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Effect of Precipitation on Location Choice of Foreign Direct Investment in China

Zhiyuan Xu [1], Yuting Zhu [1] and Yongliang Yang [1,2,*]

1 School of Economics & Management, Zhejiang Sci-Tech University, Hangzhou 310018, China; mrxuzhiyuan@zstu.edu.cn (Z.X.); 2019333503089@mails.zstu.edu.cn (Y.Z.)
2 Silk and Fashion Culture Research Center of Zhejiang Province, Zhejiang Sci-Tech University, Hangzhou 310018, China
* Correspondence: royyang@zju.edu.cn

Abstract: This paper studies the effect of precipitation on the location of foreign direct investment (FDI) based on city-level data of China from 2003 to 2018. The results show that precipitation has a significant promoting effect on the regional agglomeration of FDI. This indicates that FDI location selection is more inclined to use the dilution ability of precipitation for pollution to reduce environmental costs, rather than relying solely on water resources. Further analysis shows that the preference of FDI enterprises on precipitation in the eastern region is significantly lower than that in the central and northeastern regions. This reflects the trend that FDI enterprises gradually shift to regions with a low degree of environmental regulation to reduce environmental costs. Therefore, the efforts made by economically developed cities to improve the regional ecological environment may be offset by the location adjustment of FDI enterprises, and precipitation has become an important stimulus for the location transfer of FDI enterprises.

Keywords: FDI; location selection; pollution paradise

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1. Introduction

Over the past decade, developing countries have gradually changed their previous extensive thinking of economic development. Realizing the rise of the global value chain has become the main development goal of developing countries [1,2]. As an important means of industrial upgrading in developing countries, FDI has become a serious shackle that restrains the further development of developing countries in recent years. Based on the "pollution paradise" hypothesis, FDI not only produces technology spillover, but also produces pollution transfer effects to the host country. At the same time, due to the imbalance of regional economic development in developing countries, FDI also causes secondary transfer and structural adjustment within developing countries. Therefore, it is of great practical significance to discuss the location choice of FDI enterprises in developing countries.

The systematic study of Dunning categorizes the factors that determine FDI into three aspects: ownership, location, and internalization advantages [3]. Among them, ownership and internalization determine the internal motivation for FDI behavior of enterprises [4], while location factors highlight the external attractiveness of the host country's characteristic variables for FDI [5].

The external motivation of FDI location selection is ascribed to the following four aspects by mainstream theory. market, resource endowment, efficiency, and strategic asset-seeking for the host country [6]. The host country will continue to create opportunities to enhance its ability to attract FDI and competitiveness. Many studies show that China is one of the most important countries for FDI inflow due to its improved infrastructure [7], continuously open market [8], strengthened property rights protection [9,10], rapid expansion of economic scale, and competitive cost advantage [11]. At the same time, the distribution of FDI in China is unbalanced due to internal competition [12,13]. For example, using Chinese provincial panel data, Luo et al. (2008) showed that FDI is mainly concentrated in large cities along the southeast coast. Compared with resource endowments, policy incentives and industrial agglomeration are more significant factors in the location choice of FDI [13].

The internal motivation of FDI location selection mainly comes from its positive effect on the macro-economy of the host country, including economic growth [14,15], exports [9,16], employment [17,18], technological innovation [19,20], intellectual property protection [21,22], and policy incentive [23,24]. These benefits are particularly important for developing countries. For example, by analyzing China's provincial panel data from 1995 to 2000, Cheung and Ping (2004) found that FDI has a significant positive effect on regional small innovation capability through knowledge spillover and demonstration effect [20].

As the concept of sustainable development has gradually reached a consensus around the world, avoiding and reducing environmental costs has become an important issue considered by FDI enterprises. From the perspective of climate change, part of the research discusses the impact of external environmental changes on a country's FDI location choice. It is considered that global warming has increased production activities and production efficiency in cold regions, thus bringing new opportunities for FDI location selection [24,25]. For example, based on the research of the European energy sector, Anton (2021) found that the temperature rise can improve the production efficiency of enterprises [26]. However, global warming has inhibited the production activities in high-temperature areas [27,28], which leads to uncertainty of the comprehensive effect of FDI. Research of Barua et al. (2020) based on the global perspective further shows that the long-term impact of temperature on FDI is negative [28]. Similar studies also discuss how climate change affects FDI location choice through capital market [29]. For instance, according to Leimbach and Bauer (2018), climate change will increase the cost of emission reduction in countries with limited capital because the development and use of clean technologies need more capital to be self-sustaining [30]. This will further reduce the motivation of these countries to transform and upgrade their industries, and they will eventually become the highest inflow countries of pollution-intensive FDI.

Research based on the hypothesis of "pollution paradise" suggests that the effect of FDI on developing countries has dual externalities. Some studies indicate that FDI can improve the technology level of the host country through technology and knowledge spillover, especially clean technology [31–33]. For example, Antweiler et al. (2001) reported that FDI enterprises can bring advanced environmental pollution treatment technology and environmental management systems to the host country, which is conducive to improving the level of environmental pollution control in the host country [32]. Other contrary studies indicate that FDI from developed countries to developing countries is an industrial transfer to avoid domestic environmental regulations, resulting in negative spillover on the environment of the host country [34–36]. For example, Copeland and Taylor (1995) believe that in a specific environment, pollution-intensive industries will transfer their production activities to developing countries with more relaxed environmental standards, in order to reduce pollution treatment costs [36]. At present, there is still no consensus on these two conclusions. Even in the studies on China, the conclusion remains heterogeneous [37,38]. Hao (2020) holds that FDI can reduce the pollution emissions of the host country through technology spillover effects, but the result depends on whether the types of enterprises entering the FDI are environment-friendly [37].

The research on environmental regulation and FDI shows that when there is environmental regulation, the gradient transfer of FDI will not end, but will continue within the host country along with the unbalanced economic growth in different regions of the country. In general, a country's economic growth will improve its environmental regulation. The increase in environmental costs will make FDI enterprises adjust their industry types in the host country. Especially for pollution-intensive FDI enterprises, strict environmental regulations will urge them to move downward to regions with weak environmental regulations within host countries [39,40].

However, there is little in-depth discussion on the motivation of FDI location selection from a micro perspective. An empirical observation shows that the location choice of FDI enterprises is often concentrated in the areas with dense precipitation in the host country. This suggests that the FDI enterprises want to reduce the pollution concentration through abundant precipitation, so as to achieve the purpose of reducing environmental costs and avoiding environmental regulations [41]. If this is the case, even in areas with strict environmental regulations, enterprises may still not easily transform and upgrade or leave the area, which makes the area still a preferred gathering place for FDI enterprises [41]. The research of Barua et al. (2020) shows that FDI is highly sensitive to precipitation [28]. Although precipitation can significantly increase the scale of FDI in a country, this conclusion is not supported by consistent evidence [42].

By reviewing the relevant literature, the existing studies on the location choice of FDI are mostly focused on the macro level between countries. There is little discussion on the location choice of FDI within the host country, especially the influence of precipitation on the regional distribution of FDI enterprises in the host country. Therefore, based on the micro panel data of city-level in China from 2003 to 2018, this paper systematically discusses the impact of precipitation on the location choice of FDI enterprises in China.

The main contributions of this paper are as follows. First of all, this paper discusses the internal motivation of FDI enterprises' location choices from the new perspective of precipitation for the first time. Second, this paper also supplements the relevant literature on environmental regulation. Our research shows that the dilution effect of precipitation on pollution weakens the emission reduction effect of environmental regulations. Finally, this paper enriches the literature on the influence of environmental change on FDI location selection.

Based on the above analysis, this study proposed the following research hypotheses:

Hypothesis 1 (H1). *FDI enterprises may consider regional precipitation when making location selection.*

Hypothesis 2 (H2). *The preference of FDI enterprises' location choice on precipitation is structurally different within a country.*

2. Methods and Data

2.1. Methods

Based on the above literature review and hypothesis, this paper uses the data from 2003 to 2018 at the city-level to construct the following panel data model:

$$FDI_{i,t} = \beta_0 + \beta_1 Rain_{i,t} + \lambda X + u_i + \pi_t + \varepsilon_{i,t} \quad (1)$$

where i represents the city, and t represents the years. u_i is the unobservable regional effect, π_t is the time effect. $\varepsilon_{i,t}$ is the random disturbance term. $FDI_{i,t}$ is the number of FDI enterprises in city i in China in year t; $Rain_{i,t}$ is the average precipitation of city i in year t. X represents other influencing factors. The time range of this sample is from 2003 to 2018, and the sample contains valid data of 290 cities in China. This paper uses the Ordinary Least Square method (OLS) to estimate this model. Considering the time trend and individual heterogeneity, all models control for the time-effect and city fixed-effect. In light of the possible correlation, autocorrelation, and heteroscedasticity of cross-section data, this paper uses the robust standard error based on bootstrap sampling to estimate the results.

2.2. Data and Variables

Based on the above discussion, the resource endowment, infrastructure, economic scale, and technological innovation level of the host country all have a significant impact on the location choice of FDI. Therefore, this paper uses the Chinese city-level micro panel data for model construction and empirical analysis, focusing on the effect of precipitation on the location choice of FDI.

FDI: The number of the Foreign Direct Investment (FDI) enterprises at the city-level in China, which is the most intuitive feature of a country's ability to attract foreign investment. The data were taken from the China Urban Statistical Yearbook [43]. Since the data of FDI at city-level were not published after 2018, they were not adopted. In addition, this paper also considers other indicators such as the number of FDI enterprises in municipal areas and the number of FDI enterprises per unit area to conduct robustness tests.

Rain: Average daily precipitation in various prefecture-level cities in China. In general, the more abundant the precipitation, the more favorable it is for enterprises to reduce environmental costs by dilution of pollution, resulting in higher levels of enterprise agglomeration. The data in this paper are sorted out according to the daily value data set of surface climate data (V3.0) from the China Meteorological Network. The site data are the daily average values calculated by the daily observation data of four points (02:00, 08:00, 14:00, 20:00), and then the daily average observations in the region are weighted to obtain the daily precipitation in the region. Finally, the daily precipitation is obtained by the weighted average of the daily observations in this region, and its unit is "0.1 mm."

Humidity: Annual average humidity at prefecture-level in China, and takes the natural logarithm. Relative humidity can comprehensively reflect the water resources endowment and its dynamic change in a certain area. Therefore, this paper uses this variable as an alternative index of precipitation for robustness analysis.

Lnpgdp: The natural logarithm of per capita GDP (Gross Domestic Product) of each prefecture-level city. Many studies have confirmed that the host country's economic scale is closely related to its market potential, thus becoming one of the important factors to attract FDI [7]. This indicator is expressed by "GDP of the current year/the total population of the city at the end of the year" of each prefecture-level city. The data are obtained from the China Urban Statistical Yearbook [43]. The same below.

Lnindustry: The natural logarithm of the proportion of the industrial output value of each prefecture-level city. The higher the level of industrial development in the region, the better the industrial system and the stronger the industrial agglomeration capacity of the region [7,8]. The index is expressed by the proportion of the added value of the secondary industry in the GDP of each prefecture-level city in China.

Lnpop: The natural logarithm of the population size of each prefecture-level city. Labor resource endowment is one of the important factors in the location choice of FDI. It can reduce the production cost of enterprises and improve the competitiveness of enterprises [7,8]. The indicator is expressed by the total population of each prefecture-level city at the end of the year.

Lne: The natural logarithm of the total electricity consumption of each prefecture-level city for the whole year. There is often a positive relationship between urban electricity consumption and the level of urban industrial development [7,8].

Lnpatent: The natural logarithm of the total amount of patent authorization of each prefecture-level city [44].

Lnscience: The natural logarithm of the expenditure of science operating expenses of each prefecture-level city. The number of patents granted and the expenditure of government scientific expenses represent the intensity of intellectual property protection in the region; intellectual property protection sends a positive signal to attract FDI [44].

Bus: The total number of buses and trams in each prefecture-level city [10].

Water: Total per capita water resources in each prefecture-level city [28]. The unit is "Ten thousand cubic meters."

Internet: The proportion of Internet users in each prefecture-level city [44].

The above three indicators represent the level of urbanization in each region. A significant positive promoting effect is observed between the level of urbanization and FDI.

The descriptive statistics of each variable are shown in Table 1. At the same time, we provide a table about variable description in the Appendix A (Table A1).

Table 1. Descriptive statistics.

Variable	N	Mean	Sd	Min	P50	Max
FDI	4285	3.070	1.680	0	2.770	8.470
Rain	4575	3.910	0.480	2.260	3.960	5.010
Lnpgdp	4546	10.11	0.910	6.640	10.10	13.19
Lnindustry	4538	47.93	11.02	9	48.25	90.97
Lnpop	4561	5.850	0.740	−3.220	5.910	9.310
Lne	4457	12.90	1.310	4.620	12.90	16.57
Lnpatent	4548	6.230	1.890	0	6.130	11.85
Bus	4498	0	0.010	0	0	0.160
Water	4507	0	0.010	0	0	0.120
Internet	4520	0.0500	0.110	0	0.010	3.660
Lnscience	4551	11.94	1.790	3.580	12.28	16.08

3. Results

3.1. Benchmark Regression

The results of benchmark regression are shown in Table 2. The traditional Hausman test is not suitable for heteroscedasticity and autocorrelation. This paper uses an improved strategy for panel data based on 500 times bootstrap, and the chi-square test value is 124.75, which is significant at the 1% level [37,43].

Table 2. Benchmark regression results.

Variable	Basic Result	Fixed Effect	Random Effect	MLE [1]	XTSCC [2]
Rain	0.161 *** (3.57)	0.134 *** (2.90)	0.234 *** (5.17)	0.173 *** (4.16)	0.134 ** (2.73)
Lnpgdp		0.146 *** (3.23)	0.437 *** (9.53)	0.266 *** (5.23)	0.146 ** (2.62)
Lnindustry		0.008 *** (2.89)	0.002 (0.71)	0.005 * (1.95)	0.008 *** (4.00)
Lnpop		0.152 *** (2.74)	0.547 *** (10.98)	0.330 *** (5.45)	0.152 ** (2.94)
Lne		0.028 (0.89)	0.102 *** (3.03)	0.059 * (1.78)	0.028 ** (2.41)
Lnpatent		0.082 *** (3.31)	0.173 *** (7.18)	0.117 *** (4.57)	0.082 *** (4.44)
Bus		−0.356 (−0.26)	0.963 (0.69)	0.278 (0.21)	−0.356 (−0.48)
Water		−0.986 (−0.44)	3.465 (1.41)	1.105 (0.50)	−0.986 (−1.30)
Internet		0.124 (1.43)	0.188 (1.62)	0.154 * (1.66)	0.124 * (1.85)
Lnscience		0.040 * (1.94)	0.054 ** (2.54)	0.047 ** (2.35)	0.040 * (1.89)
Constant	1.913 *** (10.53)	−1.558 (−1.63)	−8.158 *** (−9.97)	−0.305 *** (−4.32)	−1.558 * (−2.04)
Individual effect	Yes	Yes	Yes	Yes	Yes
Time effect	Yes	Yes	Yes	Yes	Yes
Observations	4285	4106	4106	4106	4106
R-squared	0.318	0.364			
Number of city	288	285	285	285	285

Note: [1] Maximum likelihood estimate. [2] Regression with Driscoll–Kraay standard errors. The result in parentheses in columns 1 to 4 is the t value of the Bootstrap 500th, and the value of *t* in parentheses in column 5 is the t values under the Driscoll–Kraay standard errors related to the cross-section. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

The results in the first column of Table 2 (Basic result) show that there is a significant positive correlation between precipitation (Rain) and FDI without adding control variables. After adding the control variables, the results of different regression methods (fixed-effect, Random effect, MLE, and XTSCC) show that precipitation can significantly promote the agglomeration of FDI enterprises in various cities. Notably, the effect of the total water supply level of each city (Water) on the number of enterprises is not significant. This result further supports our inference, that is, enterprises rely on water resources not because of production demand, but to reduce the environmental costs caused by production pollution. All results are controlled for the heterogeneity caused by time-effect and regional-effects. The results of other variables related to regional characteristics are consistent with previous related studies. Each variable has a significant promotion effect on the number of FDI enterprises.

3.2. Robustness Test

This paper also tests the robustness of the model by replacing the index of dependent variables and excluding the number of individual samples. The results are shown in Table 3. In column 1 and column 2, the explanatory variables are replaced by "the number of FDI enterprises in municipal districts" (Rain1) and "the number of FDI enterprises per unit area" (Rain2). The results still indicate that precipitation has a significant promotion effect on the number of FDI enterprises in each city. Moreover, the impact of total urban water supply (Water) on the number of FDI enterprises is also consistent with the Benchmark results. Since China's provincial capitals and municipalities are often regional political, cultural, and economic centers the concentration of resources is significantly higher in them than in other cities. Considering the effect of these central cities on the results, the samples of "municipality directly under the central government" and "provincial capitals" are respectively eliminated in this paper. Column 3 and column 4 of Table 3 show the results after removing relevant samples. The results significantly support the positive effect of precipitation on the number of regional FDI enterprises.

The results in Table 3 are all controlled for the individual-effect and time-effect. The results further verify the effect of precipitation on the location choice of FDI enterprises in different cities in China. Faced with increasingly stringent environmental regulation, reducing the environmental cost has become a key issue for FDI enterprises to consider. The unbalanced development of the regional economy provides an alternative for enterprises to adjust their location within the host country. Under the environmental constraints, precipitation will become an important factor for FDI enterprises to reconfigure resources.

In order to increase the robustness of the results, on the one hand, on the basis of benchmark regression, we gradually controlled the regional air pressure, wind speed, temperature, sunshine, and other factors, and the results remained stable (Table A2). On the other hand, this paper uses the annual average humidity of each city as an alternative index of precipitation, so as to measure the dynamic change of regional precipitation more comprehensively (Table A3). This paper also uses the stepwise regression method to test the robustness, and the results are still stable. The results further prove that FDI enterprises will consider the regional precipitation when making location selection.

Table 3. Robustness test results.

Variable	Rain1	Rain2	City1	City2
Rain	0.096 * (1.86)	0.116 *** (2.67)	0.117 ** (2.48)	0.119 ** (2.36)
Lnpgdp	0.136 ** (1.96)	0.106 ** (2.45)	0.109 ** (2.39)	0.134 ** (2.48)
Lnindustry	0.006 (1.54)	0.009 *** (3.26)	0.009 *** (3.15)	0.008 *** (2.66)
Lnpop	0.108 (1.42)	0.066 (1.09)	0.072 (1.13)	0.113 (1.54)
Lne	0.067 (1.41)	0.030 (1.00)	0.029 (0.99)	0.028 (0.81)
Lnpatent	0.121 *** (3.93)	0.076 *** (3.03)	0.076 *** (3.05)	0.071 *** (2.74)
Bus	−0.955 (−0.55)	−0.429 (−0.32)	−0.395 (−0.27)	1.522 (0.47)
Water	1.282 (0.47)	2.539 (0.70)	2.395 (0.69)	2.442 (0.62)
Internet	0.0781 (1.00)	0.076 (0.98)	0.103 (0.99)	0.125 (0.86)
Lnscience	0.030 (1.30)	0.020 (0.98)	0.017 (0.81)	0.021 (0.91)
Constant	−2.051 (−1.43)	−9.876 *** (−10.81)	−9.931 *** (−10.83)	−10.480 *** (−9.65)
Individual effect	Yes	Yes	Yes	Yes
Time effect	Yes	Yes	Yes	Yes
Observations	3916	4106	4046	3657
R-squared	0.230	0.353	0.351	0.344
Number of city	281	285	281	255

Note: Table 3 corresponds to the estimated results under the fixed effect, and the t value of the Bootstrap 500th is shown in the parentheses below. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

3.3. Heterogeneity

Previous studies have shown that urban characteristic variables such as the level of "regional economic development" and "intensity of environmental regulation" affect the location and agglomeration of FDI enterprises. This may lead to a heterogeneous effect of precipitation on the number of FDI enterprises in different regions. Table 4 presents the heterogeneity of four geographical regions in China. The impact of precipitation on FDI is not significant in the eastern region (column 1) and the western region (column 2). The possible reasons for this finding are as follows. First, the eastern region has the highest level of economic development in China, so it is also the region with the most stringent environmental regulations. This further increases the cleaning cost of FDI enterprises, thus promoting the industry distribution of FDI enterprises to gradually climb to a high value chain. Pollution-intensive industries tend to transfer to areas with lower environmental regulations, or directly withdraw from the host country market. Second, the scarcity of water resources makes it impossible for economic development to form a significant preference on precipitation. As a result, there is significant positive impact of precipitation on the agglomeration of FDI enterprises in this region.

Table 4. Heterogeneity analysis based on different regions.

Variable	Eastern Region	Western Region	Central Region	Northeast Region
Rain	−0.013 (−0.22)	0.167 (1.60)	0.200 * (1.93)	0.412 * (1.88)
Lnpgdp	0.302 *** (3.86)	0.148 (1.51)	0.149 ** (2.56)	0.145 (1.48)
Lnindustry	−0.007 (−1.26)	0.015 *** (2.90)	0.005 (0.92)	0.006 (0.70)
Lnpop	0.350 *** (3.91)	−1.094 *** (−2.73)	0.167 ** (2.21)	0.661 (0.51)
Lne	0.050 (0.81)	−0.005 (−0.12)	0.110 ** (2.12)	0.124 (1.26)
Lnpatent	0.190 *** (4.02)	−0.017 (−0.31)	0.039 (1.09)	0.038 (0.42)
Bus	−0.316 (−0.25)	2.149 (0.46)	−7.929 (−1.09)	−3.631 (−0.27)
Water	2.467 (0.61)	−1.183 (−0.09)	2.552 (0.36)	−5.645 (−0.64)
Internet	0.034 (0.42)	0.392 (1.11)	0.177 (0.45)	0.599 (1.00)
Lnscience	0.078 ** (2.25)	0.082 ** (2.00)	0.004 (0.09)	0.096 (1.39)
Constant	−2.865 (−1.47)	4.624 * (1.83)	−2.903 * (−1.88)	−6.665 (−0.81)
Individual effect	Yes	Yes	Yes	Yes
Time effect	Yes	Yes	Yes	Yes
Observations	1313	1080	1235	478
R-squared	0.598	0.262	0.424	0.406
Number of city	86	85	80	34

Note: Table 4 corresponds to the estimated results under the fixed effect, and the t value of the Bootstrap 500th is shown in the parentheses below. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

The effect of precipitation on FDI is significantly positive in the central region (Column 3) and northeast region (Column 4). This result further illustrates the precipitation preference of FDI agglomeration in different regions within the host country. At the same time, compared with the results of the different regions, under the environmental regulation, FDI enterprises have a downward transfer trend within the host country targeted by precipitation. Importantly, if strict environmental regulation exists only in some economically developed cities, then the industrial upgrading effect of environmental regulation is likely to be offset by the new pollution caused by the transfer of industry to areas with lower environmental regulation. Furthermore, the weak environmental supervision and treatment capacity in areas with poor environmental regulation can give the false impression of a decline in pollution.

4. Conclusions

This paper analyzes the impact of precipitation on the location choice of FDI enterprises in China. On the whole, precipitation has a significant promoting effect on the regional agglomeration of FDI, which indicates that FDI enterprises are more inclined to use the pollution diluting capacity of precipitation to reduce environmental costs, instead of simply relying on the water resources. The robustness test of alternative variables further supports this conclusion. The results showed a relatively stable promoting effect of precipitation on FDI.

The results of sub-samples from different regions show significant heterogeneity. The preference of FDI enterprises on precipitation in the eastern region is obviously lower than that in the central region and the northeastern region. To a large extent, the results reflect the trend that FDI enterprises gradually transfer to regions with lower environmental regulations to reduce environmental costs. As a result, the efforts made by developed cities to improve the ecological environment may be offset by the downward transfer of FDI enterprises. Precipitation has become the main driving factor for FDI enterprises to transfer to regions with lower environmental regulation.

Compared with previous studies, the conclusions of this paper make significant contributions in the following aspects. First, the results of this paper enrich the relevant literature on the impact of environmental characteristics on the location choice of FDI, especially based on the in-depth discussion of the new perspective of precipitation. Second, this study supports the previously reported conclusion, while the difference is that this paper further illustrates the preference of FDI location choice on precipitation within a country. At the same time, the results of this paper control the static factor of regional water resources endowment. This paper mainly focuses on the impact of the dynamic characteristics of precipitation on the location choice of FDI, in order to provide evidence to support the relevant research that precipitation can reduce the environmental cost of FDI enterprises by diluting pollution.

Therefore, the Chinese government should strengthen environmental supervision in areas with abundant precipitation. In addition, more attention should be paid to the global and domestic environmental changes in order to deal with the profound impact of environmental changes on global FDI flows. At the same time, the uncertain risks to FDI flows caused by the above environmental factors can be covered by new methods such as weather derivatives in the future.

This paper has some limitation in the following aspects: (1) The specific mechanism of precipitation on the location choice of FDI enterprises is not discussed in depth. (2) Due to the limitations of the data, this paper cannot discuss the heterogeneous influence of precipitation on the location choice of different FDI enterprises at the firm-level. In particular, it is impossible to analyze the preference of FDI enterprises with different levels of technological innovation on precipitation. (3) The research data in this paper are not ideal, which may affect the robustness of the results. If more detailed hydrological information of each city can be collected, it will help to obtain more accurate parameters. Obtaining more accurate data will be a research focus in the future.

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Appendix A

Table A1. Variable description.

Variable	Description of Variables
FDI	The number of the Foreign Direct Investment enterprises in Chinese cities.
Rain	Average daily precipitation in various prefecture-level cities in China.
Humidity	Annual average humidity at prefecture-level in China.
Lnpgdp	Per capita GDP (Gross Domestic Product) of each prefecture-level city, and take natural logarithm.
Lnindustry	The proportion of industrial output value of each prefecture-level city, and take natural logarithm.
Lnpop	The population size of each prefecture-level city, and take natural logarithm.
Lne	The total electricity consumption of each prefecture-level city for the whole year. and take the natural logarithm.
Lnpatent	The total amount of patent authorization of each prefecture-level city, and take natural logarithm
Lnscience	The expenditure of science operating expenses of each prefecture-level city, and take the natural logarithm.
Bus	The total number of buses and trams in each prefecture-level city.
Water	The total per capita water supply in each prefecture-level city.
Internet	The proportion of Internet users in each prefecture-level city.

Table A2. Robust results of controlling for more meteorological features.

Variable	(1)	(2)	(3)	(4)
Humidity	0.134 *** (3.04)	0.134 *** (3.03)	0.135 *** (3.00)	0.131 *** (2.64)
Lnpgdp	0.145 *** (3.26)	0.146 *** (3.28)	0.144 *** (3.24)	0.144 *** (3.25)
Lnindustry	0.008 *** (2.84)	0.008 *** (2.85)	0.008 *** (2.82)	0.008 *** (2.82)
Lnpop	0.152 *** (2.81)	0.151 *** (2.80)	0.149 *** (2.76)	0.149 *** (2.77)
Lne	0.028 (0.89)	0.028 (0.89)	0.030 (0.93)	0.030 (0.93)
Lnpatent	0.082 *** (3.35)	0.083 *** (3.37)	0.084 *** (3.41)	0.084 *** (3.41)
Bus	−0.374 (−0.39)	−0.442 (−0.45)	−0.432 (−0.44)	−0.430 (−0.44)
Water	−1.004 (−0.55)	−0.921 (−0.50)	−0.933 (−0.51)	−0.935 (−0.51)
Internet	0.124 ** (2.13)	0.121 ** (2.10)	0.121 ** (2.10)	0.121 ** (2.09)
Lnscience	0.040 ** (2.02)	0.041 ** (2.08)	0.041 ** (2.04)	0.041 ** (2.04)

Table A2. *Cont.*

Variable	(1)	(2)	(3)	(4)
Pressure [1]	−0.845 (−0.22)	0.080 (0.02)	0.002 (0.00)	0.039 (0.01)
Wind [2]		0.051 (0.46)	0.052 (0.46)	0.053 (0.47)
Airtemp [3]			0.025 (0.20)	0.026 (0.20)
Sunshine [4]				−0.014 (−0.13)
Constant	4.269 (0.16)	−2.147 (−0.09)	−1.657 (−0.06)	−1.795 (−0.07)
Individual effect	Yes	Yes	Yes	Yes
Time effect	Yes	Yes	Yes	Yes
Observations	4106	4106	4106	4106
Number of city	285	285	285	285

Note: (1) Average daily air pressure, with the unit of 0.1 hPa, and takes natural logarithm. (2) Average daily temperature, with the unit of 0.1 °C, and takes natural logarithm. (3) Average daily wind speed, unit is 0.1 m/s, and takes natural logarithm. (4) Average daily sunshine hours, the unit is 0.1 h, and takes natural logarithm. *** $p < 0.01$, ** $p < 0.05$.

Table A3. Influence of air humidity on location choice of FDI.

Variable	Fixed Effect	Random Effect	MLE [1]	XTSCC [2]
Humidity	0.3923 * (1.68)	0.548 *** (2.80)	0.448 ** (2.22)	0.392 ** (2.37)
Lnpgdp	0.144 *** (3.24)	0.434 *** (8.74)	0.263 *** (4.93)	0.144 ** (2.48)
Lnindustry	0.008 *** (2.91)	0.002 (0.70)	0.005 ** (1.97)	0.008 *** (4.01)
Lnpop	0.147 *** (2.78)	0.542 *** (10.30)	0.323 *** (5.13)	0.147 ** (2.64)
Lne	0.028 (0.94)	0.101 *** (3.01)	0.058 * (1.73)	0.028 ** (2.24)
Lnpatent	0.084 *** (3.40)	0.175 *** (7.52)	0.118 *** (5.02)	0.084 *** (4.63)
Bus	−0.196 (−0.15)	1.228 (0.83)	0.473 (0.36)	−0.196 (−0.26)
Water	−1.072 (−0.48)	3.447 (1.42)	1.012 (0.47)	−1.072 (−1.35)
Internet	0.126 (1.51)	0.189 * (1.70)	0.155 (1.63)	0.126 * (1.81)
Lnscience	0.036 * (1.86)	0.048 ** (2.33)	0.042 ** (2.13)	0.036 (1.64)
Constant	−2.619 ** (−2.06)	−9.472 *** (−8.78)	-5.538 *** (−4.17)	−2.619 *** (−3.80)
Individual effect	Yes	Yes	Yes	Yes
Time effect	Yes	Yes	Yes	Yes
Observations	4106	4106	4106	4106
Number of groups	285	285	285	285

Note: [1] Maximum likelihood estimate. [2] Regression with Driscoll–Kraay standard errors. The result in parentheses in columns 1 to 4 is the t value of the Bootstrap 500th, and the value of t in parentheses in column 5 is the t values under the Driscoll–Kraay standard errors related to the cross-section. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

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