, Naughton (2014) observed a threshold effect on the impact of home country environmental regulations on OFDI. Specifically, when the intensity of home country environmental regulations is low, these regulations will promote OFDI through the “pollution haven effect”. When these regulations reach a certain level, they generate a ‘shutdown effect’ that inhibits OFDI. Luo et al. (2021) investigated the effects of different types of environmental regulations on China's OFDI and found that command-and-control and marked-based environmental regulations inhibit the OFDI of enterprises, whereas informal environmental regulations play a significant positive role in promoting enterprise OFDI. Overall, research on the impact of home country environmental regulations on OFDI remains at the exploratory stage. At present, studies on the impact of environmental regulations on enterprises' OFDI have been limited due to the lack of microdata. Previous studies also fail to provide an effective mechanistic analysis. Relevant research should analyse the impact channels and effects of environmental regulations on OFDI from the micro-enterprise level to help understand the effectiveness and significance of existing environmental regulation policies and provide a realistic basis for governments to formulate relevant environmental regulatory policies.

This study supplements the literature as follows. Firstly, this study combines environmental regulations with OFDI based on the micro perspective of Chinese enterprises. As previous studies have mostly analysed the impact of environmental regulations on OFDI from a macro perspective, such impact has rarely been micro-tested at the enterprise level, hence failing to provide not only a comprehensive understanding of the differences in the impact of environmental regulations on OFDI across different industry characteristics and enterprise types but also micro evidence that can guide the formulation of macro environmental regulatory

policies. Secondly, based on the theoretical framework of heterogeneous enterprises, this study explores the influence channels and internal mechanisms of the effect of environmental regulations on enterprise OFDI. Conventional economic theory posits that strong environmental regulations will increase the pollution control cost of enterprises, promote industrial transfer to low-pollution areas and increase the OFDI of enterprises. However, whilst environmental regulations promote OFDI through pollution transfer channels, strict environmental regulations will stimulate these enterprises to engage in technological transformation and upgrading. Moreover, environmental regulations will increase the productivity level of enterprises and enhance their competitiveness in international markets to promote their OFDI. This study then abandons the traditional pollution transfer hypothesis by exploring the influence mechanism of environmental regulations on enterprise OFDI from the perspective of firm productivity based on the theoretical framework of heterogeneous firms.

The rest of this paper is organised as follows. Section 2 presents the theoretical hypotheses. Section 3 establishes the econometric model, selects the research variables and describes the data. Section 4 presents and analyses the empirical results. Section 5 concludes the paper and discusses its policy implications.

2. Theoretical Mechanism And Research Hypotheses

2.1. Theoretical Mechanism

Environmental regulations both have a positive “strengthening effect” and a negative “offsetting effect” on the OFDI of enterprises. On the one hand, environmental regulations promote enterprises to improve their production processes or pollution control capabilities, which would consequently enhance their competitiveness, level of productivity and external economies of scale. On the other hand, strong environmental regulations will increase the cost of pollution control and reduce the investment of enterprises' R&D funds, which would reduce the profitability of firms and negatively affect their advantage in market competition. This effect has been described as an “offsetting effect”.

2.1.1. Strengthening effect

The Porter hypothesis introduces dynamic innovation as an analytical mechanism. Specifically, this hypothesis posits that a reasonable and effective environmental regulation will enhance enterprise R&D investment and promote technological innovation. Therefore, jointly improving environmental regulations and enterprise productivity through the “innovation compensation effect” and “first-mover advantage” will indirectly encourage enterprises to engage in OFDI (Porter and Linde 1995; Ambec et al. 2013; Santis et al. 2021).

Continuous environmental regulatory pressures will force enterprises to innovate their products and processes and improve their utilisation of existing resources, which would consequently increase their productivity (Lanoie et al. 2011; Ai et al. 2020). In this case, enterprises experience the “innovation compensation effect.” Environmental regulations also raise the environmental awareness of society, which

would consequently encourage enterprises to take the lead in adopting environment-friendly measures to change their business philosophy (Rubashkina et al. 2015; Peng et al. 2021), such as by improving their environmental performance and developing green products and technologies. By taking the lead in introducing new products and technologies into the market, an enterprise can outperform its competitors in occupying the market. As a result, this enterprise receives more consumer favour, which would increase its productivity levels and lead to a “first-mover advantage”. Moreover, the adoption of environmental regulatory measures to improve the degree of environmental protection, the government inevitably encourages the technological reform and innovation of enterprises through policy support (Zhang et al. 2015). For instance, the government may adjust energy prices according to environmental costs or provide preferential policies to those enterprises that utilise new energy and materials in their production processes. The formulation and implementation of these policies are conducive to improving the productivity levels of enterprises (Hu et al. 2021).

In addition, an increase in the productivity of firms will also affect their OFDI behaviour. Breaking away from the assumption of firm homogeneity in traditional international trade theory, Melitz (2003) explained the transnational business behaviour of firms from the perspective of productivity heterogeneity. Helpman et al. (2004) extended the international market entry model from exports to OFDI based on the heterogeneous enterprise model and obtained two key conclusions. Firstly, the most productive firms will conduct OFDI by overcoming the high fixed costs in their overseas production and operations. Secondly, moderately productive firms will participate in international markets through exports, whereas the least productive firms can only produce and sell their products and services in the domestic market (Marti et al. 2015; Tian and Yu 2020). Many empirical studies have also supported the view that productivity is a key factor in determining the OFDI of enterprises. For instance, Eaton et al. (2004), Girma et al. (2005) and Yeaple (2009) used data on French firms, UK firms, and US multinational corporations to show that firms with a higher productivity have a larger OFDI scale. These studies all confirm the conclusions of the theoretical model of Helpman et al. (2007). In addition, by using data on Chinese enterprises, some scholars have demonstrated that a higher firm productivity corresponds to a greater probability of engaging in OFDI (Shao and Shang 2016; Wang et al. 2016; Yan et al. 2018). In other words, the arguments of heterogeneous firm trade theories still apply today. Therefore, benefiting from the “strengthening effect”, environmental regulations promote OFDI by boosting firm productivity.

2.1.2. Offsetting effect

Stronger environmental regulations also impose new constraints on the production decisions of enterprises. Specifically, stronger environmental regulations will increase pollution control costs and capital investment by generating a crowding out effect on technological innovation funds, which would adversely affect the production and operation of enterprises (Guo et al. 2017; Tang et al. 2020). Pollution is regarded as a special element input in the production processes of enterprises. As a result, stronger environmental regulations will force enterprises to pay a large amount of pollution taxes to deal with environmental regulation measures. However, despite reducing the pollution emissions from the production process of enterprises, paying pollution taxes also increases the environmental costs required by enterprises (Zhang et al. 2017), hence forcing these enterprises to transfer their resources from technological innovation to

pollution treatment, reduce their investment of R&D funds and affect the improvement in their R&D and productivity levels. Therefore, stronger environmental regulations will crowd out the technology investment funds of enterprises and weaken their competitive strength in the international market. In this case, environmental regulations generate have an “offsetting effect” on the OFDI of enterprises.

However, Murty and Kumar (2003) found that despite imposing constraints on firms, environmental regulations also stimulate these enterprises to improve their production processes by engaging in green technology innovation or improving their pollution control capabilities to meet the corresponding environmental standards. These initiatives all reduce the adverse impact of pollution control investment on the management performance of enterprises. Moreover, the resulting “innovation compensation” will fully offset or even exceed the additional costs complying with the environmental regulations. This finding has received further support in subsequent studies. For instance, Zhao et al. (2018) found that strict environmental regulations will stimulate technological progress, encourage enterprises to break through their living environment under cost pressure and enhance their competitive advantage, all of which offset the adverse effects of environmental regulations on the production and operations of enterprises. In other words, stronger environmental regulations are less likely to inhibit OFDI by crowding out the technological capital investment of enterprises.

In sum, environmental regulations influence the OFDI by firms through their “strengthening” or “offsetting” effects, of which the “strengthening effect” is in a dominant position. In other words, environmental regulations affect OFDI mainly through the “strengthening effect”. This study then proposes the following:

Hypothesis 1

Environmental regulations push enterprises into carrying out OFDI by increasing their productivity level.

2.2. Heterogeneity Hypothesis

The effects of environmental regulations on the OFDI of enterprises may be heterogeneous. Specifically, such effect may vary depending on the investment motivations and industry categories of these enterprises. Therefore, this study examines the differential impacts of environmental regulations on OFDI from the perspectives of investment motivation and industry characteristics.

2.2.1. Heterogeneity of investment motivations

According to the investment motivations of multinational enterprises, OFDI can be categorised into market-, cost- and technology-seeking OFDIs (Dunning and Lundan 2008). Firstly, market-seeking OFDI aims to expand and open up overseas markets, accept import and export trade orders and provide after-sales services. Therefore, market-seeking multinational enterprises make full use of the “innovation compensation effect” and “first-mover advantage” provided by environmental regulations, which will improve their level of technological innovation, enhance their competitive advantage in the international market and expand their exports to overseas markets, all of which will promote their OFDI. Secondly, cost-seeking OFDI aims to obtain relevant resources and reduce production costs. However, the “innovation compensation” generated

by environmental regulations will offset pollution control costs due to compliance with environmental regulatory standards (Lanoie et al. 2008). Therefore, productivity gains and additional cost offsets will affect the motivation of cost-seeking multinational corporations to operate overseas. Thirdly, technology-seeking enterprises maintain a competitive advantage in international markets by acquiring advanced production technologies or using the innovative capabilities of developed countries. In addition, the "strengthening effect" of environmental regulations will enhance the ability of technology-seeking multinational enterprises to absorb advanced technologies from their host countries, hence facilitating a technology integration between multinational enterprises and overseas subsidiaries, further improving the comprehensive R&D level of multinational enterprises and consequently promoting their OFDI. The following hypothesis is then proposed:

Hypothesis 2

Environmental regulations help promote OFDI by market-seeking and technology-seeking enterprises but have a lesser impact on cost-seeking enterprises.

2.2.2. Heterogeneity of industry categories

Following Cai et al. (2020), this paper divides the sample industries into technology-intensive, labour-intensive and capital-intensive industries. Given that the "innovation compensation effect" and "first-mover advantage" brought about by environmental regulations may differ across these industries, these regulations also affect the OFDI of firms in each industry differently. Firstly, technology-intensive industries rely on sophisticated and advanced science and technology in their production processes. Therefore, these industries are greatly affected by the "innovation compensation effect" and "first-mover advantage". In addition, an enhancement in R&D level and innovation ability will increase product complexity (Mbanyele and Wang 2022), hence creating a comparative advantage for the OFDI of enterprises. Therefore, environmental regulations can encourage technology-intensive industries to engage in OFDI. Secondly, labour-intensive industries require a large amount of labour input in production and have low reliance on advanced technology and equipment. Although the "innovation compensation effect" and "first-mover advantage" will increase the productivity levels and enhance the competitive advantage of firms in overseas markets, compared with technology-intensive industries, environmental regulations have a smaller role in promoting the OFDI of labour-intensive industries. Thirdly, access to adequate capital is a key factor in the OFDI of technology-intensive industries. Nevertheless, whilst environmental regulations increase the technological content of enterprises, enhance their productivity and promote their engagement in OFDI, the use of R&D funds will transfer the capital that is initially allocated by capital-intensive enterprises to OFDI (Dechezlepretre and Sato, 2017), hence weakening the competitiveness of these enterprises in international markets and offsetting the positive impact of environmental regulations on the OFDI of capital-intensive enterprises. In sum, environmental regulations do not significantly promote the OFDI of capital-intensive industries. The following hypothesis is proposed:

Hypothesis 3

The impact of environmental regulations on technology-intensive industries OFDI is stronger than that on labour- and capital-intensive industries.

3. Methodology And Data

3.1. Model Settings

To test the impact of environmental regulations on the OFDI of Chinese enterprises, the following measurement model is built:

$$ofdi_{ijkt} = \alpha_0 + \alpha_1 lnERS_{jt} + X_{ijkt} + v_t + u_k + \gamma_j + \epsilon_{ijkt} \quad (1)$$

where i, j, k and t represent the enterprise, industry, region and year, respectively, $ofdi_{ijkt}$ represents the OFDI of enterprises, ERS_{jt} is the core explanatory variable that represents the intensity of environmental regulations, X_{ijkt} represents the firm- and industry-level control variables, including enterprise size, age and capital intensity, v_t, u_k and γ_j represent the year, regional and industry effects, respectively, and ϵ_{ijkt} denotes the random interference items of the model.

3.2. Variable Description

3.2.1. Dependent Variable

$ofdi$ is a binary variable that equals 1 when an enterprise conducts OFDI and equals 0 otherwise.

3.2.2. Core Explanatory Variable

Drawing on Fu and Li (2010), industrial environmental regulation intensity is comprehensively measured by using data on industrial wastewater, industrial sulphur dioxide, industrial soot, industrial dust emissions and industrial fixed waste generation. Firstly, the individual pollution emission indicators are standardised as follows by combining their maximum and minimum values to eliminate the impact of the unit of measure:

$$UE_{jct} = \frac{E_{jct} - \min\left(E_{ct}\right)}{\max\left(E_{ct}\right) - \min\left(E_{ct}\right)}$$

2

where E_{jct} represents the original value of the class *c* indicator from industry *j* in year *t*, $\max\left(E_{ct}\right)$ and $\min\left(E_{ct}\right)$ represent the maximum and minimum values of pollutant class c indicators in all industries from 2004 to 2010 and UE_{jct} represents the standardised value of E_{jct}.

The adjustment coefficients of each indicator, denoted by W_{jct}, are then calculated. Given the huge differences in the nature of each industry, the proportion of pollutant emissions amongst these industries also greatly differ. In addition, the emission intensity of different pollutants varies greatly even if they belong to the same industry. Therefore, the adjustment coefficients are calculated as follows to reflect the changes in the emission intensity of major pollutants in various industries:

$$W_{jct} = \frac{E_{jct} / \sum_{j=1}^{n} E_{jct}}{Q_{jt} / \sum_{j=1}^{n} Q_{jt}}$$

3

where $\sum_{j=1}^{n} E_{jct}$ represents the total amount of class *c* pollutants emission across the country in year *t*, Q_{jt} represents the output value of industry *j* in year *t* and $\sum_{j=1}^{n} Q_{jt}$ represents the total industrial production in year *t*.

The overall pollution emission intensity of industry *j* is then calculated as follows by using the standardised values and average weights of each individual indicator:

$$S_{jt} = \frac{1}{m} \sum_{c=1}^{m} W_{jct} \times UE_{jct}$$

4

Even if pollution emission intensity remains the same across industries, the cost of achieving the same constraints amongst these industries may differ. Therefore, the operating costs per unit of pollution control facilities, denoted by F_{jt}, are used to measure the pollution control costs paid by different industries. On the basis of F_{jt}, the indicator S_{jt} is revised as follows:

$$ERS_{jt} = F_{jt} / S_{jt}$$

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3.2.3. Control Variables

The control variables are divided into firm- and industry-level variables. The firm-level variables include firm size, age, capital, profit and export. Firm size (*size*) is measured by using the total assets of enterprises, firm age (*age*) is measured by using the time difference between the establishment of enterprises and the observation year and firm capital intensity (*capital*) is measured by using the ratio of fixed assets to the number of employees. These three variables are treated with a natural logarithm. Meanwhile, profit margin (*profit*) is measured by using the ratio of a firm's net profit to its sales revenue, and export (*export*) is measured by using dummy variables. If export delivery values are present, then *export* equals 1; otherwise, *export* equals 0.

The industry-level variables include industry competitiveness, proportion of state-owned capital and proportion of foreign capital. Industry competitiveness (*HHI*) is expressed using the Herfindahl-Hirschmann

index, proportion of state-owned capital (*state*) is measured by using the proportion of state-owned and collective capital to paid up capital in the industry and proportion of foreign capital (*foreign*) is measured by using the proportion of foreign capital and Hong Kong, Macao and Taiwan capital to paid up capital in the industry.

3.3. Data Sources

To identify the impact of environmental regulations on the OFDI of Chinese enterprises, this study matched the data from the China Industrial Enterprise Database to those from the Directory of Overseas Investment Enterprises (Institutions) for years 2004 to 2010. The China Industrial Enterprise Database provides basic information at the enterprise level, including gross industrial output value, capital stock, total output and ownership structure of enterprises. Following Li et al. (2018), the sample data were processed as follows. Firstly, the duplicate or erroneously recorded data were excluded. Secondly, those samples with key variable data of less than or equal to 0 were removed. Thirdly, those samples with less than 8 employees were excluded. Fourthly, those samples that do not conform to the accounting principles (i.e. firms whose total assets are less than their current assets or total fixed assets) were removed. Meanwhile, the Directory of Overseas Investment Enterprises (Institutions) provides basic information on the OFDI of enterprises, including the name of the investment entity, year of investment, host country and business scope. This study excluded the directory information for investments to “tax havens”. The data from these two micro databases were matched and merged based on year and enterprise name to obtain basic data information at the enterprise level.

Data on environmental regulations were collected from the China Environmental Statistics Yearbook. “Other mining industries” and “waste resources and waste material processing industries” were excluded from the study due to lack of data, hence leaving 37 industries in the sample.

4. Empirical Results And Discussion

4.1. Benchmark Estimation Results

Before the benchmark regression, the relevant coefficient matrix was used to test for the presence of multi-collinearity amongst the explanatory variables. All relevant coefficients measured amongst the variables were less than 0.5, thereby indicating that the potential multi-collinearity effects are minor. Given that enterprise OFDI is a binary variable, logit regression analysis was performed for the empirical testing. The results are shown in Table 1.

In the benchmark regression, firstly, the empirical test was not controlled by other relevant factors. Secondly, the enterprise- and industry-level control variables were added. Thirdly, the fixed effects of year, region and industry were gradually controlled. Column (1) in Table 1 only considers the impact of environmental regulations on enterprise OFDI. The estimated coefficient of environmental regulation is positive and passes the significance test at the 1% level, hence suggesting that environmental regulations have significantly enhanced the willingness of enterprises to engage in OFDI. Columns (2) and (3) add the enterprise- and industry-level control variables in turn. The regression coefficient of environmental regulation remains

positive and highly significant, hence suggesting that environmental regulations still significantly facilitate the OFDI of enterprises after controlling for corporate- and industry-level-related factors. Moreover, year, region and industry differences can also influence the OFDI decisions of an enterprise. On the one hand, in certain years, such as after the implementation of the “going global” strategy, the establishment of pilot free trade zones and the enforcement of bilateral investment treaties, a large number of enterprises were encouraged to invest and operate across borders (Williams et al. 2017; Bhagwat et al. 2021). On the other hand, due to geographical environment advantages and the role of government policy support, the number of multinational enterprises in the eastern region is higher than that in the central and western regions (Kong et al. 2021). Moreover, OFDI thresholds vary across industries. For instance, the threshold for labour-intensive firms is usually lower than that for capital-intensive firms. In sum, controlling for the influence of these unobservable factors ensures that unbiased estimates will be derived from the regression results. These results are reported in columns (4) to (6) in Table 1. The environmental regulation coefficients are significantly positive at the 1% level after considering the fixed effects of controlling industries, regions and years. In other words, the differences amongst years, regions and industries do not affect the promoting influence of environmental regulations on OFDI. Therefore, environmental regulations facilitate the OFDI of enterprises, which is consistent with the theoretical assumptions of this study.

We further explain the estimation results of the control variables in column (6). The estimated coefficient of *size* is significantly positive, thereby suggesting that a larger enterprise has stronger advantages to overcome the risks associated with overseas investment. Therefore, this firm opens itself up to the international market, which increases its possibility of engaging in OFDI (Huang and Chi 2014). Meanwhile, the estimated coefficient of *age* is negative and not significant. This regression result contrasts the expected result. In theory, an enterprise with a longer establishment period has greater awareness of its external market environment. However, compared with an emerging company, this enterprise lacks investment in scientific and technological innovation. Therefore, this firm has no absolute advantage for OFDI (Pradhan 2004). The estimated coefficient of *capital* is significantly negative, which may be due to the fact that the productivity of Chinese high-capital-intensive enterprises is lower than that of similar foreign enterprises. As a result, capital intensity reduces the competitive advantage of enterprises in overseas markets and thereby reduces their possibility of engaging in OFDI. The estimated coefficient of *profit* is significantly positive, which suggests that companies with high profit margins are more likely to overcome the cost pressures faced by OFDI, hence encouraging them to engage in OFDI]. The estimated coefficient of *export* is also significantly positive, which suggests that export-oriented enterprises are more likely to conduct OFDI than non-export-oriented ones (Wei et al 2014). The estimated coefficient of *HHI* is positive and not significant, which indicates that industry competitiveness does not significantly promote enterprises to conduct OFDI. The estimated coefficient of *state* is significantly positive, hence indicating that an increase in the proportion of state-owned capital is conducive for enterprises to conduct OFDI. This result may be due to the close ties of state-owned enterprises to the government, which allows them to easily obtain government support in the OFDI process (Warner et al. 2004). The estimated coefficient of *foreign* is negative and not significant, which indicates that the involvement of foreign capital has a limited impact on the OFDI of enterprises.

Table 1
Estimation results of the benchmark tests

Variables	(1)	(2)	(3)	(4)	(5)	(6)
ERS	0.150***	0.091***	0.041**	0.153***	0.162***	0.442***
	(11.71)	(6.30)	(2.39)	(7.04)	(7.33)	(4.11)
size		0.777***	0.782***	0.766***	0.761***	0.767***
		(31.12)	(30.90)	(30.97)	(29.75)	(29.89)
age		-0.085***	-0.079**	-0.067**	-0.024	-0.010
		(-2.78)	(-2.53)	(-2.11)	(-0.75)	(-0.30)
capital		-0.174***	-0.165***	-0.113***	-0.082***	-0.061**
		(-6.76)	(-6.47)	(-4.56)	(-2.97)	(-2.11)
profit		1.320***	1.406***	0.990***	1.163***	1.147***
		(4.70)	(4.79)	(3.50)	(3.79)	(3.62)
export		1.429***	1.377***	1.398***	1.298***	1.242***
		(21.57)	(20.48)	(20.54)	(18.22)	(17.51)
HHI			-0.043	-0.609*	-0.549*	0.213
			(-0.17)	(-1.93)	(-1.78)	(0.42)
state			-0.378***	0.596***	0.676***	0.972**
			(-3.45)	(4.14)	(4.63)	(2.35)
foreign			1.940***	-0.029	-0.537	-2.371
			(7.17)	(-0.08)	(-1.42)	(-1.54)
Constant	-6.394***	-14.503***	-15.235***	-17.654***	-18.70***	-18.541***
	(-185.12)	(-61.03)	(-54.93)	(-39.38)	(-37.61)	(-29.92)
Year fixed effect	No	No	No	Yes	Yes	Yes
Region fixed effect	No	No	No	No	Yes	Yes
Industry fixed effect	No	No	No	No	No	Yes
N	1,348,534	1,051,364	1,051,364	1,051,364	1,050,643	1,050,643
Pseudo R^2	0.0066	0.1422	0.1449	0.1583	0.1764	0.1813

Note: Figures in () are z values; ***, ** and * indicate significance at the 1%, 5% and 10% levels, respectively.

4.2. Robustness Checks

To ensure the reliability of the estimation results, this study further conducts a robustness test by replacing the dependent variable, adding a relevant control variable, removing the interference samples and changing the econometric model.

4.2.1. Replace the Dependent Variable

The explained variable is replaced in the robustness test. In the benchmark testing, this study measures OFDI by using binary dummy variables. Therefore, this section uses the cumulative number of enterprise OFDI for the robustness test. Poisson regression is also performed to estimate the data because the explanatory variables are counted. The estimated results in column (1) of Table 2 show that the environmental regulatory coefficient remains significantly positive at the 1% level. In other words, environmental regulations significantly promote the OFDI of enterprises, which is consistent with the results of the benchmark testing. Therefore, the model is proven to be robust.

4.2.2. Add a Relevant Control Variable

The macro factors that affect OFDI are further controlled. According to Hong et al. (2009), technology level affects the OFDI of enterprises. To address the omission bias caused by missing variables, the GDP growth rate, number of patent applications and proportion of R&D workers in each province are controlled. The regression results in column (2) of Table 2 suggest that the environmental regulation coefficient remains significantly positive, hence further verifying the reliability of the benchmark results.

The fixed effects in other dimensions are also controlled. In addition to controlling the three levels of year, region and industry, the robustness test also controls the cross-fixing effect of region and year to control for the impact of non-observed factors that change over time at the regional level and to address the problem of missing variables. The robustness of the regression results is also enhanced in this process. The regression results in column (3) of Table 2 show that the environmental regulatory variable is significantly positive at the 1% level after controlling for the cross-fixing effects of provinces and years, hence verifying that environmental regulations are conducive to the OFDI of enterprises and confirming the robustness of the benchmark regression results.

4.2.3. Remove the Interference Sample

Firstly, those sample firms that have invested in Hong Kong are removed. Hong Kong is an important entrepot trade region in the world, and those Chinese enterprises that invest in this region may turn to investing in other countries. The sample comprises 327 companies investing in Hong Kong, which account for 20.74% of all foreign-funded enterprises in the sample. Therefore, this study empirically analyses those sample enterprises that have no investments in Hong Kong. The regression results in column (4) of Table 2 show that the estimated coefficient of environmental regulation remains significantly positive, which is consistent with the conclusions from the benchmark regression.

Secondly, those samples after the implementation of the pollutant emission control policy are retained. The 11th Five-Year Plan emphasises the binding nature of pollutant emissions. As a result, the intensity of pollutant emission regulations has increased significantly in various regions of China since the

implementation of this plan in 2005, which generated significant externality policy shocks for firms during the sample period. In this case, 2006 is selected as the starting point for pollutant emission control policies, and the sample of enterprises from 2006 to 2010 are selected to test whether environmental regulations have different effects on the OFDI decisions of Chinese enterprises at different stages of the environmental policy implementation. The regression results in column (5) of Table 2 show that environmental regulations significantly increase the willingness of enterprises to conduct OFDI after the above sample selection, hence further supporting the conclusions of the benchmark regression.

4.2.4. Changing the Econometric Model

Previous studies have used logit or probit models to deal with situations where the explanatory variable is a binary variable. This study then uses the logit model for the estimation in the benchmark regression and the probit model for the robustness test. The regression results in column (6) of Table 2 suggest that the environmental regulation coefficient is significantly positive at the 1% level, thereby indicating that the benchmark regression results are not affected by the choice of econometric model and confirming the stability of the research conclusions.

4.3. Endogeneity Tests

In the benchmark regression, the endogeneity problem resulting from the missing variables is mitigated by controlling for the relevant variables and by adding the fixed effects of years, regions and industries. However, this approach cannot easily address the endogeneity problem resulting from a reciprocal causal relationship between environmental regulations and OFDI. To obtain more stable findings, this study uses an instrumental variable to address the potential endogeneity issues. Chinese industrial energy standard coal and the lagging phase of environmental regulation are selected as tool variables in this case. On the one hand, the energy indicators and the previous environmental regulations have strong correlations with the current environmental regulatory variables. On the other hand, the industry standard coal indicator and the previous environmental regulation are historical indicators that do not directly affect the OFDI of enterprises and can only influence OFDI through the current environmental regulations. Therefore, these variables meet the selection criteria and conditions of the instrumental variable. The endogeneity test results in column (7) of Table 2 indicate that the environmental regulation coefficient is significantly positive, which is consistent with the estimation results of the benchmark testing. Therefore, the benchmark test does not have significant endogeneity problems, and its results are credible. In addition, the under-identification and over-identification test results indicate that the selected tool variable is not weak and satisfies the two prerequisites of relevance and exogeneity, thereby proving that the instrument variables are reasonable and valid.

Table 2
Estimation results of the robustness and endogeneity tests

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
ERS	0.460***	0.374**	0.425***	0.443***	0.545***	0.147***	0.031***
	(5.54)	(2.51)	(3.91)	(3.89)	(3.86)	(4.37)	(3.91)
GDP Growth Rate		3.484					
		(0.46)					
Patent Apps		0.155					
		(0.30)					
R&D Labour Rate		3.478					
		(0.53)					
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Province × Year fixed effect			Yes				
Over-identification test							17.08
							[0.000]
Under-identification test							0.665
Under-identification test							[0.415]
N	1,051,364	586,493	947,460	1,047,972	781,961	1,050,643	624367
Pseudo R^2	0.2002	0.1956	0.1840	0.1728	0.1738	0.1805	0.2363

Note: To save space, the control variables refer to the main control variables included in this study.

4.4. Heterogeneity Analysis

4.4.1. Heterogeneity Test Based on Investment Motivations

In the theoretical analysis, the OFDI motivation of enterprises is divided into market-seeking, cost-seeking and technology-seeking, on the basis of which this study analyses the impact of environmental regulations on enterprise OFDI from different investment incentives. This section empirically examines the effects of environmental regulations on the OFDI of enterprises with different investment motivations. The regression results in Table 3 show that environmental regulations significantly promote the OFDI of market- and technology-seeking enterprises but do not significantly facilitate the OFDI of cost-seeking multinational corporations. This result is consistent with the theoretical assumption of Hypothesis 2. The OFDI of market-seeking firms aims to open up and expand their overseas markets. Moreover, the “innovation compensation effect” and “first-mover advantage” generated by environmental regulations are the main sources of competitive advantage for multinational enterprises in international markets. Therefore, environmental regulations help market-seeking enterprises operate across borders. Meanwhile, “innovation compensation” either fully or partially offsets the pollution control costs that result from the compliance of enterprises with environmental regulatory standards (Berman et al. 2001). However, this effect weakens the incentive for cost-seeking enterprises to engage in OFDI and affects the possibility of cost-seeking OFDI. Despite stimulating technological transformation and upgrading (Cheng and Kong 2022), environmental regulations enhance the capacity of multinational enterprises to absorb advanced technologies overseas, which will promote OFDI by technology-intensive enterprises.

Table 3
Estimated results of market-, cost- and technology-seeking OFDI

Variables	**(1)**	**(2)**	**(3)**
	market-seeking	**cost-seeking**	**technology-seeking**
ERS	0.062***	0.021	0.102***
	(2.75)	(0.34)	(2.63)
Control variables	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes
Region fixed effect	Yes	Yes	Yes
Industry fixed effect	Yes	Yes	Yes
N	1,033,476	1,016,693	1,016,988
Pseudo R^2	0.1896	0.1981	0.1310

4.4.2. Heterogeneity Test Based on Industry Categories

This study further examines the differential impacts of environmental regulations on OFDI across different industries. This section divides the sample enterprises into technology-, labour- and capital-intensive enterprises according to factor intensity by performing a cluster analysis. The estimated results in Table 4 show that the regression coefficient of environmental regulations is significantly positive at the 1% level for technology-intensive industries. In addition, the environmental regulation coefficient of labour-intensive industries is significantly positive but lower than that of technology-intensive industries. However, the

environmental regulation coefficient is not significant for capital-intensive industries. These conclusions are consistent with the theoretical assumptions of Hypothesis 2 and may be ascribed to 3 reasons. Firstly, compared with labour-intensive industries, the “innovation compensation effect” and “first-mover advantage” generated by environmental regulations are more in line with the actual situation of technology-intensive enterprises. Secondly, improving technological innovation capabilities will enhance the competitive advantage of technology-intensive enterprises in international markets (Peng et al. 2021) and thereby promoting the OFDI of these enterprises. Therefore, technology-intensive industries are greatly affected by the “strengthening effect” of environmental regulations. Third, whilst environmental regulations force firms to innovate, the use of R&D funds will affect the access of capital-intensive enterprises to adequate funding for their OFDI (Ferjani 2011), hence offsetting the beneficial impact of environmental regulations on OFDI. Therefore, capital-intensive industries are less dependent on the “strengthening effect” of environmental regulations.

Table 4
Estimated results of the technology-, labour- and capital-intensive industries

Variables	(1)	(2)	(3)
	technology-intensive	labour-intensive	capital-intensive
ERS	1.178***	0.734**	0.294
	(3.20)	(2.18)	(1.29)
Control variables	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes
Region fixed effect	Yes	Yes	Yes
Industry fixed effect	Yes	Yes	Yes
N	289,120	301,016	399454
Pseudo R^2	0.1740	0.1752	0.1870

4.5. Influence Mechanism Testing

According to the analysis of the influence mechanism, environmental regulations affect OFDI behaviour through the “positive strengthening” effect. To further verify the channel through which environmental regulations affect the OFDI of enterprises, this section empirically tests whether environmental regulations significantly affect the productivity level of enterprises. The following regression model is established:

$$tfp_{ijkt} = \alpha_0 + \alpha_1 lnERS_{jt} + X_{ijkt} + v_t + u_k + \gamma_j + \epsilon_{ijkt}$$

6

The productivity level of enterprises is measured by using the LP method. Table 6 shows that the environmental regulation coefficients are significantly positive with the addition of control variables and fixed effects, hence suggesting that environmental regulations can significantly improve the productivity

level of enterprises. This section then verifies the theoretical hypothesis that environmental regulations and firm productivity achieve a “win-win situation”. Moreover, new trade theory suggests that productivity level is a key factor in determining the pattern of firms that enter international markets from firm heterogeneity (Melitz 2003; Helpman et al. 2004). Specifically, a higher productivity corresponds to a larger OFDI scale of enterprises. This conclusion is further tested by using data of Chinese enterprises. Besides, results show that productivity levels influence the OFDI decision-making behaviour of firms. Therefore, productivity level has a partial mediating effect on the relationship between environmental regulations and OFDI behaviour of firms, that is, environmental regulations encourage enterprises to conduct OFDI by raising their productivity levels. This result further validates the “positive strengthening” effect of environmental regulations.

Table 5
Estimated results of the mediating role of productivity level

	(1)	(2)	(3)	(4)	(5)
ERS	0.064***	0.043***	0.070***	0.075***	0.169***
	(44.43)	(28.61)	(44.84)	(49.33)	(76.95)
Control variables	No	Yes	Yes	Yes	Yes
Year fixed effect	No	No	Yes	Yes	Yes
Region fixed effect	No	No	No	Yes	Yes
Industry fixed effect	No	No	No	No	Yes
N	389,829	389,070	389,070	389,070	389,070
R^2	0.0090	0.2175	0.2291	0.2629	0.2965

5. Conclusions

This paper explores the effect and impact mechanism of environmental regulations on the OFDI of enterprises by using data from the China Industrial Enterprise Database and the Directory of Overseas Investment Enterprises (Institutions) for years 2004 to 2010. The three main findings of this study are as follows. Firstly, environmental regulations can significantly improve the OFDI of Chinese companies, which is consistent with the regression results of the robustness and endogenous tests. Secondly, the promotion effect of environmental regulations on the OFDI of enterprises obviously differs across investment motivations and industry characteristics. Specifically, environmental regulations significantly promote market- and technology-seeking enterprises to conduct OFDI compared with cost-seeking enterprises. In addition, environmental regulations have a stronger promoting effect on the OFDI of technology-intensive industries than labour-intensive industries and have no obvious promotion effect on the OFDI of capital-intensive industries. Thirdly, the theoretical mechanisms and empirical test results show that environmental regulations promote OFDI by improving the productivity level of enterprises.

Based on the above findings, we propose the following policy suggestions. Firstly, environmental regulations will significantly increase the productivity level of enterprises and promote their OFDI. To some extent, this finding shows that the development of enterprises is less affected by the cost constraints caused by environmental regulations. Therefore, enterprises should abandon the traditional concept that environmental regulations are not conducive to the production and operation of enterprises in the local market. Instead, these enterprises should take a proactive approach in tackling environmental regulatory measures. Secondly, policymakers should reasonably improve environmental regulations according to the actual situation of enterprise development. Governments should ensure that environmental regulations are within a reasonable range to improve the technological innovation and productivity levels of enterprises. Furthermore, they should promote the OFDI of enterprises, which would lead to a “win-win” situation between environmental protection and high-quality development of enterprises. Thirdly, in the case of environmental regulations promoting OFDI, the government should implement a precise policy strategy. In other words, government departments should formulate strict and flexible environmental regulatory policies based on the degree of pollution emissions and the actual situation of enterprise development. Whilst strengthening environmental protection, the government should try to meet the production and operation needs of different types of enterprises.

This study has some limitations that will be addressed in future research. Firstly, this paper was unable to investigate the effect of the different types of environmental regulations on the OFDI of enterprises. Secondly, an earlier sampling time was selected due to the limited availability of micro-enterprise data, hence preventing this study from testing whether the impact of environmental regulations on OFDI in recent years is consistent with theoretical assumptions. Thirdly, this study examined the effects of environmental regulations on the OFDI of firms from a single linear perspective but did not divide environmental regulations into several stages. As a result, this paper lacks optimal findings on the nodes of environmental regulation policies. Relevant scholars should then explore the differential impacts of various environmental regulations on the OFDI of enterprises. Future studies should also explore the different effects of command-controlled and market-incentivised environmental regulations on OFDI by using a more recent sample. They should empirically examine how the implementation of recent environmental regulatory policies affects the OFDI of enterprises. Scholars should also consider building nonlinear models to test whether OFDI varies depending on the implementation stage of environmental regulations.

Declarations

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