

## 第六部分：讀一篇要大改的文章

附上的論文是某作者投稿用的第一稿。他肯投出去，大概以為沒有問題了。我拿掉了原作者的名字和機關，為省空間，也拿掉了所附的圖和表，因為我的目的不是要讓大家搞懂這論文。

這是典型的國人用英文寫的論文——大、小毛病一大堆。最後被接受的形式，和下面所顯示的頗不相同。

請挑出所有你能挑出的毛病（包括大小寫的不當和標點的小錯）。用紅筆在錯的地方註上就好。

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### The impact of FDI on regional innovation capability: a case in China

**Abstract:** FDI have been traditionally considered as an important channel in the diffusion of advanced technology. Whether it can promote technology progress for the host country or not is a focused problem in recently decades. This paper analyzes the relationship between FDI and regional innovation capability (RIC). We find that the spillover effects of FDI are not significant as we usually thought. The impact of FDI on RIC is weak; the entry of FDI has no use for enhancing indigenous innovation capability. The research manifests, increasing domestic R&D inputs, strengthening the innovation capabilities and technology absorbency in domestic enterprises are determinants to improve RIC.

**Key words:** FDI, less developed countries, regional innovation capability, spillover effect, the level of entrepreneurship

#### 1. Introduction

Multinational companies (MNCs) play an important role in the process of global economic integration. Through capital outward, MNCs maintain tight connection with the international economy. The foreign direct investment (FDI) concomitant with MNCs has already become vital source for many less developed countries (LDCs) to obtain international capitals and advanced technology increasingly. Chinese government always attaches lots of importance to attracting foreign investment since the reformation and the "open-door" policy was carried. They implemented the "market for technology" policy, and tried to facilitate the technological progress through attracting inward FDI. China has already

received the total amount of foreign investments over 562.1 billions dollars until the end of 2004, and since 1993 China has been the largest FDI recipient in the LDCs. In 2003, despite of the breakout of the epidemic SARS, the amount of inward FDI reached 53.505 billions dollars which surpassed America and made China become the most inward FDI country all over the world. In 2004, the amount of inward FDI reached 60.63 billions dollars. Now the ratio of FDI to GDP has surpassed 40 percent. [Gong, 2005]

FDI is the important driving force to boost economic development in China. The impact of FDI has penetrated into many aspects of the national economy with the increase of total amount. The negative function appeared gradually such as the homogeneous expansion of Chinese manufacturing and the international trade dissension because of the excessive reliance of FDI and FDI technology. How about the strategic effect of the "market for technology" policy? Does FDI facilitate the technology progress in domestic enterprises? More and more Chinese scholars begin to think about the FDI strategy retrospectively. Many international scholars plunged into the vehement dispute.

As the main way of international capitals fluxion, the impact of FDI on the economy and technology to the host country has been paid more and more attention by international researchers. Many researches showed that FDI was important to facilitate economic development and technological progress for the host country, especially for the developing countries [Kokko, 1994; Kokko et al., 1996; Sjöholm, 1999; Borensztein et al., 1998]. However, the empirical research on the spillover effects of FDI didn't support standpoints above. Recently some empirical researches indicated that the spillover effects of MNCs were weak, and the positive effects of FDI on economy development should have some certain conditions [Young, 1992; Haddad and Harrison, 1993; Kokko, 1994; DeMello, 1996, 1997]. For many LDCs, the correlation between FDI and technological progress or productivity growth was not significant, except for those export-oriented countries [Balasubramanyam, Salisu, and Sapsford, 1996] and those countries having high-level of human capitals [Borensztein, DeGregorio, and Lee, 1998].

Whether FDI can bring the technology progress in China? Chinese scholars also have different opinions. Two scholars in Chinese Academy of Social Sciences Xiaojuan Jiang and Chunfa Wang raised some researches on this problem in 2001 and 2003 respectively. They both investigated the enterprises invested by MNCs and after analyzing the collected data, they obtained contrary conclusions. According to the view of Xiaojuan Jiang, FDI can boost technology progress. There need not any precondition. MNCs will definitely bring their advanced technology, machine and equipments to share Chinese market and consequently enlarge their proportions. While Chunfa Wang considered that the technology spillover effects of FDI were not distinct. Advanced machine and equipments are not equal to technological capabilities. On the contrary, FDI enterprises would decrease and squeeze out R&D activities in domestic enterprises.

Foreign direct investments are carried through by MNCs primarily. MNCs have obvious advantages relatively compared to domestic firms, and hold the most vigorous parts in the world economy. The contribution of MNCs through direct investments on technology transfer is obvious in theory. MNCs combine their own predominance including capital, technology, management skills, marketing channel, R&D and so forth with the advantages in the host country including nature resources, human resource and market scale and so forth to realize the advantage being repaired with each other in the whole world. MNCs

pay more great attention on the R&D of new products. The direct investments of MNCs may bring precious resources including capitals, technology, management skills, R&D capabilities, and the network of international trade for the host country. LDCs attract FDI; bring technology spillover effects through demonstration, imitation, reverse engineering, individual contact, diffusion of management skills, and the exploitation of international market. This is beneficial to shrink the gap in high-technology with developed countries, to upgrade the industrial technology in acceleration, and to fetch up the technology indentations and lag in the course of development. Furthermore, MNCs have stronger technology consciousness and skills; they make use of research institutions, universities and other service organizations more positively, so MNCs can facilitate the construction of national innovation system for the host country to some extent.

FDI may also bring negative spillover effects. The technology spillover effects of MNCs are likely to very feeble. It is one kind of crucial means that MNCs invest in LDCs in order to keep their own technology advantages and at the same time to share the cost advantages with LDCs. MNCs mostly invested the capital-intensive and technology-intensive industries which were laggard in China under the consideration of the global strategy and they aimed to occupy Chinese market in the long term. MNCs have obvious competitive advantages compared to domestic firms. They always bring more advanced technology and equipments through FDI. However, the spillover effects can't come into being automatically. Imbriani and Reganati (1997) represented that the spillover effects from FDI enterprises were in inverse proportion to the size of technology gap between foreign and domestic firms from the Italian evidence. Kokko (1994), Kokko, Tansini and Zejan (1996) also found that a positive and statistically significant spillover effect only in plants with a moderate technology gap. There almost were not any spillover effects when the technology in foreign firms was much higher than domestic firms according to the research of Mexico and Uruguay. Generally speaking the introduced technology must be suitable with the factor endowments in the host country. If the technology gap were too large, although there may be many opportunities for domestic firms to imitate and learn, domestic firms may have not enough technological capabilities to absorb and imitate advanced technology from FDI enterprises and can't make the advanced technology be endogenous. Thus it results in little spillover effects. Because of the stickiness of information, most technology and knowledge are tacit knowledge. Only through practice can they be mastered. Just as the study of Borensztein (1998) showed that the introduction of more advanced technology and the requirement of absorptive capability in the host country were twinborn factors of economic growth. FDI was more productive than domestic investment only when the host country had a minimum threshold stock of human capital. DeMello (1999) discovered that FDI had positive effects to the countries with high technology and had negative effects on the followers. So the contribution of FDI not only depends on the technology level brought by foreign investment, but also depends to a large extent on the ability of absorption and assimilation of advanced technology of domestic firms. To acquire the spillover effects of FDI, the host country must be in possession of enough human capital that has received good education and trainings, and proceeds to reform and innovate constantly after utilizing the acquired technology effectively.

Because MNCs possess more advanced technology and management skills compared with domestic firms, their entries monopolize the original competition market in the host country, squeeze out the domestic firms in the industry and lower the market share of domestic enterprises. Kokko (1994) found that no evidence would show the positive effects of FDI on domestic productivity growth when the market share of MNCs was big and the

technology gap was too large. Demonstration and competition effects are really effective mechanism of spillover effects, but this must be based on corresponding technology capabilities in domestic firms. MNCs invest, incorporate and purchase the potential rivals in the host country, which may cause the innovation activities in the purchased enterprise be decreased, be transferred or be closed; furthermore decrease the regional R&D activities, make us excessively rely on foreign countries about key technology and bring the negative influence.

The majorities of MNCs invest in our country and engage in only the production and operation of the final product at present. Those key intermediate products were usually supplied by MNCs internally. So the linkage effects were limited. MNCs integrate with the Chinese base of manufacture very slowly to protect their own technology and the manufacturing expertise. Also, they seldom have relation with Chinese universities and research institutes. MNCs usually take the global production strategy and arrange every kind of functional behaviors in the whole world to excavate the competitive advantages on each step. Chinese enterprises are just one of its manufactured chains in the global production. This is manufacture transfer but not technology transfer. Technology circulation happened only within the MNCs. This is one kind of floating economic with bad ground-work. The advanced technology and equipment can't be transferred to domestic firms automatically. The technology stream can't be transformed into endogenetic technology capabilities easily.

The purpose of this paper is to analyze quantitatively the relationship between FDI and regional innovation capabilities (RIC) and to find the determinants of RIC. We will empirically do research on the correlation between FDI and RIC using data of each province in China; verify whether the more of inward FDI in a province will lead to a higher level of innovation capability. The paper is organized as follows. Section 2 presents our research method. Section 3 gives the concept of regional innovation capabilities. Section 4 researches empirically the relationship between FDI and RIC using multivariate statistics analysis. Section 5 constructs empirical model to analyze the impact of FDI on RIC further. Section 6 analyzes the effect of FDI to the level of entrepreneurship. Section 7 concludes.

## 2. Research design

In this paper, we focus on the relationship between FDI and RIC and highlight the role of FDI in the RIC in China. What is the regional innovation capability? This is the principal issue we should conduct on. So we make certain the concept of RIC firstly. In fact, the connotation of RIC is very abundant. Inward FDI is just one of the main factors of RIC; it means the ability of technology introducing and transfer. On the basis of the comprehension on the meaning of the concept, we establish a series of indicators to reflect RIC completely and objectively. Then we construct synthetic evaluating function. The score of the constructed function can represent RIC accurately.

We use principal component analysis of multivariate statistics to obtain synthetic evaluating function. We adopt the first principal component (PCR1) as the synthetic evaluating indicator to appraise RIC and calculate the correlation between FDI and RIC. Because PCR1 is the weighted sum of each original variable, and its variance is the biggest, it can

reflect majority of the information of all original data. The factor loadings of each original variable on PCR1 are the correlation of each original variable and PCR1. Through this analysis we can also obtain the determinants of RIC. We will elaborate on the characteristics of some typical regions. We conduct on detailed compare and analysis to summarize the rules of development of RIC.

We establish the empirical model with regression analysis to compare the importance of each factor that be related to RIC using the number of patent applications to measure RIC. Then we use correlation analysis through scatter diagram and the determinate coefficients of regression model to manifest the impact of FDI on the level of entrepreneurship. All analyses are dealt with SAS statistical software.

All data used in this research are obtained from China Statistical Yearbook, China High-tech Industry Statistical Yearbook, and China Science and Technology Statistical Yearbook. These three yearbooks are compiled by National Bureau of Statistic of China. Some of the variables can't be directly obtained and we proceed to some simple computation. All data are the most up-to-date currently available.

### **3. What is the regional innovation capability?**

Technological innovation is a concept of economic category; it means the economic-technological activities including R&D, production and commercial applications of new technology (include new product and new craftwork). Technological innovation is one kind of commercial activities which creates new economic value by means of new technology (entirely new or modification). It is the first commercial application of new technology, and realizes the combination of economy and technology. Technological innovation has three particular characteristics. First, it emphasizes that the degree of market realization and acquisition of the business benefits are the ultimate standard to verify whether the innovation is successful or not. Second, it emphasizes that it is a systematic engineering from the research and development of new technology to the first commercial application. Third, it emphasizes that the business enterprises are the subjects of technological innovations.

Technological innovation has two types of realization modes, namely the independent innovation mode based on R&D, and the second-innovation mode based on introducing in and assimilating advanced technologies. The investments on independent innovation of new technology and new products are considerable, and the risk is also stupendous. It needs very strong capability of R&D and needs large amounts of funds for support. Because of the large technology gap between developed countries and China, the second-innovation mode is usually taken in China. With the fast development in technology and science, the scope of technological innovations become more and more wide, the competence of making use of the exterior knowledge has become an important part of technological innovation capability.

The regional innovation vitalities are enslaved to innovation capabilities. The regional innovation capabilities are the potentialities of producing streams of innovations related to commerce in a region. They refer to the capabilities of converting knowledge into new product, new craftwork, and new service. The regional innovation capabilities are not

merely the capabilities of science and technology, nor just the technological competition ability, for they pay more attention to the economic applications of new technology. The strong technological competition ability of a region doesn't mean that the innovation capabilities are strong too. The regional innovation capabilities are made up of those factors as follows: Technology human resource, the creators of knowledge and employees who grasp the subjects of craftsmanship; the ability of knowledge fluxion, that is the ability of making use of all kinds of resources in the world constantly, and the ability of knowledge fluxion among each innovation units; the capabilities of technological innovation in enterprises; innovation environments and the economic performances of innovations, that is the output of innovations.

The innovation capabilities will decide the long-term economic competitiveness in a region. The innovation capabilities are the most important factor to explain the differences of the degree of economic prosperity among high-income nations. For LDCs to say, obtaining and developing the technology has become an essential driving force to improve the competitiveness [The Global Competitiveness Report 2002-2003]. For LDCs to say, introducing in advanced technology and assimilating, realizing the second-innovation is the shortcut to improve the regional innovation capabilities and international competitiveness.

#### **4. The correlation analysis between FDI and RIC**

##### **4.1. To establish the series of indicators of RIC**

To evaluate the correlation between FDI and RIC accurately, we need to describe RIC exactly first, so we must establish a series of indicators to evaluate RIC. The establishment of the series of indicators of RIC is the further step of comprehension on the essence and the meaning of the concept of innovation, and is also the development of innovation theory. The connotation of RIC is very abundant; the determinants include education, science and technology resources, innovation capability in enterprises, regional synthetic strength and information condition; and also include the regional policy and management skill. The series of indicators of RIC must reflect the present conditions and the utilization efficiency of regional knowledge and technology objectively and try to evaluate the RIC completely and objectively. The indicators being chosen should be brief and terse. On the basis of reflecting RIC accurately, try to select those synthetic indicators which have the commonness and are maneuverable. Therefore, we select 22 indicators altogether to measure RIC as listed in table 1.

Table 1 about here

##### **4.2 The principle component analysis**

We use the principal component analysis to establish the synthetic variable evaluating RIC of each province. Its excellence is that the weights are based on the inherent configura-

tion relationships of the variables from the data analysis, there doesn't have any influence of subjectivity, and is objective perfectly. This is beneficial to analysis and appraise synthetically. We analyzed the data of 31 provinces in China about above 22 variables with principal component analysis, using SAS software to deal with. The biggest eigenvalue of the correlation matrix values 11.1167 and the first principal component reflects 50.53

Table 2 about here

By the eigenvector of the biggest eigenvalue in table2, we can get the expression of the first principal component (PCR1) as following:

$$\begin{aligned}
 PCR1 = & 0.1237RFUND + 0.1338FDI + 0.2793TVMARKET - 0.0814EXPPT \\
 & + 0.1971EXPIT + 0.1107RR\&D + 0.0818RS\&T + 0.2875UTILITY \\
 & + 0.2380DESIGN + 0.0727OVEQUIP - 0.0136EXPTR \\
 & + 0.2426NEWSALES + 0.2494NEWRATE + 0.2589COLLEGE \\
 & + 0.2781HIGHEU + 0.2611BOOKEXP + 0.2685NS\&E \\
 & + 0.2237NPTE + 0.2303NHTE + 0.2597NNE \\
 & + 0.2871PGDP + 0.1447LPRODUCT
 \end{aligned}$$

The expression shows, PCR1 is the weighted sum of each original variable, most of the coefficients are positive excluding two indicators of EXPPT and EXPTR. Indicator EXPPT means the average expenditure on purchase of domestic technology of each enterprise. Generally speaking, the higher of technological capabilities, the less domestic technology enterprises would purchase. So the negative value of the coefficient is reasonable. Indicator EXPTR means the average expenditure on technology renovation of each enterprise. The coefficient is negative, but the number values only -0.0136, so its influences is not big. We can neglect it. Thus PCR1 can reflect the innovation capability of each province synthetically. So we use PCR1 as the synthetic evaluating indicator to appraise RIC.

### 4.3 The impact of FDI on RIC

The loadings in table 2 are the factor loadings of each original variable on PCR1. Factor loadings are the correlations of each original variable and the principal component in fact. The correlation coefficient between FDI and PCR1 is only 0.4462, there has no significant correlation between FDI and RIC. By table 2 we find that the variables having high relationship with RIC include: TVMARKET (respects the ability of technology transfer), UTILITY and DESIGN (respect the ability of design in enterprises), NEWSALES and NEWRATE (respect the ability of innovation output in enterprises), COLLEGE, HIGHEU, BOOKEXP (respect the caliber of employees), NS&E (respects the human resource in S&T), NNE (respect the level of entrepreneurship) and PGDP (respects the performance of innovation). Therefore, for a nation or a region to say, the determinants of innovation capability include: paying attention to the investments of S&T, the ability of upgrading the human resource in S&T and making full use of all kinds of resources

of S&T; the technological innovation capability in enterprises; having good environments beneficial to innovations, the mechanism and system that is open and can make full use of the local special resources and the global S&T resources; the outstanding performance of local economic, which become the powerful pull force of innovation. We analyze the correlation between FDI and RIC further using the synthetic variable obtained from the principal component analysis, drawing the scatter diagram, establishing the regression model and obtaining the regression curve. See as figure 1.

Figure 1 about here

We can observe the relationship between FDI and regional innovation capability clearly by picture 1. From the scatter of points that represent each region in picture 1, we can discover that there have many points far away with the regression curve, such as Beijing, Shanghai, Tianjin, Guangdong and Jiangsu. The determinate coefficient  $R^2$  is only 0.1991, it indicates that FDI can explain 19.91

By picture 1, we can also find that there have a lot of points almost gathered together. These points represent the provinces in which both FDI and RIC are all lagged behind. These provinces locate in the centered or western region of China, are less developed in economy because of the lagged notion, policy and geographic location. The behindhand innovation capabilities are mainly induced by the lagged economic conditions. To eliminate the influence of economic development, we calculate the correlation again canceling the regions in which both FDI and RIC are all lagged behind and obtain the correlation is minus 0.3626. This indicates that FDI has the negative impact on RIC.

FDI in Guangdong and Jiangsu are the biggest. The amount of FDI in Guangdong is 11.334 billions dollars in 2002, and 10.19 billions dollars in Jiangsu. The amount preponderated over other regions greatly. But their regional innovation capabilities lie in the fourth and the fifth respectively, and just bigger than the latter regions a little. Then we compare each original variable carefully and discover that on three variables that respect the caliber of employees, which are number of college and higher level per 10000 populations (COLLEGE), number of graduates from institutions of higher education per 10000 populations (HIGHEDU), the books sales per capita (BOOKEXP), Guangdong located in 12 and 13 and 21 respectively in the whole country. Variable that respects the human resource in S&T, number of scientists & engineers per 10000 populations (NS&E), Guangdong located in No.7. And Jiangsu located in 20, 6, 4 and 5 on above variables respectively. These show that the level of human capital doesn't match the amount of FDI in Guangdong and Jiangsu. Whether the stock of human capital is high or low will decide the spillover effects directly, and influence a nation's independent innovation capabilities and potentiality directly. Only when the volume of FDI match the stock of human capital and technological capabilities, can the RIC be developed and enhanced.

The region with the strongest RIC is Shanghai, followed by Beijing, while FDI in these two regions listed in the fourth and the eighth respectively. What drive the innovation capability in Beijing and Shanghai? Obviously we can't get the reasonable explain only from the FDI. The superiority in Beijing include the abundant S&T resources, strong abil-

ity of creating new knowledge, attaching importance to the investments for S&T, having the most excellent employees, and the good environments for innovation. While in Shanghai, there have a good foundation for industrial innovation; the ability of technological innovation of enterprises in Shanghai keep ahead in the whole country; and there have the strong financial strength and powerful capital advantage. Zhejiang is the province in which private economy developed very well, the capability of innovation in private enterprise is extraordinary. Zhejiang developed quickly because of the dual superiorities of S&T and the system. People have great enthusiasm to start-up an enterprise. There have the perfect system for regional scientific and technological innovation, investment and financing and supporting for the talented person in Zhejiang. Zhejiang is the apotheosis of making full use of local resources to improve the innovation capability.

Therefore, being open to external, attracting FDI is not the unique means to increase RIC, and it isn't the important means either. The speed of reformation and the degree of marketization in economy will decide the level of innovation, the notion and system will influence the innovation capability. The determinants of the innovation capability include the original drive force of innovation, the technological innovation capability in enterprises, the ability of making full use of the local special resources and all kinds of S&T resources, having the good environments beneficial to innovation, perfect mechanism and system for regional scientific and technological innovation. Besides above factors, the local economic condition is the strong pull force for innovation. On the other hand, the level of GDP will be high in the regions that have strong innovation capability, and the international competitiveness will be strong too.

## 5. The empirical model of the effect of FDI to the innovation capability

We measure the innovation capability with various different variables in the above analysis. But scholars often use the patent data to measure the technological innovation, because when an inventor or creator apply patent to the patent censorship, this is usually the potential sign of economic value of innovation and representation of the innovation capability. Furthermore the patent data are complete, accurate and can be obtained easily.

In less than 20 years, China has made tremendous progress in establishing a legal system for the protection of innovation. China's first patent law was enacted in 1984 and came into effect in 1985. Since then, the law has been amended twice. Since the passage of the 1984 patent law, the central government has issued over 20 regulations and guidelines so as to promote innovation activity in China. Today's patent law in China is pretty much in line with the international standard [Kui-yin Cheung, 2004].

The patent law of China divides patents into three categories: invention, utility model, and external design. The invention patent refers to the new techno-project put forward on the product, method or its modification, which can form the products having independent intelligent property. The utility model patent means the new practical techno-project put forward on the shape, structure of the products or their combinations. The external design patent is the new design which is full of pleasant impression and suited for the application in industry about the shape, pattern, color, or their combinations of the products. The innovative level is relative low of the utility model patent and the external design patent. The term of protection is 20 years for invention patents and 10 years for utility model and

external design patents. Among three types of patents the invention patents are regarded as major innovations, they can represent the innovation level mostly.

The number of patent authorized was influenced by the abilities of the patent censorship, so in this text we use the number of patent applications in our country to measure the regional innovation capabilities.

We use the following model to estimate the spillover effects of FDI on innovation capabilities in China.

$$Patent = f(FDI, PGDP, S\&TEXP)$$

We use the number of patent applications (Patent) as a measure of innovation capability. FDI refers to the realized values of FDI lagged one period considering that FDI inflow to China impacts on domestic innovations within a short period of time. As measures of input to R&D activity, we use expenditures on science and technology development (S&TEXP). Finally, considering the fact that different provinces are at different stage of economic development so that their innovation capabilities should also differ, we include the level of per capita GDP (PGDP) in our estimation.

The model can also be expressed as:  $Patent = A \cdot FDI^\alpha PGDP^\beta S\&TEXP^\gamma$ , then we take logarithm in both sides, and the model can be written as following:

$$\ln Patent = C + \alpha \ln FDI + \beta \ln PGDP + \gamma \ln S\&TEXP + u$$

Where C is the estimated intercept of the equation,  $u$  is the statistic error, the coefficient  $\alpha, \beta$  and  $\gamma$  is the elasticity of the increase of FDI, PGDP, S&TEXP to the patent increase respectively. For convenience, the equation was written as follows:

$$Patent = \beta_0 + \beta_1 FDI + \beta_2 PGDP + \beta_3 S\&TEXP$$

The coefficients  $\beta_1, \beta_2, \beta_3$  measure magnitude of the influence of FDI, PGDP and S&TEXP respectively. The data are taken from China Statistical Yearbook and China Technology Statistical Yearbook, covering 30 provinces. Tibet is excluded in our analysis because most of the relevant data for it is either not available or zero during the time period examined.

We used SAS software to estimate the equation with the ordinary least squares (OLS). And we estimated the equation for each type of patent (invention, utility model, and design) as well as the total patent applications.

Table 3 about here

By table3, the determinate coefficients  $R^2$  of four models are all above 0.77, and the values of F-statistic are significant at the level of 0.0001. This shows that four models all have great statistic significance and they can explain the variations of all types of patent

applications more than 77 percents. For the amount of invention patent, the coefficient of FDI is positive, but it is statistically insignificant even under the level of 0.10. So FDI has no significant effect to the amount of invention patent. There has positive effect for FDI to the amount of utility patent, and has significant effect to the amount of external design patent and total patent. S&TEXP has significant effect to the amount of all three types of patent and the total patent under the significant level of 0.0001, except the external design patent is under the significant level of 0.05.

The results manifest that S&TEXP is the most important factor to increase the innovation capabilities. FDI has positive spillover effects to some extent, but has no significant effect to increase creative inventions and the inventions having independent intelligent property rights.

## 6. The effect to the level of entrepreneurship

We use the number of new registered enterprises (NNE) and private technology enterprises (NPTE) and high technology enterprises (NHTE) as a measure of entrepreneurial level. FDI refers to the realized values of FDI lagged one period considering that FDI inflow to China impacts on innovation activities within a short period of time.

The effect of FDI to the entrepreneurial level can be showed as the following figures.

Figures 2, 3, 4 about here

We observe three scatter plots in which each point represent each province, and find that there have many points far away with the red regression curve. Three correlation coefficients between FDI and the number of all kinds of new enterprises and the determinate coefficients of regression equations are all very low. So we can make conclusions that FDI has no direct significant effect to the level of entrepreneurship. The more FDI will not bring the higher entrepreneurial level.

This result may be induced by the crowing-out effect of FDI. Because of the high risk to start-up an enterprise, a successful entrepreneur must be adventurous pioneer daring to take the tremendous risk and failure. The presence of foreign enterprises may provide higher wage for employees and increase the competition in the market, this increase the difficulty of successfully starting an enterprise. So it is likely that many people having certain entrepreneur spirits would rather select the secure and steady job in foreign enterprises than undertake the risk to carve out.

## 7. Conclusions and policy implications

As far as LDCs are concerned, introducing in advanced technology is the shortcut to facilitate the technology progress. FDI has been regarded as an important channel for technology diffusion. However, the results in this paper demonstrate as follows.

First, the correlation between FDI and RIC is insignificant statistically. The impact of FDI on the regional innovation capability is inappreciable. The regions which attract more FDI haven't the higher regional innovation capability. Only when the volume of FDI match the stock of human capital and technological capabilities, can the RIC be developed and enhanced. This finding is the same to Borensztein (1998). Attracting FDI is not the unique means to increase RIC, and it isn't the important means either. The determinants of RIC include the original driving force of innovation, the technological innovation capability in enterprises, the ability of making full use of the local special resources and all kinds of S&T resources, having the good environments beneficial to innovation, and the local economic conditions.

Second, the results of the statistical model indicate that investment in R&D activities is the most important factor to enhance the innovation capabilities. FDI has positive spillover effects to some extent, but has no significant effect to increase creative inventions and indigenous innovation capabilities.

Third, through three scatter diagrams and correlation coefficients between FDI and the number of new enterprises and the determinate coefficients of regression equations, we find that FDI has no direct significant effect to the level of entrepreneurship.

To sum up above results, MNCs have the technological advantages to some certain; the inward FDI will facilitate the technology progress and improve the regional innovation capabilities in some degree. But we can't think blindly that we introduce in FDI the more the better. The advanced technology and equipments of FDI can't be transferred to domestic firms automatically. There have no significant correlation between FDI and RIC, the more of FDI will not necessarily bring the stronger innovation capabilities and spirits. So we can barely rely on FDI to improve RIC. The determinants to improve RIC include such factors as following: increasing domestic R&D investments, enhancing the stock of human capitals, improving the technological innovation capabilities and technology absorbency in domestic enterprises, having good environments for innovations.

The findings in this paper may provide some insights for both the host countries and foreign investors. Based on above analysis we put forward some policy implications as follows, which may also be effective to other LDCs. Firstly, it is urgent for China to improve the stock of human capital and indigenous R&D capabilities. Whether the stock of human capital is high or low will decide the spillover effects directly, and influence a nation's indigenous innovation capabilities and potentiality directly. It is necessary for China to enlarge investments in fostering human capitals, especially the investments for fostering R&D personnels. It is necessary for China to strengthen cultivating the independent R&D capabilities, particularly supporting for the R&D activities of techno-intensive industries. These are important to shrink the technology gap between domestic enterprises and foreign capital enterprises. Only when the host country has certain technological talented persons, can MNCs arrange R&D projects in the host country and train the native high technological talented persons, to reduce the cost of human resource and make products locally better. Therefore making native innovative systems perfect, cultivating R&D capabilities of domestic enterprises positively, promoting and stimulating independent innovations in domestic enterprises are the basis for improving technological progress from making use of the spillover effects of FDI. Secondly, Chinese government should focus on the quality of inward FDI and insist on the sticking point to advance independent innovation capa-

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bilities. Try to urge and guide FDI to be on the trajectory which is beneficial to improve our independent innovation capabilities. Thirdly, China should try to create a fair competition environment for domestic enterprises to compete with foreign enterprises, and keep sufficient rivalrousness of the market. Under the intense competition environments it may force MNCs to increase the degree of technology transfer to our country.

**References are omitted, end of paper for correction.**

September 4, 2006