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Zheyi Liu†

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1 . Introduction

Along with the process of world economic integration, foreign direct investment (FDI) plays more and more important role in China's economic growth. China is one of the most successful developing countries in attracting FDI. Among the largest FDI recipients, China rose to second place after the United States in 2009[1]. Meanwhile, China's fast growing trade surplus help the government accumulate its foreign reserves to a large amount. Therefore, currently China's purpose of attracting FDI has changed from taking the advantage of capital accumulation effect in the beginning of the reform and opening up into exploiting the advanced foreign technology spillover effect of FDI.

Previous research has focused on the issue of how inflows of FDI impact on economic growth. FDI could exert a positive influence on economic growth through the transfer of advanced technology and spillover efficiency. However, such a positive contribution of FDI is strongly dependent on the circumstances in the host country. Only recent years, attention has been paid to the role of financial development on the relationship between FDI spillover and economic growth. There are several ways in which a higher level of financial development allows the domestic country to take advantage of FDI more efficiently. Firstly, in order to imitate and

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1) See *World Investment Report 2010*.

learn from the new foreign technology, local firms need to alter everyday activities, buy new machines and hire new managers and skilled workers. The greater the technological-knowledge gap between their current practices and new technologies, the greater the need for external finance (Alfaro et al., 2004). In addition, the presence of an efficient financial system facilitates FDI to create backward linkages, which are beneficial to the local suppliers in the form of improved production efficiency (Javorcik, 2004). Therefore, the level of financial development in one region affects its capability to absorb the FDI spillovers.

When refer to the case study of China, the research of Li and Zeng (2009) points out that FDI spill-over effect depends on the development level of the host country's financial market, and a well developed financial market could have a positive impact on FDI spill-over effect by lowering the threshold for undertaking enterprises. Their research results imply that the difference on absorptive capacity of FDI technology spill-over effect which is caused by the different development level of the regional financial market could be an important explanation to China's current imbalanced regional economic growth. Pan and Lin (2006) study the relationship between economic development strategy and economic convergence through a theoretical model. When they analyze the absorptive capability of FDI spill-over effect, they discover that technological gap between local enterprises and foreign investment is an important factor which affects the spill-over effect of foreign investment. If the gap between foreign technology and local technology is small, it is beneficial for local enterprises to learn the advanced technology from foreign enterprises, thus generating positive spill-over effects of technology. However, their research does not consider the role that financial development played in the absorptive capability of FDI spill-over effect, which has been concluded by many scholars in their research. Meanwhile, Pan and Lin's research could not explain why under the same development strategy China's economy suffers imbalanced development paces among regions.

This paper further explores the relationship among financial development, FDI spill-over effect (especially the technological gap between local and foreign enterprises) and regional economic growth in China. The main contribution of this paper is that for the first time an attempt is made to link the two strands of literature by examining the absorptive capability of FDI spillovers considering both financial development and technological gap between local and foreign firms. We use panel data of China's 31 provinces from 1998 to 2007 to carry out the econometric tests. The empirical analysis supports our theoretical hypothesis that financial development and technology gap play an important role in a region's absorptive capability of FDI spillovers, as well as in regional economic growth. At present, the low efficiency of financial market and the introduced foreign technology which is beyond local enterprises absorptive ability

are not beneficial for the positive effect of FDI spillover in China.

The remainder of the paper is organized as follows. Section 2 reviews the relevant literature and proposes the hypothesis of this paper. Using China's macroeconomic panel data, Section 3 carries out the econometric tests to examine the hypothesis from the previous theoretical discussion. Section 4 summarizes the econometric test results and gives the relevant analysis. Section 5 concludes.

2 . Theoretical Analysis and Hypothesis

Technology diffusion plays a central role in the process of economic growth[2]. Easterly et al. (1994) summarizes that technology diffusion can take place through a variety of channels including imports of high-technology products, adoption of foreign technology and acquisition of human capital through various means. Besides these channels, foreign direct investment by multi-national enterprises (MNEs) is considered to be a major channel for the access to advanced technologies by developing countries. MNEs are the most technologically advanced firms in the world, and they are willing to invest in the research and development to keep their technological advantages. Some papers on economic growth have highlighted the role of foreign direct investment in the technological progress of developing countries. Findlay (1978) assumes that FDI increases the rate of technological progress in the host country through a contagion effect from the more advanced technology used by the foreign enterprises. Wang and Blomstrom (1992) incorporate this idea into a model by postulating that the increase in knowledge applied to production is determined as a function of FDI. Javorcik (2004a) uses the firm-level data from Lithuania and finds the evidence of positive spillovers from FDI taking place through backward linkages.

When referring to the determinant factors of FDI spillovers, the existing literature could be summarized into five main categories: absorptive capability and technological gap, regional effect, domestic firm characteristics, FDI characteristics and other factors. Among these factors, absorptive capability together with technological gap has been studied in most detail. With the globalization trend of the world economy, scholars pay more attention to FDI technology spillover effects on the host country, especially the absorptive capacity of the host country and the technological gap between host enterprises and multi-national enterprise (MNEs). Using the definition of Narula and Marin (2003), 'absorptive capacity' includes the ability to internalize

2) Previous research on technology diffusion includes Nelson and Phelps (1966), Jovanovic and Rob (1989), Grossman and Helpman (1991), Segerstrom (1991) and Barro and Sala-i-Martin (1995).

knowledge created by others and modifying it to fit their own specific applications, processes, and routines' (Narula and Marin, 2003). It is maintained that domestic firms must have a moderate technological gap with MNEs in order to benefit from the higher technology associated with MNEs. If the technological gap is too small, MNEs will transmit few benefits to the domestic firms (Kokko, 1994). However, the gap must not be too wide, as this will impede the domestic firms from absorbing the MNEs' technological advantage. From the above literature, we assume that the increase in the technological gap between local and foreign firms will lower the absorptive capability of local firms to obtain higher level of foreign technology.

The next question is about the conditions in the host country that are important to maximise the FDI spillovers. Technology diffusion is not an automatic and direct effect with introducing foreign investment. It needs the host country to have the supportive infrastructures to improve or enhance the capability to absorb and adopt the advanced technology. Some scholars maintain that the adoption of new technologies requires inputs from the labour force that is able to understand and acquire the new technology (Borensztein, et al., 1998). Other authors stress the role of intellectual property rights (Javorcik, 2004b) and the different trade policy (Balasubramanyam et al., 1996) in the process of technology spillovers.

Hermes and Lensink (2003) are the innovators who explain FDI spill-over effects to host country's economic growth from the perspective of financial development. They argue that the development of the financial system of the recipient country is an important precondition for FDI to have a positive impact on economic growth. A developed financial system positively contributes to the process of technological diffusion associated with FDI. Using cross-country data, Alfaro et al. (2004) show that countries with well-developed financial markets gain significantly from FDI. Well-developed financial market favours the occurrence of FDI spillover as it reduces the risks inherent to the investment made by domestic firms seeking to imitate the MNEs' technologies or to upgrade the qualifications of their employees. Concluding from the existing literature, we assume that if the financial market is well developed, it could be more effective for local enterprises to absorb FDI technology spillover effect.

The existing literature separately considers the influence of either financial development or technological gap to the FDI spill-over effect. However, we presume that both the financial development level and technological gap could affect the absorptive capability of FDI spillovers. The crucial assumption is that the regional financial system influences regional economic growth through the level of technological gap between local and foreign enterprises. For domestic firms, investment aiming at upgrading existing or adopting new technologies is more risky than other

investment projects. A well-functioned financial system may help reduce these risks, thereby stimulating domestic entrepreneurs to actually undertake the upgrading of existing technologies as well as imitating and learning new technologies introduced by MNEs (Huang and Xu, 1999). The same holds in case the firms aim at upgrading the skills of their employees, and these investments also need financing. In this way, financial development favours the increasing of absorptive capability of local enterprise. Furthermore, foreign firms may also need to borrow in order to extend their innovative activities in the host country, which could further increase the scope for technological spillovers to local firms.

Under certain condition of financial development, FDI technology spill-over effect, which results from technological gap between domestic and foreign investment, could exert an influence on regional economic development. Due to the different financial development level of the regions, the optimal imported technology level could also differ among regions. If the development level of the regional financial market is very low, then financial market allocates capital inefficiently, which weakens region's absorptive capability of FDI technology spill-over effect, and no positive technology spill-over effect could be gained from the MNEs. Meanwhile, if the financial market is highly developed in one region, which suggests a high absorptive capability, this region could introduce more advanced technology. Therefore, according to the different development level of region's financial market, there are differently appropriate technological gap between local and foreign enterprises making each region maximize FDI technology spillover effect to promote regional economic growth.

In China, the development level of financial markets among regions is imbalanced. This suggests that even if all the regions in China introduce the appropriate foreign technology according to their financial development level, because of the different development level of financial markets among regions, regional economic growth speeds differ. However, as a matter of fact, regions may not introduce the best suitable level of FDI technology. Under the guidance of catch-up strategy, most regions tend to introduce more advanced foreign investment technology (Pan and Lin, 2006). In such circumstances, on one hand, the backward regions' financial market is relatively underdeveloped, which makes these regions' absorptive capability of FDI spill-over effects weak; on the other hand, the technology gap between backward regions and foreign investment is larger than the gap between developed region's and foreign investment, which further reduces the backward regions' absorptive capability on FDI technology spill-over effect. Therefore, based on our previous theoretical discussions, we propose our hypothesis as follows.

Because of the low efficiency of financial market in China, the technological gap which could maximum FDI technology spillovers is actually small. However, under the guidance of catch-up strategy, regions prefer to introduce more advanced technology, which is beyond their absorptive capability. All these lead to the negative FDI technological spill-over effect in China today.

3 . Econometric Tests

3.1 Model and Data

According to the theoretical analysis above, we set the econometric model as follow:

$$g_{it}=\alpha+\beta FINANCE_{it}+\chi FDI_{it}+\delta TECH_{it}+\gamma FDI_{it}\times FINANCE_{it}+\rho FDI_{it}\times TECH_{it}+\psi CON_{it}+\zeta_{it} \qquad (i=1,\ 2...,\ 31\ ;\ t=1,\ 2...,\ 10)$$

Where the dependent variable g_{it} stands for the economic growth rate of region i at the year t, CON_{it} is a vector of control variables, ζ_{it} is an error term. The indicators used in this paper are explained as follows.

Our dependent variable is g. It is an indicator of economic growth rate, measured by the log of real GDP growth rate of each region.

Our explanatory variables are the following. FINANCE is the indicator measuring the level of financial development. This paper uses the proportion of financial institutions' loans which are issued to non-stated owned enterprises (non-SOEs) to the total loans. It measures one region's marketization level of allocating financial resources[3]. For a long time, the SOEs and non-SOEs suffered differential credit conditions in China. The share of bank credits obtained by non-SOEs is much lower than its share of output. Therefore, we use this indicator to approximately reflect regional financial development.

TECH is the indicator of technological gap, which reflects the labor productivity gap between local and foreign firms in one region. Considering the availability of data, this paper defined it as the ratio of value added per employee in non-domestic funded enterprises[4] to value added per employee in domestic enterprises. This is an indirect measure of the technological gap discussed by Findlay (1978) and Wang and Blomstrom (1992).

FDI is the indicator of inflow foreign direct investment, measured by the ratio of regional FDI amount to regional GDP.

The other control variables in this paper include INVEST, OPEN and EDU.

INVEST is the indicator of domestic fixed assets investment share in GDP.

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3) The data is from *NERI Index of Marketization of China's Provinces 2009 Report*.

4) Non-domestic funded enterprises refer to one region's industrial enterprises funded by entrepreneurs from Hong Kong, Macao, Taiwan and foreign countries.

EDU is the indicator of education level, calculated by the ratio of numbers of enrollment students of higher education to the regional population. EDU measures human resource development. OPEN is the indicator measures the openness level of foreign trade in one region. It is calculated by the total amount of regional import and export share in its GDP.

In order to examine the influence of financial development and technological gap to FDI spill-over effects, we introduce interactive terms FINANCE*FDI and TECH*FDI. FINANCE*FDI measures the effect of FDI spillover which is determined by the level of regional financial development. TECH*FDI describes the absorptive capability to the FDI spill-over effect when considering the technological gap between domestic and foreign enterprises.

This paper uses panel data of 31 provinces from 1998 to 2007 to carry out the econometric tests. Data used in this paper comes mainly from various issues of Statistical Yearbooks (*China Statistical Yearbook, Almanac of China's Finance and Banking* and *China Industrial Economy Statistical Yearbook*).

3.2 Descriptive Statistics

Table 1 Descriptive Statistics for the Variables

	g	FDI	FINANCE	TECH	INVEST	EDU	OPEN
Mean	2.395	0.557	6.061	1.483	0.427	0.009	0.315
Median	2.379	0.309	5.979	1.440	0.407	0.008	0.107
Maximum	2.650	2.623	10.153	3.182	0.652	0.028	1.489
Minimum	2.193	0.070	2.187	0.474	0.299	0.004	0.049
Standard Deviation	0.096	0.595	1.790	0.651	0.086	0.005	0.416
Skewness	0.522	1.913	0.295	0.964	1.195	2.101	1.860
Kurtosis	3.348	6.274	3.620	4.022	4.187	7.293	5.161
Jarque-Bera (Probability)	1.564 0.457	32.745 0.000	0.946 0.623	6.155 0.046	9.198 0.010	46.614 0.000	23.903 0.000
Observations	31	31	31	31	31	31	31

Table 1 provides basic descriptive statistics for the dependent variable, that is, the log of real GDP growth rate (g) and all the explanatory variables. All the variables are average values for the 1998-2007 period. From the Table 1, we could know that the standard deviations of the variables FDI, FINANCE and TECH are relatively greater than other variables, which suggests the level of financial development, the inflow of FDI and technological gap are inequality among the provinces of China. The Jarqie-Bera test values show that only the variables g and FINANCE are normally distributed. The distribution of other variables is skewed. Since most

variables are not normally distributed, we could not use the OLS regression.

Figure 1　Trends of the Variable g and FINANCE

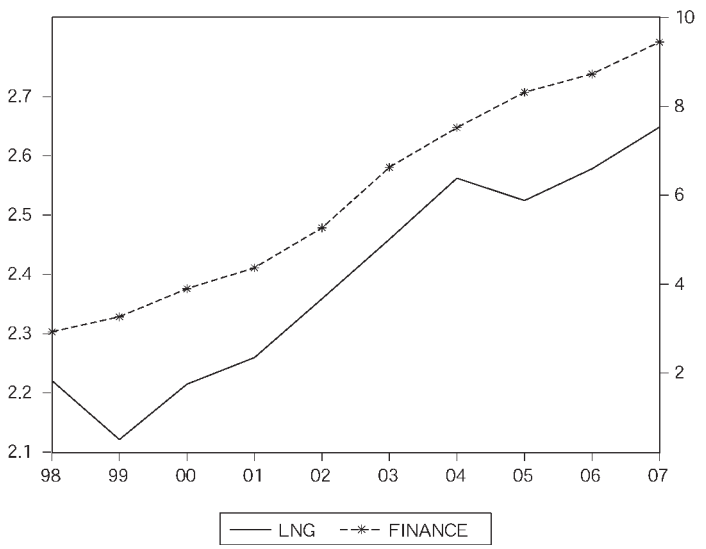

Figure 2　Trends of the Variable g and FDI

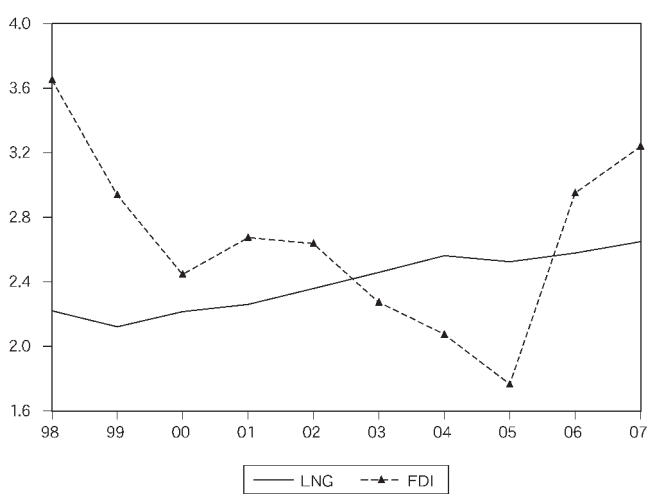

Figure 3 Trends of the Variable g and TECH

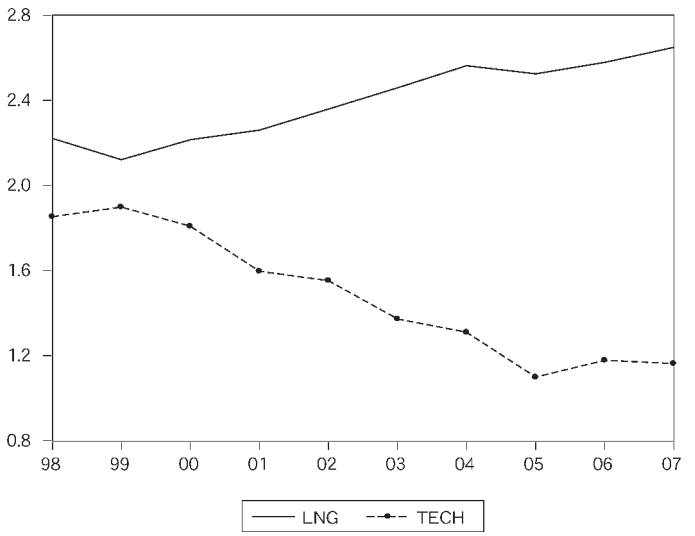

Figure 1-3 show the general trends of the dependent variable g with the main three variables respectively. Based on the panel data set, we average the values of 31 provinces and get one value for each year in order to observe the time tendency between the variables. In figure 1, the variables of FINANCE and g show the same upward tendency during the period 1998-2007. In figure 3, variable TECH shows the opposite downward tendency to the dependent variable g. These results support our assumption in section 2 that financial development is positively related to the economic growth rate, while technological gap between domestic and foreign enterprises is negatively related to the economic growth rate. However, the changing trends between FDI and g are not clear. In figure 2, the line of variable FDI is fluctuant. Since the year of 1998, the share of FDI in GDP keeps decreasing until 2005, and after that it shows the tendency of upward movement. Although the absolute amount of inflow FDI is increasing ever since 1998, the relative scale of FDI to regional GDP ratio does not always show the trend of upward going. The relationship between the economic growth rate (g) and FDI needs further test.

4 . Test Results and Analysis

The analysis starts by estimating some base equations, that is, the interactive terms and control variables are not yet included in the regression models. The results of these estimations are presented in column [1] and column [2] in Table 1. Then we include all the variables and the results are presented in column [3].

There are two models which are fixed effect model and random effect model that we could use to estimate the panel data set. For each equation, Hausman test is firstly carried out to decide the most suitable model. The results of appropriate model type for each equation are also concluded in Table 2.

Column [3] in Table 2 shows that all the estimated coefficients of variables are significant and equation's goodness of fit is high, which indicates that the estimated results are statistically significant.

The coefficient of FINANCE is positive at 1% significant level, which indicates that when not considering financial development influence on FDI spill-over effect, financial development has a positive effect on economic growth. This is consistent with most scholars' research: a more developed financial system positively contributes to a region's efficiency of financial resources allocation thus promote economic growth in the region.

In column [2] the variable FDI does not have a significantly positive direct effect on economic growth. This may be interpreted that without additional requirements or environments FDI does not enhance economic growth of a region[5]. After adding all the variables, in column [3] the coefficient of variable FDI becomes negative and significant, which suggests except for FDI spill-over effect, FDI has a negative effect on regional economic growth. The possible explanation could be that nowadays in China the capital accumulation effect of FDI is not as important as twenty years ago. These years China's fast growing trade surplus has brought a large amount of foreign reserves, and in the new century the purpose of attracting FDI has changed to take advantage of FDI spill-over effects.

The outcomes in column [3] show that the estimated coefficient of the interactive term FINANCE*FDI is negative at 5% significant level, which indicates that financial development has a negative effect on FDI spill-over effect. According to our theoretical analysis, the level of financial development plays an important role in the absorptive capability of FDI spill-over effect, and if financial development is at a low level, which means the efficiency of financial resources allocation is low, then the absorptive capability of FDI spill-over effect will be hampered. Zhao and Zhang (2007) point out that negative technology spillover of FDI results from China's process of financial deepening lagging behind the inflow of FDI. As a result, domestic enterprises especially non-state owned enterprises have difficulty in their financing, and it is not advanta-

5) This result is consistent with the empirical results which are done by Hermes and Lensink (2003).

Table 2 Financial development, FDI and Economic Growth

	[1]	[2]	[3]
FINANCE	0.0529*** (18.13)	0.0470*** (15.87)	0.0166*** (5.75)
FDI		0.0055 (1.03)	-0.0280*** (-3.96)
TECH		-0.0873*** (-5.99)	-0.0445*** (-4.28)
FDI*FINANCE			-0.0014** (-2.52)
TECH*FDI			0.0215*** (5.31)
INVEST			0.7577*** (9.87)
OPEN			0.0110** (2.17)
EDU			0.0021*** (10.19)
C	2.0750*** (106.97)	2.2266*** (60.00)	1.8457*** (51.45)
R^2	0.59	0.64	0.86
F-statistic	15.22	17.18	51.53
Model Type	Fixed effect	Fixed effect	Fixed effect
P-value of Hausman test	0.0012	0.0000	0.0000

Note: Dependent variable: g. Amount of all observations in all regression: 308. Values in parentheses are t-values. * denotes significance at the 10 percent level; ** denotes significance at the 5 percent level; *** denotes significance at the 1 percent level. R^2 is the adjusted R^2.

geous for the development of FDI relevant industries. It leads to the crowding out effect of FDI which is more obvious than the spill-over effects. The research of Yang and Lai (2006) also indicate that the low efficiency of China's financial market could not adapt to the market demanding finance, which is not favourable for the absorption of FDI technology spill-over effect.

The other interactive term TECH*FDI is positive and significantly related to the dependent variable g, where TECH alone is significantly negative as shown in column [3]. The estimated coefficient of TECH is negative at 1% significant level, which indicates that under the circumstance of not considering absorption of FDI technology spill-over effect, if the technology gap between domestic and foreign investment is too wide, it could have a negative effect on the growth of regional economy. The estimated coefficient of the interactive term TECH*FDI is positive at 1% significant level. This result suggests that the late-development advantage of the

technology in the relatively underdeveloped areas is more obvious. Within the absorptive capability of one region, the more advanced technology it introduces, the more favourable FDI spill-over effect will promote regional economic growth. The opposite signs of TECH and TECH*FDI imply that when introducing foreign advanced technology, it does not mean that the more advanced the better. We should also consider one region's absorptive capability to the FDI spill-over effect. If a region could take full advantage of FDI spill-over effects, then this region should be encouraged to introduce more advanced foreign technology.

Comprehensively considering the signs of all the main explanatory variables, we could conclude that, on the one hand, provinces are beneficial if they introduce more advanced technology of FDI to take advantage of its spill-over effects. On the other hand, the low efficiency of China's financial system reduces the absorptive capability of FDI technology spill-over effect. As a result, the optimal technology gap between local and foreign investment, which could make regions to maximize FDI technology spill-over effect, is quite small. This means that actually the regions could only grasp less advanced technology of FDI.

The estimated coefficient of INVEST is positive at 1% significant level indicating that the higher the percentage fixed assets investment to GDP is, the more is the effect on economic growth. The estimated coefficient of OPEN is positive at 5% significant level, showing that the increase in trade openness is conducive to the improvement of economic growth rate. The estimated coefficient of EDU is positive at 1% significant level, indicating that the improvement of the level of education plays a certain role in promoting the increase of economic growth rate. This outcome also suggests that a high level of human capital has a positive effect on economic growth.

5 . Conclusions

Both the theoretical analysis and econometric test show that the level of financial development and the technology gap between introduced foreign advanced technology and local technology play an important role in one region's absorptive capability of FDI technology spill-over effect, as well as in regional economic growth. At present, the low efficiency of financial market and the introduced foreign technology which is beyond local enterprises absorptive ability are not beneficial for the positive effect of FDI spill-over. On the one hand, the low efficiency of China's financial system reduces absorptive capability of FDI technology spill-over effect. As a result, the optimal technology gap between local and foreign investment, which could make regions maximize FDI technology spill-over effect, is quite small. This means actually that the regions

could only grasp less advanced technology of FDI. On the other hand, under the guidance of catch-up strategy, regions introduce more advanced technology of FDI, which is much higher than what local enterprises could absorb. This further lowers the absorptive capability of FDI technology spill-over effect. These are the important reasons for the negative effect of FDI spillover in China today.

In order to narrow the disparity of regional economic growth, besides the government policy support to the middle and west areas, these relatively backward regions need to improve the existing financial market and enhance the efficiency of financial market in the allocation of funds. Meanwhile, when introducing FDI, regions should estimate the level of existing technology and then introduce the most favourable foreign investment which could bring FDI technology spill-over effect into play. In addition, developing education and improving the quality of human resources are also available options for promoting the growth rate of regional economy.

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