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Original Research

Does Environmental Regulation Affect the Introduction of Foreign Direct Investment in China? --Empirical Research Based on the Spatial Durbin Model

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Abstract

Based on the statistical data of 30 provinces in China from 2003 to 2014, this paper uses the spatial Durbin model to empirically test the influence of China's urban environmental regulation on the introduction of foreign direct investment (FDI). The results show that there is significant spatial correlation between environmental regulation and FDI. Environmental regulation has a negative impact on the introduction of FDI, but the impact is not significant across the country, indicating that the evidence of the pollution haven hypothesis is insufficient in China. Then, the influential effect of environmental regulation on the introduction of FDI has obvious regional differences. The level of environmental regulation in the eastern region is positively correlated with the convenience in FDI introduction, while in the central and western regions, environmental regulation pose a hindrance to the introduction of FDI, which is remarkable only in the central area. In addition, labor costs and human capital levels have a direct effect on the introduction of FDI in the region. The level of regional economic development and R&D investment have a significant indirect impact on the introduction of FDI in surrounding areas, and economic openness has a significant impact on the introduction of FDI in all regions.

Keywords: environmental regulation, FDI, pollution heaven hypothesis, spatial Durbin model

Introduction

Since the reform and opening up, foreign direct investment (FDI) in China has greatly increased. In 2015 the actual utilization value of FDI in China reached $126.267 billion US, and China has been the most attractive developing country for FDI in the world [1]. Numerous studies have shown that the main reason why FDI flows to developing countries is because host countries have richer resources and more lax environmental regulations [2]. Foreign companies tend to transfer pollution-intensive and high energy consumption industries to host countries, which have

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less environmental governance responsibility, and even do not undertake them at all [3]. Thus, FDI has an obvious negative effect on environmental pollution of host countries.

However, as the global awareness of environmental protection is significantly improving, economic development gradually shifts to a low-carbon model [4-5]. In the new low-carbon economic model, the Chinese government's environmental regulation measures become more and more stringent [6-7]. In 2014, 31 local laws and regulations and 27 local government rules were formulated across the country [8]. In total, 391 local regulations and 346 local government rules are currently in effect [9]. Apart from the development of sound laws and regulations, the local government also strengthened the collection of sewage charges and stepped up the investment in the control of environmental pollution [10]. The country collected 2.08 billion yuan of sewage charges in 2013, and invested 902.1 billion yuan on the control of environmental pollution in 2014 [11-12]. In developed countries, the level of environmental regulation is also increasing year by year. In the United States, the government has formulated the Climate Action Plan, a $50 billion clean-technology risk fund set up to encourage low-carbon technological innovation, thereby reducing greenhouse gas emissions in 2013, and released a clean-energy plan to limit the carbon emissions of power plants in 2014 [13]. In 1973 the European Parliament and the Council formulated the first environmental action program that required all countries to coordinate the implementation of environmental policies within the European Community [14]. In 2001, the European Parliament and the Council adopted Recommendation 2001/331/EC, which defines minimum criteria for the organization, implementation, follow up, and publication of the results of environmental inspections in the member states [15-16]. Today the EU has implemented seven environmental action programs with more than 500 directives, regulations, and decision-making, and has formed a set of the most comprehensive environmental standards in the world [17]. Overall, the environmental conditions in most parts of Europe have reached as good an environmental level as in industrialized societies, with pollutants controlled effectively, natural resources protected, and wastes handled better (to some extent) [14].

So, will strict environmental regulation inhibit the introduction of FDI? This question has been extensively studied by scholars. Indeed, many studies support the pollution haven hypothesis (PHH) and believe that environmental regulation will inhibit the introduction of FDI. The pollution haven hypothesis posits that production within polluting industries will shift to locations with lax environmental regulation [1]. In light of heavy economic performance as the target function, the local government has to relax environmental regulation as the means to fight the mobility factor motivation [18]. Since Walte and Ugelow (1979) put forward the pollution haven hypothesis, many scholars have elaborated upon the theoretical logic of environmental regulation and FDI location choice from different angles, and from experience to verify the existence of the hypothesis [19]. With the strengthening of global environmental awareness, the last decade has witnessed a renewed interest in the relationship between environmental regulations and international capital flows. However, empirical studies have so far failed to find conclusive evidence for this so-called pollution haven or race-to-the-bottom effect where FDI is assumed to be attracted to low-regulation countries [20].

The so-called pollution haven hypothesis is more likely to be supported by many scholars. Peng et al. (2011) showed that the impact effects of environmental regulation exerted on FDI become less and less in the long-term, which verifies the "hypothesis of pollution haven" [21]. Elliott et al. (2013) presented a simple theoretical framework to demonstrate that greater stringency in environmental standards can lead to a strategic increase in capital inflow, which we refer to as environmental regulation-induced FDI [20]. Bu et al. (2014) investigated how relative environmental regulation influenced the flow of FDI, and found strong pollution haven hypothesis evidence in developed countries and developing countries [22]. Zhou (2014) said that local government often loosened environmental regulations or increased environmental investment to improve investment environments [23]. Xu et al. (2016) explored the relationship among FDI, environmental regulations, and energy consumption, and showed that environmental regulations had a negative effect on FDI in both the long and short terms [24]. Millimet and Roy (2016) used U.S. state-level data to show that environmental regulation negatively impacts inbound foreign direct investment, and that endogeneity is both statistically and economically relevant [25]. In addition, Chung (2014), Tang et al. (2016), and Zhou et al. (2016) also found strong evidence that polluting industries tend to invest more in countries with more lax environmental regulations [26-28].

If foreign firms do transfer advanced technology and management know-how to domestic firms, this will also help the introduction of technological progress and reduce pollution in developing countries [29]. More importantly, these companies will choose a cleaner country or region to transfer their technology and management, and these places are under strict environmental regulation, which suggests that stricter environmental regulation is conducive to attracting FDI. This phenomenon is contrary to the idea of pollution haven hypothesis, and a lot of scholars have proven its existence. Zhu et al. (2011) showed that the influence of environmental regulation on the influx of foreign direct investment is not significant in China, although negative correlation of the two is found in the empirical study [30]. Dong et al. (2012) used a north-south market share game model in a two-country setting to test the relationship between environmental regulation and FDI, and the results showed that the pollution haven hypothesis is not supported [31]. Manderson and Kneller (2012) did not find robust evidence to support the idea that environmental regulations robustly effect

the determinant of internationalisation decision, multinational firms do not prefer developing countries with lax environmental policy [32]. Bai and Zhang (2013) found that there is an uneven promotion effect between FDI forward spillover and environmental regulation intensity [33]. Zhang and Gao (2014) showed that both the enlargement of FDI stock-induced economic scale and the change of FDI stock-induced economic composition deteriorated the environment, while FDI stock-induced technology transfer improved the environment in China [34]. Kim and Yang (2015) showed that there are regional differences about how environmental regulation affects the FDI strategies of parent firms in developing countries and developed countries [35]. Yuan and Xie (2016) believed that FDI can drive China to strengthen the level of environmental regulation, and strict environmental regulation can effectively improve the environmental barriers to foreign investment [6]. Based on the data from 1995 to 2013 for European countries, the panel model was constructed to test the relationship between FDI and environmental policy, and the results showed that FDI is positively affected by total environmental tax revenue [36].

It can be seen that the conclusions of the studies on the impact of environmental regulation on the introduction of FDI are inconsistent. Even studies of the same region and the same country may have dramatically opposite conclusions, whose situation is more serious in China for two possible reasons: one is that the "pollution shelter" hypothesis and its supporting model are based on the strict assumption that there is no other difference among countries except for the environmental regulation level, which may ignore the key factors affecting FDI location selection such as the country's location advantage, economic development level, infrastructure construction, and cultural difference [28]. The relationship between FDI and the environmental effect is complicated, and they are influenced by such factors as the economic level, environmental policy, and energy utilization technology of the host country [37]. And the second is that China's existing research has not taken into account the spatial correlation between environmental regulation and the introduction of FDI and the spatial spillover characteristics, bringing the science of the research conclusions into question.

Indeed, many studies support the pollution haven hypothesis and believe that environmental regulation will inhibit the introduction of FDI. However, many studies have found that the pollution haven hypothesis does not exist, the more stringent the environmental regulations, the better the investment environment and the more conducive to attract foreign investment. On the whole, the conclusions of this field are inconsistent. The empirical evidence in this domain remains inconclusive because of the contrasting results observed in the literature owing to the differing characteristics of the data sets and models used in previous studies [38]. On the issue of research methods, the existing research is based on traditional econometric methods, ignoring the spatial spillover effect and spatial agglomeration characteristics of FDI in location selection and entry. This study establishes the spatial Durbin model to estimate the impact of environmental regulation on the introduction of FDI based on the panel data of 30 provinces in China from 2003 to 2014, with an expectation to further explore the relationship between the two using the spatial econometrics approach. Therefore, the aims of this paper were to:

1) Explore the spatial correlation and spatial spillovers of environmental regulation and FDI in China using the exploratory spatial data analysis method.
2) Systematically analyze the impact of environmental regulation on FDI in China using the spatial Durbin model.
3) Provide beneficial policy recommendations for improving environmental management for the Chinese government.

Material and Methods

Model Building

It is not scientific to ignore the spatial correlation between variables when analyzing the relationship between environmental regulation and the introduction of FDI [7]. Since the traditional metrological model does not take into account the spatial dependence among the geographical units, this paper will use the spatial metrological method to study the impact of environmental regulation on the introduction of FDI. According to the research of Anselin (1995), the classical spatial metrological model includes the spatial lag model (SLM) and spatial error model (SEM). Subsequently, James and Kelly expanded SLM, and put forward the spatial Durbin model (SDM), which contains both the lagged variable of the explained variable and the lagged variable of the explaining variable [11]. Moreover, when there is spatial lag term, the regression coefficient will no longer reflect the impact of the explanatory variable on the explained variable. LeSage and Pace (2010) divide the gross effect into direct effect and indirect effect, which can better describe the spatial interaction between variables and further verify the existence of spatial spillover [39]. The panel data of this model is set as follows:

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$$y_{it} = \delta \sum_{j=1}^{N} w_{ij} y_{jt} + X'_{it}\beta + \sum_{j=1}^{N} w_{ij} X'_{jt}\theta + \mu_i + \lambda + \varepsilon_{it} \quad (1)$$

If $\theta = 0$, Model (1) will degrade into the spatial panel lag model; if $\theta + \delta\beta = 0$, it will degrade into the spatial panel error model, so the spatial panel Durbin model is more general. The spatial panel model is established as follows:

$$\ln FDI_{it} = \delta \sum_{j=1}^{N} w_{ij} \ln FDI_{jt} + \beta \ln ER_{it} + \theta \sum_{j=1}^{N} w_{ij} \ln ER_{jt} + \alpha \ln FDI_{it-1} + \gamma X_{it} + \mu_i + \lambda + \varepsilon_{it} \quad (2)$$

…where $\ln FDI_{it}$ represents the logarithm of FDI at the time of t and in the city of I; FDI_{it-1} stands for the FDI of one-period lag; $\ln ER_{it}$ means the environmental regulation level of city i at the time of t; X is the collection of control variables; μ_i, λ, and ε_{it} are the area effect, time effect, and random disturbance term, respectively; ε_{it} obeys normal distribution; and w_{ij} is the spatial weight matrix representing the neighboring relationships between area i and area j. This paper establishes the weight matrix based on the spatial neighborhood relations, i.e., when area i and area j share the same vertex and boundary, w_{ij} is 1, otherwise it is 0.

Variables Measurement and Data Sources

FDI: drawing lessons from Ohno and Thanh (2016) and Zhou et al. (2016), the amount of the actually used foreign capital of each province is used to measure the level of investment introduction. The data comes from the China Statistical Yearbook on Science and Technology. Since the data on the yearbook are in US dollars, they are converted into the amount in RMB according to the annual average exchange rate of the year, and then the effect of price is eliminated by the GDP deflator of each city over the years [40].

Environmental regulation (ER): the discharge permit system, administrative penalties, and emission taxes put forward by the government to adjust the production and business activities of manufacturers in order to achieve sustainable environment and economic development [41]. In China, according to the degree of enforcement, the environmental regulation tools can be divided into three categories: direct regulation (standard, command, and control), economic instruments (taxes, tradable emission permits, etc.) and "soft" means (resources industry agreement, environmental certification plan, etc.). The purpose of the government's environmental regulations and policies are to protect the environment. The practice of Zhang (2017) is used for reference, selecting the amount of investment in pollution control in each area to measure their level of environmental regulation [9]. All the data come from the China Statistical Yearbook on Environment.

According to the traditional FDI location theory, the economic development level, labor cost, human capital, economic openness, and R&D investment of the host country are also important factors affecting FDI [42-43]. The economic development level is measured by per capita GDP. The labor cost is measured by the average annual salary of the employees in each region. The human capital is measured by the number of students in the ordinary colleges and universities. R&D investment is measured by R&D funds of large and medium-sized enterprises in various industries. Economic openness is measured by the proportion of total import and export of each province in GDP [44]. The data in this paper are mainly from the Compilation of Fifty-five Years of Statistical Data of New China, China Statistical Yearbook, China Statistical Yearbook on Science and Technology, and China Statistical Yearbook on Environment. In order to effectively eliminate the dimension of the time series, logarithmic processing is carried out during the specific analysis process.

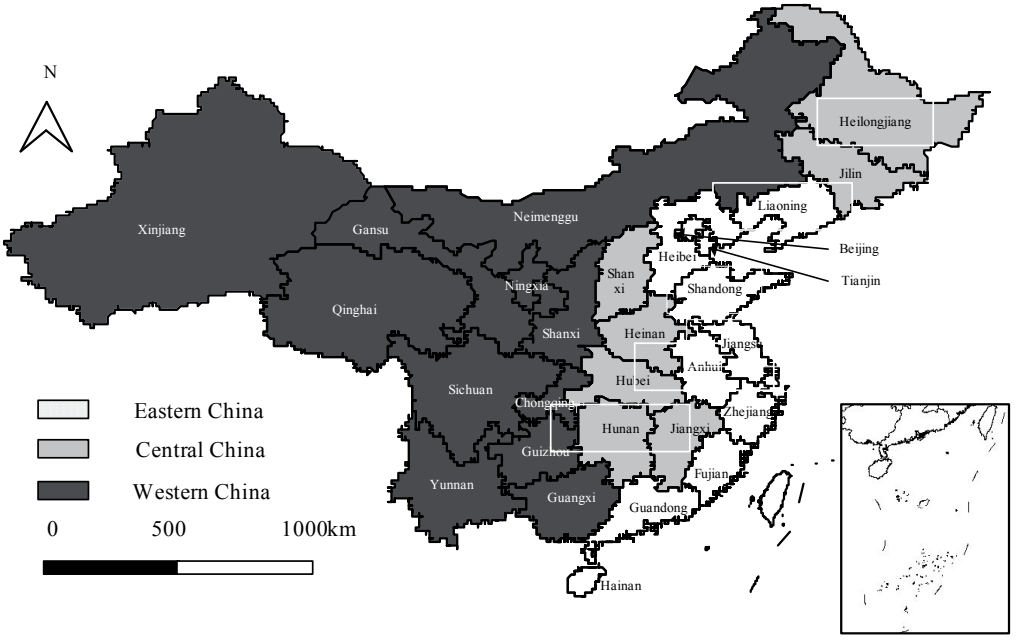

Fig. 1. Sample area description.

Table 1. Definition of variables and descriptive statistics.

Variables	Definition of variables	Minimum	Maximum	Mean	Std. deviation
lnFDI	Foreign direct investment	9.00	17.00	14.14	1.71
lnER	Environmental regulation	10.00	16.00	13.78	1.08
lngdp	Per capita GDP	8.00	12.00	10.05	0.76
lnwage	Labor cost	9.00	12.00	10.27	0.63
lnHC	Human capital	10.00	14.00	13.09	0.91
lnEO	Economic openness	1.00	5.00	2.99	1.05
lnR&D	R&D investment	9.00	17.00	13.65	1.50

Results and Discussion

Sample Description

Taking into account the statistical problem of environmental regulation data, the sample period in this paper is from 2003 to 2014, and the samples are from 30 provinces (the statistical data are unavailable in Tibet). As per the general regional division habit, the eastern region in this paper covers the 11 provinces (cities) of Beijing, Tianjin, Hebei, Liaoning, Shanghai, Jiangsu, Zhejiang, Fujian, Shandong, Guangdong, and Hainan; the central region includes the 9 provinces of Shanxi, Inner Mongolia, Jilin, Heilongjiang, Anhui, Jiangxi, Henan, Hubei, and Hunan; and the western region covers 10 the provinces of Guangxi, Chongqing, Sichuan, Guizhou, Yunnan, Shanxi, Gansu, Qinghai, Ningxia, and Xinjiang. The sample areas are shown in Fig. 1.

Then the definition of variables and descriptive statistical results are shown in Table 1, and Fig. 2 further describes the overall situation of environmental regulation and FDI. In terms of temporal distribution, the Chinese government's investment in environmental pollution control has increased year by year. From 154.38 billion yuan in 2003 to 902.11 billion yuan in 2014, the national total investment in environmental pollution has grown by nearly 5 times in the 12-year period. In the research period, the nationwide FDI is increasing continuously from 438.18 billion yuan in 2003 to 1,665.71 billion yuan in 2014. It can be seen that environmental regulation input and FDI have maintained rapid growth.

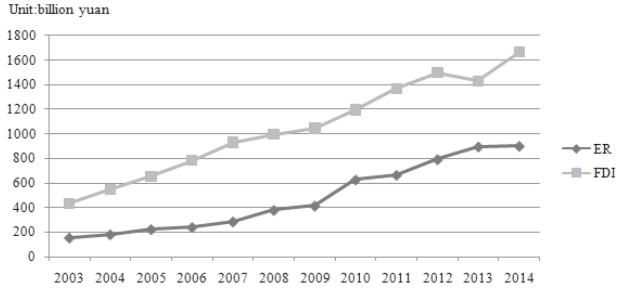

Fig. 2. Overall situation of environmental regulation and FDI in China.

Spatial Correlation Test

The spatial correlation and spatial spill characteristics of environmental regulation could be useful for explaining the characteristics of Chinese environmental regulation policies, and provide the basis for the spatial Dubin model, so the spatial correlation test is carried as follows. Table 2 shows the results of Moran's I test for environmental regulation and FDI in China from 2003 to 2014. The results show that Moran's I of FDI in Chinese cities from 2003 to 2014 has all passed the test of significance at the 5% level, and each Moran I value is positive. Moran I of the environmental regulation has all passed the test of significance at the 5% level and each of its values is positive, except for the year 2010, when its value is negative. It shows that China's environmental regulation and regional FDI level don't show a completely random state, but instead there is a robust and obvious spatial dependence between the two, that is, there is a significant spatial cluster effect between regional environmental regulation and FDI level.

The local spatial correlation features of environmental regulation and FDI can also be reflected by LISA cluster maps (Fig. 3). According to the analysis of LISA cluster maps in 2003, 2008, and 2014, the high-environmental regulation high-high cluster regions were concentrated in Shandong and Jiangsu in 2003; Jiangsu and Anhui in 2008; and Hebei, Shandong, Jiangsu, and Anhui in 2014, which means the high-environmental regulation high-high cluster regions have expanded, while the low-environmental regulation low-low cluster regions have decreased from 2008 to 2014. The low-FDI low-low cluster regions have been significantly reduced from 2003 to 2014, which was distributed in 7 regions (Inner Mongolia, Gansu, Shanxi, Xinjiang, Ningxia, Qinghai, and Sichuan) in 2003, and distributed in 3 regions (Xinjiang, Gansu, and Ningxia) in 2014. However, the high-high cluster regions of FDI were steadily maintained and concentrated in Shanghai, Jiangsu, Zhejiang, and Fujian in 2003; Shanghai, Zhejiang, and Fujian in 2008; and Shanghai, Jiangsu, Zhejiang, and Anhui in 2014.

Table 2. Results of Moran's I test for provincial environmental regulation and FDI in China from 2003 to 2014.

Years	Environmental regulation		FDI	
	Moran *I*	P value	Moran *I*	P value
2003	0.270899	0.013	0.404806	0.001
2004	0.273369	0.014	0.312849	0.006
2005	0.304102	0.004	0.341021	0.009
2006	0.267382	0.011	0.312474	0.006
2007	0.359937	0.006	0.30323	0.007
2008	0.318529	0.004	0.272467	0.009
2009	0.309379	0.006	0.238439	0.019
2010	-0.007145	0.323	0.19447	0.025
2011	0.280477	0.011	0.163222	0.056
2012	0.237961	0.017	0.195555	0.037
2013	0.276695	0.006	0.359824	0.001
2014	0.235505	0.021	0.234898	0.017

In general, environmental regulation and FDI have significant spatial cluster characteristics, which further prove the spatial correlation of the two.

Spatial Econometrics Analysis

Model Selection

Although it is found through the spatial correlation test that there is significantly positive spatial autocorrelation between environmental regulation and FDI, it is still necessary to test the science of the model specification in the empirical analysis. In this paper, the SDM model is compared with the SAR and SEM models (Table 3). The analysis results in Table 2 show that the P values are 0.0067 and 0.0327, respectively, which are both less than 0.05. The original hypothesis is rejected, indicating that the SDM model is superior to the SAR and SEM models. Furthermore, the Hausman test shows the test value is 58.4161, and does not pass the significance test,

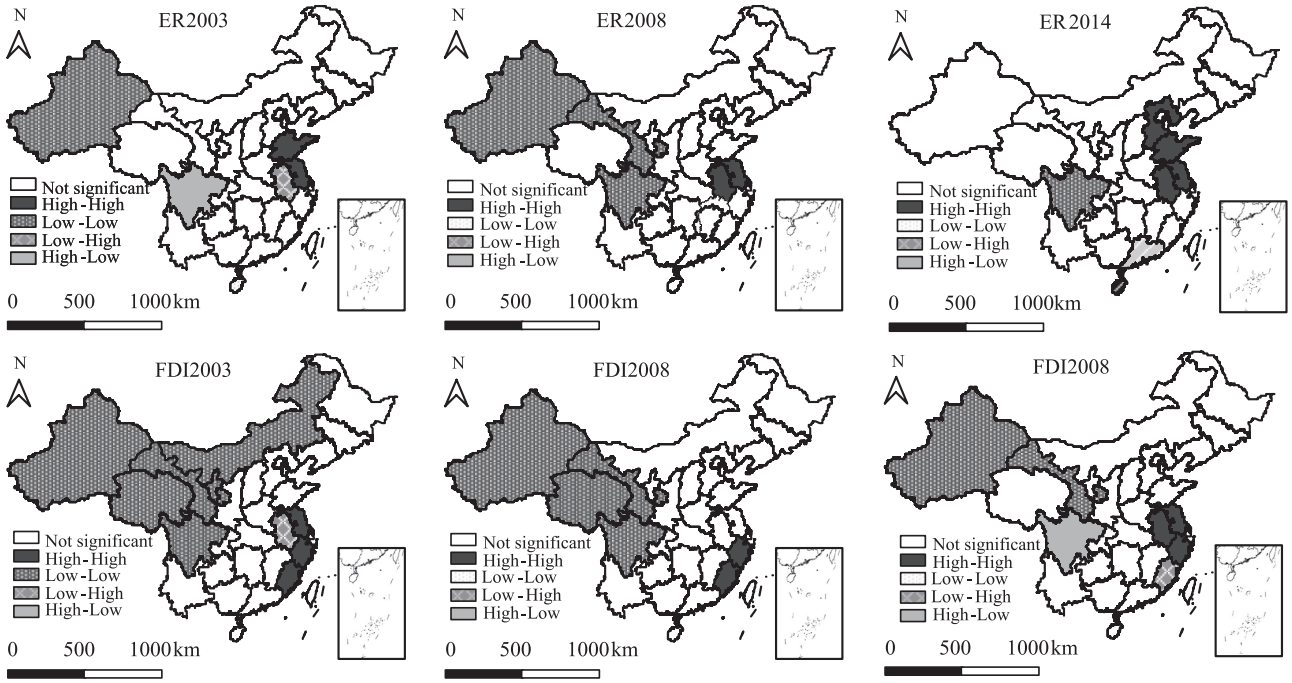

Fig. 3. LISA cluster maps of environmental regulation and FDI in 2003, 2008, 2014.

Table 3. Comparative results of SDM, SAR and SEM Models.

Model comparison	Wald_spatial_lag	Prob_spatial_lag	LR_spatial_lag	Prob_spatial_lag
SDM VS SAR	20.7498	5.2336e-06	19.5362	0.0067
SDM VS SEM	14.9886	0.0361	15.2724	0.0327

demonstrating that the fixed effect model is superior to the random effect model. Therefore, the fixed effect SDM model is selected to start the empirical analysis.

Estimated Results of the Spatial Econometric Model

Matalb2016a software was adopted to carry out spatial econometric analysis of the impact of environmental regulation on FDI, with the analysis results shown in Table 4. We can see from Table 4 that the adjusted R^2 of the model is 79.90% and the value of Log likelihood is -84.379467, showing a relatively high model fitting degree.

The regression results of the spatial Durbin model show that environmental regulation has a negative impact on the selection of FDI location, but this effect is not significant, indicating that as the level of environmental regulation continues to improve, the phenomenon that FDI tends to shift to the countries or regions with relatively lower environmental regulation level is not significant and that the hypothesis of "pollution haven" is not true in China. The spatial lag coefficient ρ (0.176959) passed the test of significance at the level of 1%, signifying significant spatial correlation. In other words, the regional FDI will increase by 0.176959% for each 1% growth in FDI in adjacent area. At the same time, the FDI of a one-period lag has significant impact on current FDI, demonstrating strong time dependence.

Table 4. Estimated results of spatial Durbin model.

Variable	Coefficient	t-stat	t-prob
$lnFDI_{-1}$	0.470195	4.535313	0.000086
lnER	-0.08207	-0.46232	0.647184
lngdp	0.710259	1.209943	0.235749
lnwage	0.805709	1.133099	0.266147
lnHc	0.580311	1.864072	0.072124
lnHO	0.338889	2.077523	0.046411
lnR&D	0.76623	2.72445	0.010638
w* $lnFDI_{-1}$	-0.18669	-2.20218	0.027653
w*lnER	-0.07196	-0.55902	0.576151
w*lngdp	0.993528	2.183405	0.029006
w*lnwage	-0.49142	-0.92044	0.357342
w*lnHc	-0.1235	-0.33739	0.735824
w*lnHO	0.182388	1.341591	0.179729
w*lnR&D	0.50741	2.33435	0.019577
W*dep.var.	0.176959	2.580483	0.009866
Adjusted R^2	0.7990		
Log likelihood	-84.379467		

Note: ***, **, and * indicate the significance at 1%, 5%, and 10% levels, respectively.

Drawing lessons from LeSage and Pace (2010), when there is spatial lag term, the gross effect of environmental regulation on FDI could be divided into direct effect and indirect effect [39, 45]. This method uses direct effects to represent the average effect of environmental regulation on the region, indirect effects to represent the average effect of environmental regulation on other regions, and total effects represent the average effect of environmental regulation on all regions. Table 5 describes the direct effects, indirect effects, and gross effects of the spatial Durbin model.

As shown in Table 5, the direct, spillover, and total effects of environmental regulation are all negative and did not pass the test of significance, which signifies unremarkable negative impact of environmental regulation on FDI location selection. The main reason may be that when investing in China, the foreign businessmen mainly take the degree of economic openness, level of human capital, and R&D input in that region into account, while the environmental regulation level is not a key factor to be considered. Another possible reason is that China is an economically developing country with a relatively low economic development level. Its environmental regulation level is lower than that of the United States, the United Kingdom, and other developed Western countries. It is a very easy thing for the foreigners to meet China's environmental regulation requirements when they enter China. Meanwhile, the direct effect of FDI of one-period lag on the current FDI is quite remarkable, while the overspill effect is not obvious.

Seen from the control variables, the impact of local economic development level on FDI is not remarkable, but the local economic development level has a significant facilitating effect and overspill effect on FDI location selection of the surrounding area, indicating that when FDI is introduced, it will choose more attractive areas by comparing the economic development level of the region and the surrounding area. Labor costs in the region play a remarkably facilitating role in the introduction of FDI in this region, but its impact on the introduction of FDI in surrounding areas is not significant, indicating that

Table 5. Direct effect, indirect effect and total effect of spatial Durbin model.

Effects	Total effect		Direct effect		Indirect effect	
Variable	Coefficient	t-stat	Coefficient	t-stat	Coefficient	t-stat
$lnFDI_{-1}$	0.470195***	4.535313	0.570591***	13.573317	-0.100396	-1.079946
lnER	-0.082072	-0.462324	-0.001088	-0.016332	-0.080984	-0.526535
lngdp	0.710259	1.209943	-0.379557	-1.440331	1.089815**	2.027853
lnwage	0.805709	1.133099	1.14809***	3.252928	-0.342381	-0.539998
lnHc	0.580311*	1.864072	0.619472***	2.48312	-0.039162	-0.102875
lnHO	0.338889***	2.077523	0.101353	1.315703	0.237535	1.567917
lnR&D	0.766226***	2.724453	0.142799	1.147478	0.623427***	2.384676

Note: ***, **, and * indicate the significance at 1%, 5%, and 10% levels, respectively.

the domestic current regional wage disparity reflects not only the difference in labor costs, but also the difference in the cost of means of livelihood and the level of labor force skill caused by the different price level. The level of human capital in the region has a remarkable direct effect on the introduction of FDI in the region, but its spillover effect on the surrounding areas is not obvious. This shows that the FDI location selection mainly considers the level of local human capital quality and skill. The economic openness of the local area has no significant impact on the introduction of FDI either in the local region or the surrounding areas, but the impact on all regions is significant. It shows that, as a whole, the economic openness of an area is an important factor in attracting foreign investment. The impact of local R&D investment on the introduction of FDI in the region is not significant, but its spillover effect on surrounding areas is remarkable. This shows that R&D investment in the region will affect the level of R&D investment in the surrounding areas, which will then affect FDI.

Generally speaking, labor cost and the level of human capital have a remarkable direct effect on the introduction of FDI in the region, which are direct factors affecting FDI location selection; the local economic development level and the R&D input have a remarkable direct effect on the introduction of FDI in the surrounding regions, which are the indirect factors affecting FDI location selection; the economic openness exerts an important impact on the introduction of FDI in all regions.

Table 6. Regional inspection results of spatial Durbin model.

Regions	Eastern region	Central region	Western region
Variable	Coefficient	Coefficient	Coefficient
$lnFDI_{-1}$	0.071736	0.631998***	-0.13618
lnER	0.18051*	-0.38158*	-0.34255
lngdp	-2.82234**	-0.40315	6.935888***
lnwage	1.854417**	0.367584	-6.69321**
lnHc	0.747004*	0.125445	0.052281
lnHO	0.853701*	0.086277	0.919955***
lnR&D	-1.27175**	0.655806**	0.322273
W*dep.var.	-0.16397*	-0.23607**	-0.23607**
Adjusted R^2	0.3307	0.9276	0.6641
Log likelihood	23.57943	65.089	43.468

Note: ***, **, and * indicate significance at 1%, 5%, and 10% levels, respectively.

Regional Tests

In order to observe the influential effect of environmental regulation on FDI in different regions of China, this paper estimates the relationship between environmental regulation and FDI in the eastern, central, and western regions with the spatial Durbin model, and the estimation results are shown in Table 6, which also shows that in the eastern region, environmental regulation has a positive effect on the location selection of FDI in the region, and this effect does not pass the test of significance. In the middle and western regions, environmental regulation has a negative effect on the location selection of FDI. This effect is remarkable at the level of 10% in the middle region, while in the western region it is not remarkable, indicating that the effect of environmental regulation on FDI location selection has obvious regional differences. The level of environmental regulation in the eastern region is positively correlated with the convenience in FDI introduction, while the environmental regulation in the central and western regions impedes the introduction of FDI. And this hindering effect is noteworthy in the middle area.

Conclusions

Based on the panel data of 30 provinces in China from 2003 to 2014, this paper uses the spatial Durbin model to analyze the influential effect of environmental

regulation on the introduction of FDI. First, we found that there is significant spatial correlation between regional environmental regulation and FDI. From the national level, environmental regulation has inhibited the introduction of FDI in the local region and the surrounding areas, but this inhibition is not significant. Second, environmental regulation has a negative impact on the introduction of FDI, but the impact is not significant across the country, indicating that the evidence of pollution haven hypothesis is insufficient in China. The influential effect of environmental regulation on the introduction of FDI has obvious regional differences. The level of environmental regulation in the eastern region is positively correlated with the convenience in FDI introduction, while in the central and western regions environmental regulation poses a hindrance to the introduction of FDI, which is remarkable only in the central area. Moreover, labor costs and human capital level have a remarkable direct effect on the introduction of FDI in the region. They are the direct factors affecting FDI location selection; the level of regional economic development and R&D investment have a significant impact on the introduction of FDI in surrounding areas, and they are the indirect factors affecting FDI location selection. Economic openness has a significant impact on the introduction of FDI in all regions.

The main policy implications are as follows:

First, environmental regulation policies should be based on the spatial correlation and spatial spill characteristics of environmental regulation. All the Moran I values of the environmental regulation passed the test of significance at the 5% level and each of its values is positive, except for the year 2010, when its value is negative, and there is a significant spatial clustering characteristic. In formulating environmental regulation policies, the government should first identify the cluster areas of environmental regulation and find its cluster characteristics. At the same time, the policy should take full account of the impact of the local policy on the surrounding areas.

Second, the conclusion that the evidence of pollution haven hypothesis in China is insufficient, which means that the destructive local competition of "race to the bottom" cannot fundamentally solve the investment promotion problem, and the foreign investment will not be transferred to other regions just because the environmental regulation gets more rigid. The method of attracting investment through relaxing environmental regulation may not work. Therefore, in the process of economic development, local policies should adhere to the concept of sustainable development, intensifying energy conservation and emission reduction to control the total energy consumption and promoting enterprise technological innovation to achieve green and coordinated development through environmental regulation.

In addition, the effect of environmental regulation on FDI location selection has obvious regional differences, and governments should deeply grasp the influence of regional discrepancy to formulate different policies on environmental regulation. The level of environmental regulation in the eastern region is positively correlated with the convenience in FDI introduction, and the government should further strengthen the implementation of environmental regulation policies in the eastern region. While in the central and western regions environmental regulation hinders the introduction of FDI to some extent, the government should adjust and revise the environmental regulation policy and eliminate this hindrance effect.

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Conflict of Interest

The authors declare no conflict of interest.

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