The Influence of Institutional Distance on the Reverse Technology Spillover Effect: Evidence from China

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ABSTRACT

There are divergent studies on the existence of a reverse technology spillover effect due to a lack of constraints on the research process. Still, only some of them consider the different amount of development of the host countries. Therefore, the host country's degree of development and institutional distance are used as constraints innovatively to study two problems. First, the existence of the reverse technology spillover effect based on different degrees of host country development is analyzed. Second, the impact of institutional distance (formal and informal institutional distance) on the reverse technology spillover effect is explored. With the support of data from China and 28 host countries from 2003 to 2015, the C-H model and the threshold model are used to conduct the research. The results show that both formal and informal institutional distance have threshold effects on reverse technology spillover effect. Still, these threshold effects show different characteristics based on the developed host country and developing host country. Based on the controversy over whether the reverse technology spillover effect exists, this study refines the research work to explore the existence of reverse technology spillover effects under different host country development levels. It thoroughly examines the impact of the informal institutional differences between the home country and the host country on the absorption and acquisition of the reverse technology spillover effect of investment for the home country.

Keywords: Formal institution distance, Informal institution distance, Reverse technology spillover effect, Threshold effect

1. Introduction

In recent years, economic globalization has gradually prompted countries worldwide to increase their outward foreign direct investment (OFDI). As an important channel of international technology spillover, OFDI can improve the productivity of enterprises in host countries [1,2]. However, the existing research has not reached a consensus on whether OFDI can bring reverse technology

spillover effects to the home country; that is, it is unclear whether the OFDI of the investment country can promote the improvement of its productivity level and transform and upgrade the industrial structure. Through a study of Japanese direct investment in the United States, Kogut and Chang (1991) found that most Japanese investment in the United States was concentrated in research and development-intensive industries, with a tendency to acquire the technology of American enterprises, and thus they have proposed the speculation of the OFDI reverse technology spillover effect [3]. Subsequently, most scholars have confirmed that OFDI can produce a reverse technology spillover effect [4,5]. However, other scholars believe the reverse technology spillover effect does not exist [6,7]. The existence of this effect is affected by various constraints, which leads to inconsistent conclusions. Therefore, based on the overall research paradigm, it is most valuable to explore the impact of special conditions on the reverse technology spillover effect [8,9,11].

Existing studies on the reverse technology spillover effect pay great attention to market-level factors, such as absorptive capacities, the technology gap, market entry mode, financial efficiency, and other factors [12,13]. In addition, some studies introduce institutional factors to explore how the effect of OFDI is affected by the host country's or home country's institutional environment. In a study, corruption, law and order, bureaucratic quality, and socio-economic conditions were used as measures of the host country's institutional environment, and it was found that the poor institutional environment of the host country hindered Chinese OFDI. Wu and Chen [14] argued that a better institutional environment in the home country promotes enterprises' overseas expansion by reducing transaction costs [14]. Peng et al. [15] found that institutional distance is negatively correlated with the risk preference of enterprises' OFDI from the perspective of voice and accountability, political stability, government effectiveness, regulatory quality, rule of law, and control of corruption [15]. However, there are few studies on the impact of institutional distance on reverse technology spillover effects from the perspective of institutional differences between the host country and the home country. Considering the impact of the degree of economic development of the host country on enterprises' investment choice, it is rare to explore further how the different levels of economic development in the host country affect the effect of institutional distance on reverse technology spillovers [16].

Therefore, this study uses the degree of development in the host country and the institutional distance as special constraints and then studies the following two scientific issues. First, the reverse technology spillover effect is systematically studied based on the host country's development degree. Second, with the same background, the influence of institutional distance on the reverse technology spillover effect is explored, including the influence of formal institutional distance and informal institutional distance on the reverse technology spillover effect. To solve the first problem, this

research uses relevant data on China and 28 host countries from 2003 to 2015 to construct a C-H double logarithm model to explore the reverse technology spillover effects under different development levels of host countries. To solve the second problem, this study uses institutional distance as the threshold variable to build a benchmark threshold effect model and studies the influence of formal institutional distance and informal institutional distance on the reverse technology spillover effect, as well as their influence and difference on the reverse technology spillover effect under different economic development levels of host countries.

The results show that, regardless of whether the host country is a developed or a developing country, the outward FDI of the investing country can produce a technology spillover effect on the investment home country, which verifies the existence of a reverse technology spillover effect. This result is consistent with previous research [17,18]. In addition, by constructing a static threshold effect model, it is found that institutional distance impacts the reverse technology spillover effect. Based on the different levels of economic development in the host country, there is a significant difference between the formal and informal institutional distance on the reverse technology spillover effect.

2. Literature Review

2.1 Outward Foreign Direct Investment and Reverse Technology Spillover Effect

2.1.1. Reverse technology spillover effect

The reverse technology spillover effect refers to the observation that a multinational enterprise's outward direct foreign investment can, to some extent, improve productivity and upgrade the industrial structure of a multinational enterprise and its home country. Most studies have confirmed the existence of the reverse technology spillover effect. Kimura and Kiyota [19], using data from Japanese firms from 1994 to 2000, studied the impact of OFDI on productivity. They found that the productivity of firms with OFDI activity exhibits 1.8% higher growth than those without. Dan Peng found that industrial firms' OFDI significantly impacts their sustainable productive capacity [20]. He [21] utilized provincial panel data from 2004–2020 and employed the spatial Dubin model to analyze and test the spatial spillover effects of OFDI reverse technology spillover. The finding reveals that reverse technology spillover has a positive direct and spatial effect on the region's innovation capability. A few scholars have argued that the reverse technology spillover effect does not exist. For example, Bitzer and Kerekes (2008) used OECD industry data and China's provincial panel data as samples. They found that the impact of the technology spillover effect of OFDI on the home country is not obvious [22].

In addition to studying the existence of the reverse technology spillover effect, many scholars have studied the influencing factors of the reverse technology spillover effect. These influencing factors generally include absorptive capacity, technological gaps, and corporate behavior. Huang

(2023) found that home country enterprises give full play to their absorption capacity, develop their technology by carrying out independent R&D and innovation, and ultimately enhance core competitiveness and innovation strength [13]. Scholars have different views on the impact of technological gaps on technology spillover. Wang and Blomström [23] believed that technology spillover is positively related to technical gaps. Glass and Saggi [23] argued that technology spillover is negatively correlated with technological gaps when these gaps are too large [24]. Razzaq [25] found that the productivity spillovers from Chinese OFDI decrease with the increase in the technology gap, and after a certain threshold, these spillovers become less pronounced.

Regarding corporate behavior, the company's business strategy, innovation ability, export experience, and rent-seeking influenced OFDI decisions [26,27]. Long et al. [28] studied the impact of OFDI on the organizational level. They found that enterprises actively participating in OFDI can enjoy a lower tax burden and better legal protection in the host country, which is conducive to acquiring and absorbing the reverse technology spillover effect.

2.1.2. Outward foreign direct investment and reverse technology spillover effect - host countries are developed countries

In previous research, most scholars have argued that when countries with a low level of development invest in countries with a higher level of development, it will positively impact the technological level of the home country due to the outstanding technological advantages of the host country [29]. For example, Makino et al. [30] argued that the main motivation of OFDI of Indian firms is to acquire intangible skills from the host country. Zhao and Liu contended that companies “outsource R-D activities” and relocate overseas to transfer spillover effects due to OFDI. Bezerra et al. [31], using a sample of 73 subsidiaries of Brazilian firms, found that subsidiaries in developed countries tend to transfer more product-oriented innovations to their parent companies than those in emerging countries. Dan et al. [20] argued the impact of OFDI on sustainable, productive capacity was more pronounced for firms whose investments were destined for developed countries. In addition, the technology transfer process across countries is affected by the size and age of these subsidiaries. When a multinational enterprise in a country with a low level of development invests in countries with a higher level of development, it influences their technological level mainly through an imitative effect, competitive effect, industrial correlation effect, personnel flow effect, and advances in IT and R&D [32,33,34]. Therefore, the hypothesis is as follows:

Hypothesis 1. When a developing country invests in developed countries, it can obtain a reverse technology spillover effect.

2.1.3. Outward foreign direct investment and reverse technology spillover effect - host countries are

developing countries

Sanna-Randaccio [35] found that OFDI will influence the overall technological level of the company through innovation incentives, thus promoting the welfare level of both the home and host country [35]. Head and Ries found that the OFDI from a developed country to a developing country has a significant impact on the technological level of the home country. It has been suggested that when a multinational corporation in a developing country invests in developing countries, it indirectly promotes the home country's transformation and upgrade of its technological level through the industrial transfer and personnel flow effect. The industrial transfer effect is when multinational enterprises transfer production links to host countries with low labor costs while retaining more core R&D design links in their home country. The external transfer of such production links helps to improve the enterprises' independent innovation ability [36]. The personnel flow effect is when multinational companies employ the host country's labor. It is, to an extent, beneficial to master the host country's market knowledge and to understand consumers' habits. This effect will help multinational enterprises integrate into the host country's environment and thus improve their productivity level [37]. Chen et al. [38] studied China's outward foreign direct investment in 12 Southeast and East Asian countries from 2003 to 2018. They found that regional infrastructures such as mobile phone telecommunication, fixed broadband, and electricity infrastructure played a crucial role in encouraging Chinese multinational firms to invest in Asian countries. In addition, Sawada [39] found that the technology gap negatively affects the absorption and acquisition of the technology spillover effect; that is, the technological gap between the home country and the host country is smaller, and the cost of technology learning is lower [39]. Therefore, the hypothesis is as follows:

Hypothesis 2. When a developing country invests in developing countries, it can obtain a reverse technology spillover effect.

2.2 Institutional Distance and Reverse Technology Spillover Effect

2.2.1. Institutional distance

As a new concept in economics, institutional research began relatively late. North [40] argued that the institution is a social game rule that mainly includes formal constraints, such as laws and regulations, and informal regularity, such as habits, codes of conduct, and ethical norms [40]. Based on North's definition of the institution, Estrin [41] formally defined institutional distance and divided it into two types: formal and informal [41]. Formal institutional distance refers to the differences between countries regarding formal constraints, such as laws and regulations; informal institutional distance refers to the differences between countries regarding nonformal constraints, such as codes of conduct, customs, ethics, and culture. Only some scholars currently consider the influence of

institutional distance on the acquisition and absorption of the reverse technology spillover effect. However, some researchers have explored the impact of the institutional environment of the home country and the institutional environment of the host country on the absorption of the reverse technology spillover effect [42,43].

2.2.2. Formal institution distance and reverse technology spillover effect

(1) Formal Institution Distance and Reverse Technology Spillover Effect-Host Countries Are Developed Countries.

When the host country is a developed country, the formal institutional distance between the host and home countries provides institutional welfare, technology learning, and technology transfer to the daily operation of multinational corporations. Institutional welfare mainly means that the developed legal institution, the government's rapid response ability, and the strong corruption control ability of developed countries facilitate the daily operations, technology learning, and technology transfer of multinational enterprises. Shi et al. [44] suggested that the institutional environment of investment destinations matters for reverse technology spillovers from OFDI [44]. Good institutions have positive and comparable direct effects on the technological level [42]. For example, Fahad et al. (2022) used 2010-2019 panel data from Chinese provincial OFDI and found that focused industrial policies increased regional OFDI reverse technology spillover by 0.133%. The study's findings further reveal that environmental regulation and biased policy effectively promote the regional OFDI reverse technology spillover with certain stability [43]. Yi et al. [45] proposed that companies operating in areas with high intellectual property protection, market development, and internationalization can absorb the spillover effect and increase productivity. However, Wang [46] argued that host countries with intellectual property protection that is either too weak or too strong are unattractive. Some studies suggested that the formal institutional distance between the home country and host country increases the cost of daily operations, technology learning, and technology transfer for multinational enterprises, which is not conducive to the realization and acquisition of the reverse technology spillover effect by the company and its home country [47,48,49]. In addition, the formal institutional distance in developed countries is larger, and the companies in developing countries will face high institutional risk. In the case of institutional risk, firms will face additional hazards, restrictions, and costs from the difference in institutions. Based on these findings, the hypothesis is as follows:

Hypothesis 3. When the host country is a developed country, there is a threshold effect on the impact of formal institutional distance on the reverse technology spillover effect. When the formal institutional distance is lower than the threshold value, it is positively related to the reverse technology spillover effect; when it is higher than the threshold value, its positive impact on the reverse

technology spillover effect is more obvious.

(2) Formal Institution Distance and Reverse Technology Spillover Effect-Host Countries Are Developing Countries

When the host country is a developing country, the formal institutional distance between the host country and the home country provides an opportunity for institutional arbitrage by multinational enterprises. Institutional arbitrage mainly refers to the loopholes in the host country's institutions that create a convenience condition for risk aversion, daily operation, and technology learning by multinational enterprises. In addition, institutional arbitrage will positively affect the enterprise's ability to innovate products. High-dimensional fixed effects (HDFE) show that the overall institutional distance positively affects OFDI [50]. Peng [15] found that high voice and accountability, low government efficiency, and low corruption control will drive enterprises' low-risk investment preference in "the Belt and Road" countries, while low government efficiency, low regulatory quality, and high legal level will drive enterprises' low-risk investment preference in other countries. The formal institutional distance between countries also increases the cost of daily operations and technology learning of multinational corporations [48,49], weakening the positive impact of institutional arbitrage on the technological level of a multinational corporation and its home country. Therefore, the institutional arbitrage caused by formal institutional distance will promote the absorption and acquisition of a company's and its home country's reverse technology spillover effect. However, as the formal institutional distance increases, the difficulty and cost of institutional arbitrage increase. In addition, when entering developing countries, multinational corporations are challenged to bridge the differences between home and host countries, which increases the cost of adapting to and studying host countries [41]. Therefore, the impact of technology spillover will also be significantly weakened. Based on this finding, the hypothesis is as follows:

Hypothesis 4. When the host country is a developing country, there is a threshold effect on the impact of formal institutional distance on the reverse technology spillover effect. When the formal institutional distance is below the threshold value, it is positively related to the reverse technology spillover effect; this positive relationship will be weakened when it is above the threshold value.

2.2.3. Informal institution distance and reverse technology spillover effect

In the international business field, increasing scholars are beginning to study the impact of informal institutional distance on international business activities. For example, Xu and Shenkar [47] argued that the more host countries differ from the home country in terms of institutions, the more difficult it is for firms to adapt to host countries. Based on Chinese firm-level data, Jiao et al. [51] studied the impact of cultural distance on the relationship between OFDI and reverse technology spillover. They found that cultural distance hurts the acquisition of reverse technology spillover.

When a multinational corporation from a developing country engages in OFDI, the informal institutional distance mainly affects the absorption and acquisition of the reverse technology spillover effect through the following three aspects. First, the informal institutional distance will make it more difficult for multinational companies to observe and integrate the local environment. Therefore, the greater the informal institutional distance is, the more difficult it is for multinational managers to acquire and master the technological knowledge of the host country. Second, informal institutional distance increases the difficulty of knowledge replication and understanding. Therefore, the greater the informal institutional distance between the home country and the host country, the more difficult it is for multinational companies to learn the corresponding technological knowledge when investing in the host country [52]. Third, informal institutional distance will increase multinational enterprises' coordination and governance costs. Therefore, the hypotheses are as follows:

Hypothesis 5. When the host country is a developed country, informal institutional distance negatively correlates with the reverse technology spillover effect.

Hypothesis 6. When the host country is developing, informal institution distance negatively correlates with the reverse technology spillover effect.

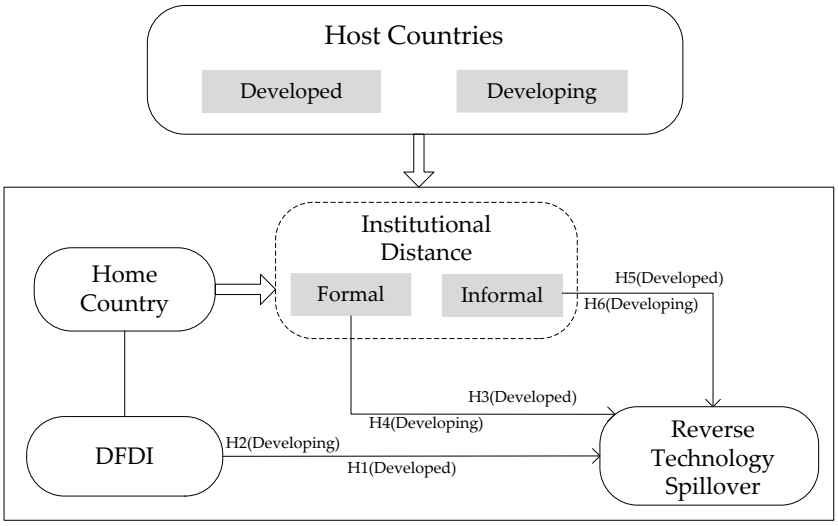

Figure 1. Research Figure

3. Model AND Variables

3.1 Model Introduction

3.1.1. C-H model

Coe and Helpman [53] thought that in an open economic environment, a country's total factor productivity (TFP) is not only related to the stock of domestic R&D knowledge (S_d), but also to the

stock of the international R&D knowledge capital (S_f). In addition, import and export trade, foreign direct investment, and outward foreign direct investment between countries will bring non-materialized knowledge stock to the home and host countries (S_u). Therefore, considering the impact of knowledge spillover effect on the total factor productivity of country I, the standard research paradigm pioneered by Coe and Helpman [53] should incorporate non-materialized knowledge capital that are not represented in the form of capital goods and are difficult to quantify. The model is as follows:

$$TFP_i = AS_d^{\alpha} S_f^{\beta} S_u^{\gamma} \quad [1]$$

TFP_i: Total factor productivity of country A

A: the factor of the external economic environment

α: elastic coefficient of the stock of domestic knowledge capital

β: the stock of international intellectual capital

γ: the capital of non-materialized knowledge

Then taking both natural logarithms on both sides of formular 1, the following regression model is obtained.

$$lnTFP_i = C + \alpha lnS_d + \beta lnS_f + \gamma lnS_u \quad [2]$$

C: constant value, equal to lnA

3.1.2. Threshold Regression Model

The model of this study is based on the study of Hansen (1999) [54], which gave the basic formular:

$$y_{it} = \mu_i + \beta_1' x_{it} I\ (q_{it} \le \gamma\ ) + \beta_2' x_{it} I\ (q_{it} > \gamma\ ) + e_{it} \quad [3]$$

I (·): the indicative function

i: the subscript represents the individual.

t: the subscript represents time.

y_{it}: the dependent variable is scalar.

q_{it}: the threshold variable is scalar.

x_{it}: the regressor is a k vector.

Formular 3 can also be expressed as the following formular:

$$y_{it} = \mu_i + \beta^{'} x_{it}(\gamma) + e_{it} \quad [4]$$

Where $\beta = (\beta_1^{'}\ , \beta_2^{'})^{'}$. The observations are divided into two "range"by the threshold variable q_{it}. If $q_{it} \le \gamma$, the regression slopes of x_{it} is β_1'. And if $q_{it} > \gamma$, the regression slopes of x_{it} is β_2'. It is also assumed that the error is independent and identically distributed (iid) with mean zero and finite variance σ^2.

3.2 Model Introduction

3.2.1. Model construction of the existence of the reverse technology spillover effect

Based on the formular 2, to study the existence of the reverse technology spillover effect, a double logarithmic model is built as follows:

$$lntc_{it} = C + lnsofdi_{it} + \varepsilon_{it} \quad i = 1,2,3 \cdots i \qquad [5]$$

tc_{it}: the number of patent applications filed by China in the host country i in year t

$sofdi_{it}$: the international R&D capital stock obtained by the home country h through investing in country i in year t

Calculations were made using the method proposed by Lichtenberg and Potterie [55]:

$$sofdi_{it} = \frac{OFDI_{it}}{Y_{it}} S_{it} \qquad [6]$$

$OFDI_{it}$: the amount of home country' s outward foreign direct investment to host country i in year t

Y_{it}: the GDP of the host country i in t year

S_{it}: the amount of R&D investment of the host country in t year

3.2.2. Model Construction of the Influence of Institutional Distance on the Reverse Technology Spillover Effect

Based on hypothesis 4 to 6, the impact of institutional distance between home and host countries on reverse technology have a threshold effect. Considering that the threshold model is more suitable for the study of non-single linear relations, so the threshold effect model is as follows:

$$lntc_{it} = \alpha_0 + \alpha_1 lnsofdi_{it} \times I(x_{it} \le \gamma_1) \alpha_2 lnsofdi_{it} \times I(x_{it} > \gamma_1) + \beta_1 tech_{it} + \beta_2 eco_{it} + \beta_3 human_{it} + \beta con_{it} + \varepsilon_{it} \qquad [7]$$

I(·): the indicative function

γ: the threshold value

x_{it}: the institutional distance between home country h and the host country i in year t, including formal institution distance (ist) and informal institution distance (cd).

3.3 Variables

3.3.1 Formal institution distance

Based on the index of global government governance proposed by Kaufmann and Kraay [56], the formal institution is divided into 6 subdimensions: corruption control, government efficiency, political stability, rule of law index, regulatory quality and political democracy. The range of these six indicators is "-2.5, 2.5". The larger the value is, the more complete the formal institution of a country is. The Kogut-Singh distance index is used to calculate the formal institution distance [57]. The calculated formula is as follows:

$$ist_{it} = \frac{1}{6}\sum_{j=1}^{6} \frac{(I_{ijt}-I_{hjt})^2}{var_{ijt}} \quad [8]$$

ist_{it}: the formal institution distance between home and host country i in year t

I_{ijt}: the value of the jth formal institutional indicators of the host country i in year t

I_{hjt}: the value of the jth formal institutional indicators of the home country h in year t

var_{ijt}: the variance of the jth formal institution indicators in year t

3.3.2 Informal Institution Distance

The informal institution is divided into six sub-dimensions: power distance, uncertainty avoidance, individualism and collectivism, masculinity and femininity, long-term or short-term orientation, and indulgence and restraint. The data of these six indicators are available on the website (http://www.geert-hofstede.com), this website only provides data from the 6th survey. In this study, the Kogut-Singh distance index algorithm is used to calculate the informal institution distance. The formula is as follows:

$$cd_{it} = \frac{1}{6}\sum_{j=1}^{6} \frac{(C_{ijt}-C_{hjt})^2}{var_{ijt}} \quad t = 2015 \quad [9]$$

cd_{it}: the informal institution distance between home country and country i in year t

C_{ijt}: the value of the jth informal institutional indicators of the host country i in 2015

C_{hjt}: the value of the jth informal institutional indicators of the home country h in 2015

var_{ijt}: the variance of the jth formal institution indicators in 2015

Considering that the informal institution distance only has data for one year, it should be revised. On the one hand, after establishing diplomatic relations between the home and host countries, the informal institution distance between the two countries will be reduced because of trade contact and personnel movement. On the other hand, the informal institution distance should satisfy the law of diminishing; that is, as the communication between the two countries continues to deepen, the informal institution distance between the two sides will gradually shrink. Therefore, based on the Kogut-Singh distance index calculation method, the ages for establishing diplomatic relation between home and host country are introduced, such that the formula for calculating the informal institution distance is as follows:

$$cd_{it} = \frac{1}{6}\sum_{j=1}^{6} \frac{(C_{ij}-C_{hj})^2}{var_{ij}} - \frac{1}{t-y_i} \quad 2003 \le t \le 2014 \quad [10]$$

C_{ij}: the value of the jth informal institution index of country i between 2003 and 2015

C_{hj}: the value of the jth informal institution index of home country between 2003 and 2015

var_{ij}: the variance of the jth indicator of informal distance

y_i: the year of establishing diplomatic relation between home and host country

3.3.3 Control variables

The control variables in formular 7 include the technical distance (tech) between home and host country, the economic development distance (eco), the human capital distance (human), and the trade between home country and host country (con). Based on the study of Lerner (2009), the technical gap between the two countries is measured by the ratio of the number of patent applications of the host country residents to the number of home country' s resident patent applications; the economic development distance is measured by the ratio of the per capita GDP of the host country to home countries [58]. The human capital distance is measured by the ratio of the number of R&D personnel of every million people of the host country to home countries. Trade between countries is measured by the ratio of the amount of home country's import and export with the host country to home country' s total import and export volume.

3.4 Data Source

Taking China as an example, the influence of the institutional distance between the home and host countries on the absorption and acquisition of the reverse technology spillover effect is studied. Considering the integrity and availability of data, the panel data of 28 host countries from 2003-2015 is selected as samples. Host countries mainly include 15 developed countries and 13 developing countries. Among them, developed countries include Australia, Austria, Canada, Denmark, France, Germany, Britain, Japan, Korea, the Netherlands, New Zealand, Singapore, Spain, Sweden, and the United States; developing countries include Argentina, Brazil, Chile, Colombia, India, Iran, Malaysia, Mexico, Pakistan, the Philippines, Poland, Thailand, Turkey. The number of patent applications filed by China in the host country originates from the statistical annual report of the China State Intellectual Property Office. The data on China's outward foreign direct investment amount originate from the statistical Bulletin of China's Outward Foreign Direct Investment. China's total import and export volume each year and its detailed data are derived from the Yearbook of China Statistical Data. Data such as GDP, R&D investment, number of R&D personnel for every million people, and number of patent applications by residents of the host countries are derived from the World Bank database. The data of OFDI and the value of imports and exports have been deflated by the base period 2003. Based on formula 6, the reverse technology spillover effect from host countries is calculated. And based on formulas 8 and 10, this study calculates the formal and informal institutional distances between China and the host country i. The described statistical results of the variables in this study are shown in Table 1.

Table 1. Described statistical results of variables

Variable	obs	Mean	std	Min	Max
tc	364	291.01	76.62	0.00	18040.00
Sofdi	364	5535.10	877.19	0.12	161798.38
ist	364	16.92	0.58	0.87	37.70
cd	364	16.74	0.39	0.76	30.55
tech	364	0.17	0.03	0.00	6.31
eco	364	7.64	0.39	0.17	31.40
human	364	3.24	0.12	0.07	9.91
con	364	0.02	0.00	0.00	0.16

Source: By authors

4. Results and Discussion

4.1 The Existence of the Reverse Technology Spillover Effect

To prove the existence of the reverse technology spillover effect of home country, based on the degree of development, the host country is divided into two types, developed countries and developing countries. The results are shown in Table 2. First, China will obtain reverse technology spillover effect when it is investing in developed countries. Therefore, the conclusion supports Hypothesis 1. It is mainly because the technology level of developed countries is relatively high compared with China. Therefore, when Chinese enterprises invest in developed countries, they can improve their productivity levels through demonstration, imitation, competition and personnel flow effect. Second, China's outward direct investment in developing countries will also have reverse technology spillover effect; the conclusion supports hypothesis 2. This finding is because when China invests in developing countries, it can use the cheap labor and space of the host country to produce products while retaining core R&D and design links in the home country. Therefore, investing in developing countries provides sufficient time and money for China to improve productivity. It can be concluded that developing countries can obtain reverse technology spillover effect whether the host country is a developed or developing. In general, it is found that these conclusions support hypotheses 1 and 2.

Table 2. Results of empirical regression analysis of the existence of the reverse technology spillover effect

Etc	Developed countries	Developing Countries
Lnsofdi	0.37***	0.44***

	(12.33)	(15.14)
C	1.04***	0.96***
	(2.63)	(2.77)
R2	0.51	0.40
Wald test	152.13	229.24
Obs	195	169

Note: ***, **, and * respectively indicate that the data are significant at the 1%, 5%, and 10% levels. In the () is the value of t.

Source: By authors.

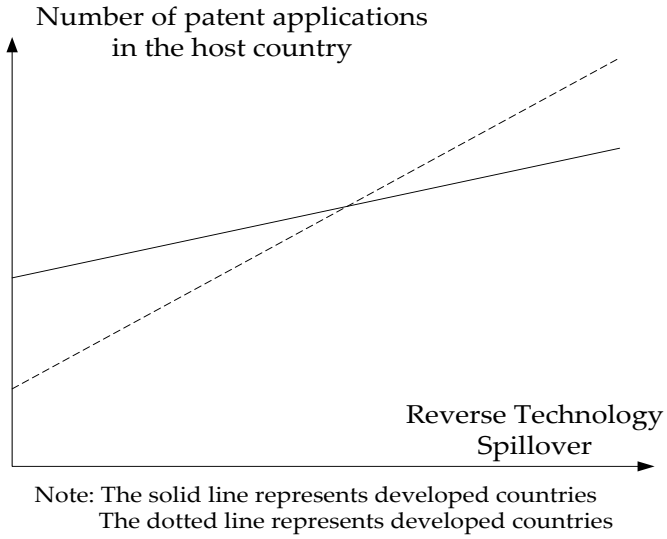

Figure 2. Mechanism of the reverse technology spillover effect

Source: By authors.

Figure 2 can be obtained by analyzing Table 2. In Figure 2, the horizontal axis is the reverse technology spillover effect obtained from the host country, and the vertical axis is the number of patent applications in the host country. As can be observed from the figure, the reverse technology spillover effect is positively related to the number of patents granted by China's host countries. Therefore, regardless of whether the host country is a developed or a developing country, China can obtain a reverse technology spillover effect, which will directly affect the technology level. These conclusions are consistent with the hypothesis 1 and the hypothesis 2. However, the development of host countries differs significantly in influencing the reverse technology spillover effect. When China began to invest in other countries and regions, its reverse technology spillover effect from developed countries was more obvious. However, with the accumulation of outward foreign investment

experience, when the host country is a developing country, China's reverse technology spillover effect is significantly higher than when the host country is a developed country.

4.2 Study on the Influence of Institutional Distance on the Reverse Technology Spillover Effect

The threshold effect model is introduced to study the relationship between institutional distance and the reverse technology spillover effect. The results are shown in Table 3.

Table 3. Impact of institutional distance on the reverse technology spillover effect - based on the threshold effect model. Note: ***, **, and * indicate that the data are significant at the 1%, 5%, and 10% levels, respectively. The value of t is in the ().

It can be observed from Table 3 that there is a threshold effect on the impact of formal institution distance on the reverse technology spillover effect, and the relationship between the two parties is affected by the degree of development of the host country. It represents that when the host country is a developed country when the formal institutional distance between China and the host country is lower than 25.43, the coefficient of the formal institutional distance is 0.31. When the formal institutional distance is higher than the threshold value of 25.43, the impact of formal institutional distance on reverse technology spillover is more obvious, with a coefficient of 0.37. When the host country is a developing country, the formal institutional distance between China and the developing country is lower than the threshold value of 11.63, and its influence coefficient on the reverse technology spillover effect is 0.26. When it is above the threshold value, its effect on the reverse technology spillover effect is not significant. So, the mechanism of the formal institution distance effect on the reverse technology spillover effect can be obtained (Figure 3).

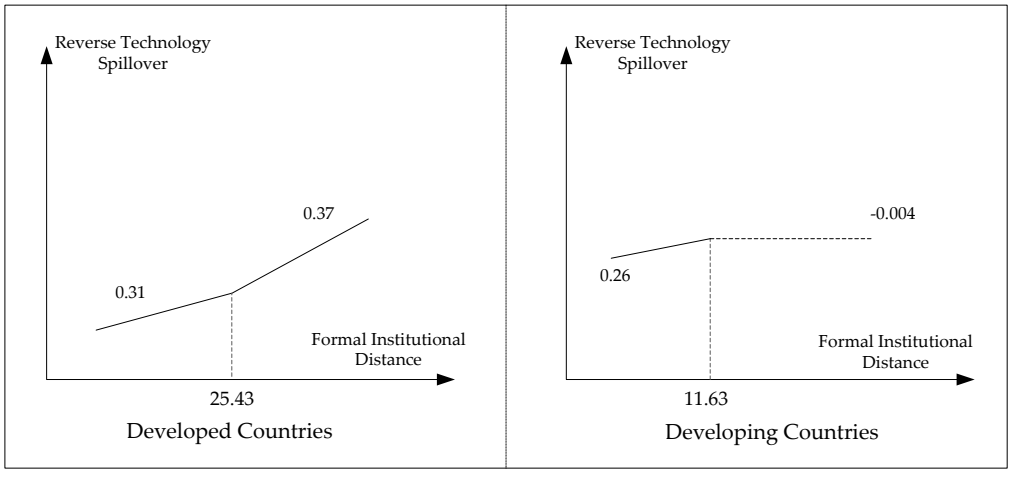

Figure 3. Mechanism of the formal institutional effect on the reverse technology spillover effect

Source: By authors.

Figure 3 shows the horizontal axis, the formal institutional distance between China and the host

country. The vertical axis is the reverse technology spillover of OFDI from China to the host country. As can be observed from the above figure, when the host country is developed, the formal institutional distance positively impacts China's reverse technology spillover. However, there is a threshold value of the relationship between formal institutional distance and reverse technology spillover. When the formal institutional distance between China and the developed countries is less than 25.43, the distance between China and the host country is conducive to the absorption and acquisition of China's reverse technology spillover effect. When this distance is above the threshold value, the positive impact of formal institution distance on the reverse technology spillover effect is more obvious; therefore, assumption 3 is supported. When the host country is developing, the formal institutional distance positively impacts China's reverse technology spillover. However, there is a threshold value of the relationship between formal institutional distance and reverse technology spillover. When the formal institution distance between China and developing countries is lower than 11.63, it is conducive to the absorption and acquisition of China's reverse technology spillover effect. When this distance exceeds the threshold value, the relationship between formal institution distance and the reverse technology spillover effect is not obvious; therefore, assumption 4 is established.

Based on Table 3, figure 4 is drawn, which shows the mechanism of the informal institution distance effect on the reverse technology spillover effect. In Figure 4, the horizontal axis is the informal institutional distance between China and the host country. The vertical axis is the reverse technology spillover of OFDI from China to the host country. If the host country is a developed country, the informal institutional distance negatively impacts China's reverse technology spillover. However, there is a threshold value of the relationship between informal institutional distance and reverse technology spillover. When the informal institution distance is lower than the threshold value (9.20), the reverse technology spillover effect will be negatively affected. When that distance exceeds the threshold value, the negative impact of informal institution distance on the reverse technology spillover will be significantly weakened. If the host country is a developing country, the informal institutional distance also negatively impacts China's reverse technology spillover. However, there is a threshold value of the relationship between informal institutional distance and reverse technology spillover. When the informal institutional distance is lower than the threshold value (25.03), it will negatively affect the absorption and acquisition of the Chinese reverse technology spillover effect; when it is above the threshold value, the negative impact is strengthened. Therefore, the conclusions support hypotheses 5 and 6.

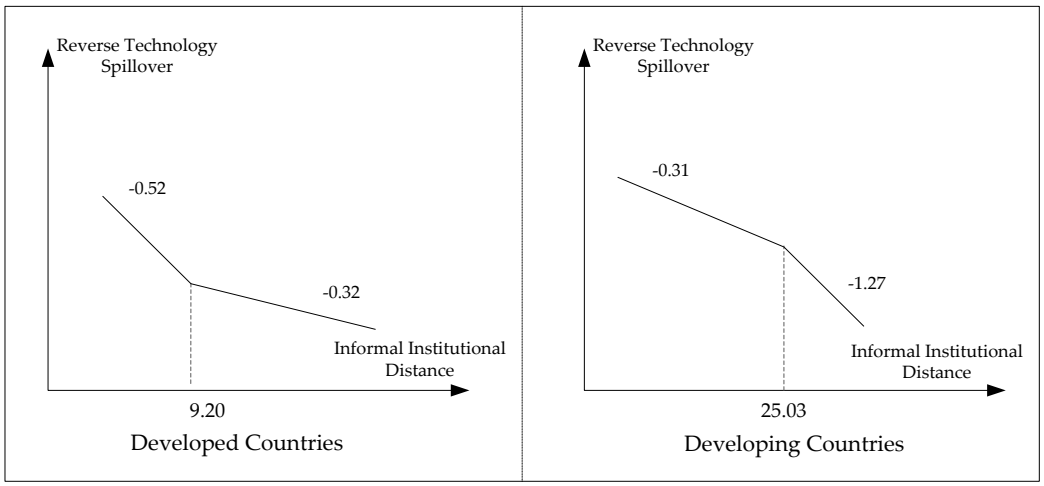

Figure 4. Mechanism of the informal institutional effect on the reverse technology spillover effect

Source: By authors.

4.3 Theoretical Contribution

This study makes the following three main theoretical contributions:

1) First, based on the controversy over whether the reverse technology spillover effect exists, this study further refines the research work. It explores reverse technology spillover effects under different host country development levels. It is found that the OFDI of developing countries will have a reverse technology spillover effect, which exists regardless of whether the host country is a developing or a developed country. In general, due to the high technological level of developed countries, investors are more inclined to invest in developed countries and obtain reverse technology spillover effects through technology transfer. Through cost-sharing mechanisms, investors can obtain reverse technology spillover effects on investment in developing countries. For the difference in reverse technology spillover effects obtained under different levels of development in the host country, it is believed that at the beginning of OFDI, due to the technological endowment of developed countries, the reverse technology spillover effect of investment countries (developing countries) investing in developed countries is significantly higher than that of developing countries. However, due to the declining marginal effect of technology learning, when the outward investment period reaches a certain level, and the host country is a developing country, the home country's reverse technology spillover effect is significantly higher than when the host country is a developed country.

2) Second, due to the lack of research on the influencing factors of the reverse technology spillover effect, the institutional distances are grouped to explore the impact of formal institutional distance on the reverse technology spillover effect under different economic development levels of the host country. The empirical results show that regardless of the degree of economic development in the host country, the formal institutional distance will promote the absorption and acquisition of

the reverse technology spillover effect of the investor country. In addition, the impact of distance on the reverse technology spillover effect has a threshold effect. However, when the degree of development of the host country is different, there is also a difference in the level of influence on the reverse technology spillover effect. Specifically, when the host country is a developed country, the formal institutional distance will promote the absorption and acquisition of the reverse technology spillover effect, and this effect becomes more apparent after the formal institutional distance reaches the threshold. When the host country is a developing country, the formal institutional distance will also significantly promote the absorption of the reverse technology spillover effect. Still, this effect occurs only before the threshold, mainly because there is a difference in the impact mechanism of formal institutional distance on the reverse technology spillover effect. Suppose the host country is a developing country. In that case, the formal institutional distance between countries provides an opportunity for the institutional arbitrage of multinational corporations, which helps the technological learning of multinational corporations and home countries [58]. Because the institutional environment in developed countries is better than that of emerging economies when the host country is a developed country, the host country's optimal legal system, rapid government response-ability, and strong corruption control ability bring system benefits for multinational corporations to operate and learn technology [59, 60]. Therefore, investment in developed countries can help countries achieve reverse technology spillover effects to a great extent.

3) Finally, based on the difference in the degree of development in the host countries and the heterogeneity of the countries in the informal system, this study explores in depth the impact of the informal institutional differences between the home country and the host country on the absorption and acquisition of the reverse technology spillover effect of investment for the home country. This approach further broadens the current research perspective on the factors affecting technology spillover and enriches the theory of OFDI in developing countries based on institutional perspective. This study finds that, regardless of whether the host country is a developed or developing country, informal institutional distance will hinder the absorption and acquisition of the reverse technology spillover effect of the home country, and its impact on the reverse technology spillover effect has a threshold effect. Jiao et al. (2017) used data from Chinese companies as a sample. They found that the cultural distance between countries could be more conducive to the technological learning of Chinese multinational enterprises, which is consistent with this research conclusion [51]. When the host country is a developing country, the hindrance effect is more obvious when the threshold value is exceeded. The informal institutional distance hinders the home country’s reverse technology spillover effect because informal institutional distance increases the difficulty of knowledge replication and understanding by multinational enterprises and increases the internal coordination

cost of multinational enterprises and agency costs [61,62]. As Keig et al. (2019) mentioned, when the cultural differences between the host country and the home country are large, the multinational subsidiaries need to spend more time and effort adapting to the host country's cultural environment [63]. Subsidiaries and parent companies may also have conflicts in internal systems, which is not conducive to the technological learning of Chinese multinationals and the acquisition of reverse technology spillover effects in the home country.

4.4 Practical Contribution

First, this research has important guiding significance for the OFDI strategy formulation in the home country. Considering that the difference in the degrees of development of the host countries will affect the degree of the reverse technology spillover effect of OFDI, the factor of development of the host country should also be considered when a developing country conducts OFDI activities. Moreover, the country's years of investment and investment experience will affect the external effect of OFDI in developing countries. When beginning to invest in other countries, the reverse technology spillover effect obtained from developed countries is significantly higher than that from developing countries. In addition, when a certain investment period is attained, the reverse technology spillover effect obtained from developing countries is more obvious. Therefore, the home country can encourage multinational enterprises to invest in developed countries in the beginning to learn their advanced technology; with the accumulation of OFDI experience, the home country can encourage multinational enterprises to invest in developing countries.

Second, our research has important significance as a reference for the technology learning of multinational enterprises. The technological learning of multinational corporations is affected by many factors, such as the absorptive capacity of the learner, the technological gap between the two parties, and the influence of institutional distance on the learning effect of technology, which cannot be ignored. Moreover, the effect of institutional distance on the effectiveness of technological learning will also be affected by the degree of development of the host country. Our research can help multinational corporations deeply understand the role of institutional distance in technology learning and provide certain suggestions for enterprise technology learning. For example, when companies plan to invest in other countries, they should understand the important influence of institutional distance between countries on their technological learning. They can create opportunities for their technological learning through institutional learning and integration.

Finally, the research in our study has important significance as a reference for multinational corporations when selecting a location. Multinational corporations will consider many factors when selecting a location for OFDI because it is directly related to the success or failure of multinational corporations' outward investment strategy. Therefore, analyzing the influence of the degree of

development of the host country and the impact of institutional distance on the technological learning effect of the home country has important reference value in the location selection of multinational enterprises. Thus, when enterprises plan to invest in other countries, they need to consider their economic conditions as well as the outward investment policy of the home country, the host country's resources, and the investment environment. Multinational enterprises also need to consider the degree of development of the host country and the institutional distance between the home and host countries. These factors are directly related to the technology learning efficiency of multinational enterprises, which is crucial for their long-term development.

5. Conclusions

In the past, researchers mainly analyzed the existence of the reverse technology spillover effect from the overall paradigm and the factors affecting the absorption of the reverse technology spillover effect from the home country's or host country's perspective. Based on previous research, the key constraint is introduced, which is the degree of development of the host country; this constraint reveals the existence of the reverse technology spillover effect. The influence of the institutional differences between the home and host country on the absorption and acquisition of the reverse technology spillover effect is further analyzed. It was found that the degree of host country development has nothing to do with technology spillover acquisition. In addition, there is a large difference between the influence of formal and informal institutional distance on the reverse technology spillover effect, and the impact of the two institutional distances on the reverse technology spillover effect has a threshold effect. This study breaks the application boundary of knowledge spillover effect theory and provides a new understanding of combining knowledge spillover theory with institutional theory.

However, this study also has limitations. The study's limitations are reflected mainly in the following two aspects. On the one hand, our conclusions have reference significance for developing countries that are home countries. However, this study ignores the reverse technology spillover effect from the developed country in a home country perspective.

Therefore, in the future, developed countries should be used as samples to analyze the existence of the reverse technology spillover effect systematically. On the other hand, this study studies the relationship between institutional distance and the reverse technology spillover effect. However, institutional distance includes formal and informal institutional distance, which also contain different subdimensions. Further exploration of how these sub-dimensional institutional distances act on the reverse technology spillover effect is required. In the future, researchers should focus on the impact of these subdimensions on the reverse technology spillover effect.

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