



## Research Paper

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# The role of outward investment of Chinese enterprises in promoting innovation capacity and economic growth

### ABSTRACT

The outward foreign direct investment of China has exceeded 100 billion US dollars over the past 30 years of reform and opening, and for the first time it has become one of the three largest outward foreign direct investment (OFDI) in the world. Under the background of "the Belt and Road" policy, Chinese enterprises are actively exploring the possibility of investing overseas. This study attempts to use empirical analysis methods including econometric model and threshold effect theory to estimate the turning-point value of the effect of OFDI, and to explore the impact and role of Chinese enterprises' overseas investment on the economic growth effect, technological progress effect, industrial structure upgrading effect and trade promotion effect domestically after the threshold level. Finally, this study argues that Chinese enterprises' overseas investment, on the premise after reaching the threshold value, can promote the productivity of domestic economic factors, and then increase the growth of domestic economic output. At the same time, it is conducive to transferring domestic excess production capacity, prolonging product life cycle, making investment enterprises crop more beneficial, and also conducive to promoting the optimization and upgrading of domestic industrial structure and bringing enterprises with a positive export trading effect.

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**Key words:** Outward foreign direct investment, Chinese companies, technological innovation, threshold effect.

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### INTRODUCTION

Driven by the wave of world economic globalization, outward foreign direct investment (OFDI) has become a hot way for enterprises to explore development. More and more enterprises in China are actively exploring the possibility of foreign direct investment, attempting to achieve their own development at the same time. Since 2000, the OFDI of Chinese enterprises has been grown rapidly, and the total amount of OFDI has been expanded greatly. By the end of 2016, China's OFDI stock reached US\$1357.4 billion, and the total OFDI flow reached US\$19.61 billion, exceeding the US\$131 billion for actually utilized capitals that year. This means that China's OFDI has not only exceeded 100 billion US dollars, but also exceeded the actual utilization of foreign capital. In the end of 2017, China's OFDI stock amounted to \$189 billion, accounting for 5.9% of the total global OFDI stock, ranking second in the total global OFDI stock, four times higher than the previous

year. It can be seen that the impact of China's outward FDI in global OFDI is expanding, and occupies a very important position. However, China's OFDI stock is only 23.2% of that of the world's first country US (\$7.8 trillion) (China's Commerce Department, 2017). There is still a considerable gap between them.

From the regional distribution of overseas investment, China has made outward foreign direct investment in more than 190 countries and regions around the world. According to the national bureau of statistics, it showed that in 2016, China's investment of \$130.3 billion with Asian countries, accounted for 66.4% of the total amount of investment, the direct investment of \$20.2 billion in Latin America, accounted for 10.3% of the total investment. The growth rate of foreign direct investment was one of the largest in North America, up from \$2010 in 2.6 billion to \$2016 in 20.4 billion, increased by about 6.8 times. In 2017,

**Table 1:** Investing cycle development theory -- four stages of national economic development.

Stage	Per capita GDP=Y (US dollars)	Features
One	$Y < 400$	No direct foreign investment; no ownership advantage; low foreign capital inflows; investment environment at home is not ideal.
Two	$400 < Y < 2000$	Increased inflows of foreign capital; small amount of foreign investment.
Three	$2000 < Y < 4750$	Increase in foreign investment; increase in foreign investment may exceed the growth rate of foreign investment inflows; negative net foreign investment; start on the road of international production specialization.
Four	$Y > 4750$	Foreign investment exceeds the inflow of foreign capital; reach the level of developed countries; strong ownership advantage; positive and expanding net foreign investment.

the direct investment flows to countries along the "Belt and Road" route were \$20.2 billion, up 31.5% at the year-on-year basis and accounted for 12.7% of China's total OFDI flows in the same period (China's Commerce Department, 2017).

From the perspective of the industry distribution of OFDI, in 2017, China's commercial service, manufacturing, wholesale and retail, financial, and other fields of investment accounting for more than 80% of the total amount of outward foreign direct investment, including leasing, business services, wholesale and retail trade, information transmission and computer services and software industry, the financial industry, mining and manufacturing stock investment scale all over billions of dollars, accounted for 86.3% of China's outward foreign direct investment stock (China's National Bureau of Statistics, 2018).

In general, from 2010 to 2017, the scale of China's OFDI has been increasing, the countries and fields of OFDI have been expanding, and the development trend of OFDI is very good. Therefore, it is of great practical significance to study the role of Chinese enterprises' overseas direct investment on the effect of innovation capacity and economic growth.

## LITERATURE RESEARCH

With the economic development of developing countries, the economic influence of developing countries on the world as a whole is increasing, and the attention of relevant theoretical research on foreign investment to developing countries is also largely focused. Since the 1980s, the theoretical research societies have enriched their research on the behavior of developing countries' outward foreign investment. Some scholars have also reinterpreted the traditional theories of transnational investment so that they can be applied to explain various problems arising in the progress of developing countries' foreign direct investment.

Dunning's (1973) investment development cycle theory explains the relationship between a country's economic development level and the status of international direct investment from a dynamic perspective. According to this

theory, the tendency of a country's OFDI depends on two aspects: first, the stage of its economic development; second, whether the country has the advantages of ownership, internalization and location. At the same time, Dunning divided economic development into four stages according to the level of per capita income (Table 1), and believed that OFDI at different stages had different characteristics. From the perspective of the practice of foreign investment in the world, the transition of the status of international direct investment of developed and developing countries in the world basically has conformed to such a development trend.

Cantwell and Tolentino's (1987) theory of technology accumulation and industrial upgrading is based on Vernon's (1966) theory of product cycle. It emphasizes the important role of experience acquisition, local technological change and technological accumulation in the early stage of FDI. According to this theory, FDI also has its own characteristics of different stages. In his view, the upgrading process of industrial structure in developing countries is due to the improving technological capabilities of enterprises, while the improvement of technological capabilities of enterprises is the result of continuous capital accumulation. Further, the improvement of technological capabilities of enterprises in developing countries is directly related to the growth of their OFDI, and it is concluded that the industrial and geographical distribution of OFDI in developing countries is gradually changing with the passage of time. Thus, it can be predicted according to this theory, which affirms the correlation between outward foreign investment and technological growth in developing countries, and holds that in the process of technological diffusion, developing countries do not blindly imitate and passively accept other technologies, but have certain or partial own innovative capabilities. However, this theory is based on the technological gap between developed and developing countries. Technological innovation in developing countries is also carried out at the end of technological diffusion. It implies the assumption that the OFDI path is irreversible, but it cannot explain the reverse investment of developing countries to developed countries.

According to the research results of Cournot duopoly

model of international investment decision-making established by Fosfuri and Motta (1999), technological upgrading can be achieved through direct investment in technologically advanced countries by technologically backward home companies. On the premise that the technological level of host country is higher than that of home country, OFDI of home country enterprises promotes the improvement of production efficiency and technological level by means of technological diffusion effect, demonstration-imitation effect, industry correlation effect and personnel training effect, thus supporting the theory that OFDI can promote the technological progress of home country. Potterie and Lichtenberg (2001) first introduced OFDI as spillover channel into the international R&D spillover model proposed by Coe and Helpman (1995), and tested the reverse spillover effect of technology-acquired OFDI. They tested the spillover effects of international R&D from 1971 to 1990 in 13 countries, including the United States, Japan and Germany. The results showed that the effect of investment in R&D-intensive countries could be significant if the depth of data collection were strengthened, otherwise it cannot get completely consistent verification conclusions. That is to say, investing in R&D-intensive countries does not improve the productivity of their home countries. Based on the empirical result of Bitzer (2009), the reverse spillover effect of OFDI varies from country to country. They tested the reverse spillover effect of OFDI using industry-level data of 17 OECD countries from 1973 to 2001. The results showed that on average, the impact of OFDI on total factor productivity was negative in OECD countries, but there were significant differences among countries. The reverse technology spillover effect of OFDI in France, Japan, Poland, Sweden, Czech Republic and UK is positive, while the OFDI in Canada, Germany, Denmark, Spain, Finland and Korea has not brought beneficial reverse technological spillover effect to the home country, but has a very significant negative impact. Dierk (2010)'s research on OFDI in 33 developing countries from 1980 to 2005 also found that the reverse spillover effect varied among different countries.

It can be seen that the research conclusions of reverse spillover effect of OFDI are not uniform, and even the opposite conclusions have emerged. However, the reverse spillover effect of OFDI in developing countries is similar to that of OFDI in developed countries. Some relevant studies on OFDI spillover effect show that in developed countries with higher level of economic development and some developing countries with better economic development, the possibility of OFDI spillover effect is relatively large. This is because the host country's effective learning, absorption and imitation of the advanced technology brought by transnational corporations are based on its own level of economic development. It is only when the economic development of a certain region exceeds a certain level can the technological spillover effect of OFDI be fully realized, which is called "threshold effect" in an imagery

term. In fact, "threshold" can be understood as a specific level at which OFDI technological spillover effect begins to have an impact. Only when the "threshold" level is exceeded, can OFDI technological spillover effect be brought into play.

This article intends to derive the threshold value of certain level, on the basis of relevant theories, by constructing mathematical calculation formula and to explain, based on empirical data procedures while obtaining the final estimated valuation, and finally to verify the "threshold effect" in the role of China's foreign direct investment activities and provide comparative analysis of Chinese enterprises foreign direct investment activities in various areas that have a reverse technological spillover effect, respectively.

## MODEL DESIGN

### OFDI reverse technological spillover model

Based on Potterie and Lichtenberg (2001)'s "threshold effect" theory and Coe and Helpman (1995)'s international R&D model, this study empirically examines the existence and regional differences of reverse technological spillover effects of OFDI in China. The regression model of international R&D spillover effect established in this study is shown in Equation (1):

$$\ln TFP_{it} = C + \beta_1 \ln SRD_{it}^f + \beta_2 \ln SRD_{it}^d + \ln AGDP_{it} + \ln RD_{it} + \varepsilon_{it} \quad (1)$$

Where, the TFP is the total factor productivity; the subscript i stands for domestic provinces and cities, and the subscript t stands for year;  $SRD_{it}^f$  represents the stock of R&D capital acquired by domestic provinces and municipalities through OFDI channels during t period;  $SRD_{it}^d$  represents R&D capital stock of domestic provinces and municipalities in t period; AGDP represents the average GDP of each province in China; RD represents R&D investment of domestic provinces. The specific formula used in this study to calculate foreign R&D spillover is shown in Equation (2):

$$SRD_{it}^f = \sum \frac{OFDI_{jt}}{Y_{jt}} SRD_{jt} \quad (2)$$

where,  $SRD_{it}^f$  represents the total domestic R&D capital stock acquired from the spillover of all host country j (the host countries selected for test in this paper include Australia, Bulgaria, Canada, France, Germany, Italy, Japan, South Korea, Malaysia, Singapore, the United Kingdom, the United States, the Philippines, Pakistan and Hong Kong, China);  $SRD_{jt}$  represents the R&D capital stock of host country j;

**Table 2:** Regression results of production function.

Variable	Ln (A <sub>0</sub> )	Ln (K/L)	T	R <sup>2</sup>
Estimated value	0.5827***	0.6980***	-0.2324***	0.593
t-value	(12.4)	(19.45)	(-20.79)	

Note: The brackets are t values, and \*\*\*, \*\*, \* are significant at the levels of 1, 5 and 10% respectively.

**Table 3:** Variable description statistics.

Variable	Obs	Mean	Std. Dev.	Min	Max
Lntfp	300	-0.6788	0.7330	-2.1049	1.1360
Lnsrdd	300	5.0946	1.1431	1.9149	7.6872
Lnsrdf	300	11.0147	2.6853	3.2262	16.6896
Lnagdp	300	10.49341	0.5283	9.2695	11.6801
Lnrdd	300	5.0083	1.3858	0.9555	7.6183

OFDI<sub>jt</sub> represents China's OFDI in period t to the host country j; Y<sub>j</sub> is the GDP of host country j in period t.

Finally, based on the proportion of OFDI stock for each province in the total OFDI stock in China, the SRD<sub>it</sub><sup>f</sup> of foreign R&D capital stock acquired based on OFDI spillover in each province is calculated as shown in the following specific formula (3):

$$SRD_{it}^f = SRD_t^f \times \frac{OFDI_{it}}{\sum OFDI_{it}} \quad (3)$$

where, OFDI<sub>it</sub> is the OFDI stock of i province in the t period.

### Data source and variable measurement

In this study, interprovincial panel data of 22 provinces (except Taiwan), 4 autonomous regions (data of Tibet autonomous region were screened out due to vacancies) and 4 municipalities directly affiliated under the central government were selected from 2007 to 2016. The data were obtained from China's statistical yearbooks, statistical bulletins of China's OFDI, and the Wind database.

Based on the two-factor Cobb-Douglas production function model (4), this study uses the data of output, capital stock and labor input of each province i in time t, and uses the Solow Residual Method to estimate total factor productivity (TFP):

$$Y_{it} = A_0 e^{\gamma T} K_{it}^\alpha L_{it}^\beta \quad (4)$$

where, A<sub>0</sub> represents the technical level of phase 0; γ represents the coefficient of technological progress; t represents the period; α and β are the parameters in the

production function; TFP is defined as Y<sub>it</sub>/(K<sub>it</sub><sup>α</sup>L<sub>it</sub><sup>β</sup>). Assuming that technological progress is Hicks neutral and α+β=1, the following formulas are regressed to obtain the values of α and β, which are measured according to the definition of TFP:

$$\ln(Y_{it}/L_{it}) = \ln(A_0) + \gamma T + \alpha \ln(K_{it}/L_{it}) + \varepsilon_{it} \quad (5)$$

where, L represents the labor input; Y is the output variable, converted according to the GNP index into the GNP in the base period of 2003. K is the fixed capital stock in region i in period t, measured by the perpetual inventory method, and the basic formula used is as follows:

$$K_{it} = I_{it} + (1 - \delta)K_{it-1} \quad (6)$$

where, I is the gross fixed capital formation in the t period of area i; δ is the capital depreciation rate; K<sub>t-1</sub> represents the fixed capital stock in the t-1 period of area i.

### Data analysis

Table 2 shows the TFP results estimated by OLS in STATA software. The regression results show that the fitting degree is good. The regression coefficient is substituted into the formula (5) to calculate the TFP value of each province and city in each year.

The research period of this study is 2007-2016, with 30 provinces as the research object, a total of 300 observation samples are included. The pairs of all variables are selected to reduce heteroscedasticity. Table 3 shows the descriptive statistical table of variables.

In this study, LLC and ADF-Fisher test are used to test the unit root of panel data variables to determine the stability of variables. The results show that the variables are stable

**Table 4:** Unit root test results of panel data.

Variable	lnTFP	ΔlnTFP	lnSRD <sup>d</sup>	ΔlnSRD <sup>d</sup>	1nSRD <sup>f</sup>	Δ1nSRD <sup>f</sup>
LLC	-26.1781***	-34.637	-8.5167***	-3.4667	-3.9439***	-10.522
P value	(0.0000)	(0.0025)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
ADF-Fisher	543.7214	69.0072	905.4991	176.3372	12.8531	185.548
P value	(0.0000)	(0.1992)	(0.0000)	(0.0000)	(1.0000)	(0.0000)

  

Variable	lnAGDP	ΔlnAGDP	lnRD	ΔlnRD
LLC	-8.5358***	-5.2801	-21.0806***	-7.6412***
P value	(0.0000)	(0.2592)	(0.0000)	(0.0000)
ADF-Fisher	183.7870	83.6866	647.8112	77.8606
P value	(0.0000)	(0.0153)	(0.0000)	(0.0604)

**Table 5:** Model setting test.

Test method	Statistic value	P value	Conclusion
F test		0.0000	Refusal of mixing effect
LM test		0.0000	Refusal of mixing effect
Hausman test		0.0000	Rejection of random effects

**Table 6:** Overall LSDV estimation results.

Variable	C	lnSRD <sup>d</sup>	lnSRD <sup>f</sup>	lnRD	lnAGDP	Adj-R <sup>2</sup>	F-value
Estimates	12.1242***	-0.0645	0.04335***	-0.7907***	-0.8575***	0.9593	1514.90***
t-value	(15.27)	(-1.44)	(2.84)	(-10.40)	(-7.91)		

Note: \*\*\*, \*\*, \* are significant at the levels of 1, 5 and 10% respectively.

**Table 7:** Estimation of random effect model in sub-area.

Variable	C	lnSRD <sup>d</sup>	lnSRD <sup>f</sup>	lnSRD <sup>f</sup> ×East	lnSRD <sup>f</sup> ×Central	Adj-R <sup>2</sup>	Wald-Val
Estimates	2.8222***	-0.6110***	-0.1107***	0.1346***	0.04833***	0.8449	307.69***
t value	(12.18)	(-9.50)	(-2.98)	(9.23)	(3.3)		

Note: \*\*\*, \*\*, \* are significant at the levels of 1, 5 and 10%, respectively.

after the first order difference except GDP per capita (Table 4).

In this study, F test, LM test and Hausman test are used to determine whether panel data have mixed effect, fixed effect and random effect. The results of three tests show that the fixed effect model is the most suitable one (Table 5).

Table 6 shows the regression results of estimating the national sample using a fixed-effect model. In the regression results, the regression coefficient of domestic R&D capital stock is negative, passing the 1% significance test, indicating that domestic R&D capital stock significantly inhibits the improvement of production efficiency.

The regression coefficient of foreign R&D capital stock is positive and has passed the 1% significance test, which shows that there is spillover effect in foreign R&D capital stock.

The regional differences of technological spillovers of outward investment are further compared. Table 7 shows the results of regression of sub-regional situations using the random effect model. Introducing new variables in the equation lnSRD<sup>f</sup>×Central and lnSRD<sup>f</sup>×East respectively in Eastern and Central regions of foreign R&D capital, shows that the lnSRD<sup>f</sup>×Central and lnSRD<sup>f</sup>×East coefficients are positive, having passed the test of significance of 1%. That is, the Central and Eastern part of technological spillover effect offsets the negative effect by the Western part which is -0.2936, while the positive technological spillover effect of East (0.1346) and Central (0.0483) shows that obtaining foreign R&D capital stock increases production efficiency in these regions.

The threshold estimates and corresponding 95% confidence interval values are shown in Table 8. The results show that the threshold estimate of per capita GDP is

**Table 8:** Threshold estimation results.

Threshold variable	Estimated value	95% confidence interval
AGDP	26860.00	(26433.00, 27264.00)

**Table 9:** Estimation results of threshold model.

Threshold	lnSRD <sup>f*0</sup>	lnSRD <sup>f*1</sup>	lnSRD <sup>d</sup>	lnRD	lnAGDP	C	R-sq
GDPP	0.0280*	0.0359**	-0.0530	-0.7758***	-0.9388***	12.9525***	0.9601
t-value	(1.68)	(2.31)	(-1.21)	(-10.24)	(-8.24)	(14.82)	

Note: \*\*\*, \*\*, \* are significant at the levels of 1, 5 and 10%, respectively.

26,860 RMB yuan.

Table 9 shows the result of threshold effect regression, dividing per capita GDP into two levels: low (less than 26,860 yuan) and high (more than 26,860 yuan). When the GDP per capita is low, the technological spillover effect of OFDI is low, and its elasticity coefficient is 2.8%. When the GDP per capita crosses the above threshold, the elasticity coefficient of technology spillover effect of OFDI begins to increase, exceeding 3.59%.

## SUMMARY

Through the data application of 30 provinces, cities and autonomous regions from 2007 to 2016, the following analysis results can be reliably obtained:

- 1). Under the fixed effect model, the regression coefficient of domestic R&D capital stock is negative, and the significance test of 1% is passed, indicating that domestic R&D capital stock significantly inhibits the improvement of production efficiency. The main reason is that the domestic R&D capital stock is not technologically intensive, which leads to the embarrassing situation that the R&D investment is more and the efficiency cannot be improved.
- 2). The regression coefficient of foreign R&D capital stock is positive, and has passed the 1% significance test. It shows that there is spillover effect in foreign R&D capital stock. The R&D capital investment of Chinese enterprises in the progress of overseas direct investment has a promoting effect on the improvement of domestic production efficiency. This result is also very consistent with the reality. China has indeed achieved its own economic growth in outward foreign direct investment, and the production efficiency has also been greatly improved. The gap between China and developed countries in production technology and production efficiency has been narrowing.
- 3). The regression coefficients of lnSRD<sup>f\*East</sup> and lnSRD<sup>f\*Central</sup> are both positive through the stochastic effect model, and the 1% significance test shows that there is a positive technological spillover effect in the Eastern and Central regions. These two regions improve production

efficiency by obtaining foreign R&D capital stock. For the regression coefficients, the technological spillover effect in Eastern China is higher than that in Central China.

## INSPIRATION AND SUGGESTIONS

### Inspirational facts

According to the conclusion of the above data analysis, although the reverse technological spillover effect of China's OFDI is positive, the magnitude is not obvious, and the technological spillover of OFDI in different regions also has different feedback effect. In summary, the conclusion that "the technological spillover effect in the Eastern region is higher than that in the Central region" shows that the technological spillover effect is closely related to the economic development level of the OFDI activities. The reverse technological spillover effect is more obvious in the regions with high economic development level and high production technological level. In the process of OFDI, the economic level and technical level gap between the countries of investment and the target countries must be taken into account.

"One Belt and One Road" is a big background of China's OFDI and an opportunity for win-win development between China and countries along the route. But we must recognize that the problem of China's OFDI. A prominent problem in China's foreign investment is the international image of China. Although China has made great efforts to publicize its goodwill purposes and this situation is constantly improving, there is still a voice of "China's investment threat theory" in the international arena. It is undeniable that China's OFDI in under-developed countries is mostly energy acquisition type, and it does not pay enough attention to local environmental policies, labor laws, social risks or even religious beliefs during the investment stages, so it is easy to encounter resistance or opposition from hosting countries (Leung and Zhao, 2013).

At the same time, the failure rate of China's OFDI is high and the cost of failure is painful. Between 2005 and 2014, about 1,500 OFDI projects of China had a transaction value

of more than \$1 million, among which about 150 projects failed all due to non-market reasons, involving a transaction value of \$245.9 billion (Scissors, 2015). For instance, the failure of investment in Australia, the United States and Germany is more significant, and the total amount involved accounts for 40% of the total amount of China's foreign investment failure (China Global Investment Tracker, 2014).

Although China's OFDI is not necessarily able to achieve full positive returns, it is undeniable that OFDI can still play a positive role in stimulating China's economics. The potential comparative advantages of OFDI must be taken into account, which will not automatically translate into economic benefits. Only by transforming into international competitiveness or competitive advantages in the progress of OFDI can its comparative benefits be effectively realized. And whether it can be transformed depends on the investment decisions and operational efficiency of specific enterprises and specific markets (Nie, 2001).

According to Mathews (2002), OFDI of developing countries enjoys an ownership advantage not at the enterprise level, but through an international Linkage. The success or failure of OFDI in developing countries lies not in monopolizing resources, but in better Leverage and utilization of resources through cooperation with developed countries. The formation of this competitive advantage must be through frequent Learning. Such a Mathews' view, known as the L-L-L pattern model, actually sees OFDI as a means for developing countries' multinationals to acquire strategic assets such as technology, human capital and brands that they lack.

China can also take foreign direct investment as a way to seek its own economic development, and improve its economic level and production technology through outward foreign direct investment. However, this requires careful selection of objects of foreign direct investment, as well as appropriate and stable ways of outward foreign direct investment.

## Suggestions

Based on the analysis of results of the provincial panel data of China's OFDI and the discussion on the existing problems of China's OFDI, we put forward the following suggestions, hoping to serve as a reference for China's OFDI activities:

1). The target of China's OFDI can choose countries that are close to China's similar level of development, but complementary to China in terms of resources, to achieve a win-win strategy of promoting technology and resources complementarity and common development by means of OFDI, or countries with relatively higher economic level than China, to escalate the total level of economy and production technology through OFDI.

2). Correct international publicity should be given to China's outward foreign direct investment. Make good use

of domestic and foreign media, do a good job in diplomacy and public relations, and set up a positive image of a friendly, honest and responsible country for the international community. Better publicize the positive role of China's OFDI in the host country's economy and employment, highlight the similarities and universality between China and other countries, and increase the international community's correct understanding and acceptance of China's OFDI.

3). Sign two-way investment agreements with mature international countries, which can increase the confidence and enthusiasm of Chinese enterprises to "go global", improve the success rate of Chinese enterprises' outward foreign direct investment, reduce the risk of failure, and play a role in promoting and guaranteeing the outward investment of private enterprises.

4). According to the difference of economic development in the Eastern and Western regions, different OFDI host country's guidance should be implemented in different regions. Large regions such as the East, the Central and the Western can also be further divided into small areas according to the level of economic development, so as to achieve more accurate targeting of OFDI.

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