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神戸大学大学院経済学研究科

総合経済政策専攻

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Yang Chao

Contents

Preface

The objective of the paper is to accesses how foreign direct investment (hereafter FDI) influences the domestic production, technology improvement, domestic investment and trade in China. With a productive function embodying FDI production into domestic firm's production function, the external effects of FDI on China's domestic industrial production are theoretically and empirically investigated with the relatively new threshold estimation method. Furthermore, using China's 29 provinces panel data, this paper tests the Granger causality relationship among FDI, domestic investment and trade in China's economy. The relationships are estimated with a new estimation method, System generalized methods of moment (GMM), which leads to a consistent and asymptotic estimator for a dynamic panel data model. Lastly, the relationship of growth rates between TFP and FDI inflow is investigated. I calculated TFP growth rate in China's industry sector with a different approach which considers the residual of Solow model regression as TFP growth rate. Even this approach is very different from the approach used by the earlier papers, the similar estimates of TFP growth rate are obtained. It is found that TFP growth rate has become a significant attractive factor for FDI inflow toward China in recent years.

The author acknowledges my supervisor Professor Masayuki Hara for his helpful comments and suggestions. His continuous help throughout three yeas is one of the most important factors that encourage me to complete the three years' hard studying in PH.D course.

Chapter 1: Introduction for Foreign Direct Investment in China

1: Concept and Characteristics of Foreign Direct Investment

According to IMF (1993, p86), foreign direct investment (hereafter FDI) is the category of international investment that reflects the objective of a resident entity in one economy obtaining a lasting interest in an enterprise resident in another economy. IMF does emphasize the lasting interest which implies the existence of a long-term relationship between the direct investor and the enterprise and a significant degree of influence by the investor on the management of the enterprise.

One of important differences between FDI and portfolio investment is benefit. Direct investors could derive benefits in addition to the investment income that may accrue on the capital that they invest (e.g., the opportunity to earn management fees or other sorts of income). In contrast, portfolio investors are primarily concerned about the safety of their capital and usually seek short-term benefits.

Another important characteristic of foreign direct investment enterprise emphasized by IMF is that: in a foreign direct investment enterprise, a direct investor, who is resident in another economy, owns 10 percentage or more of the ordinary shares or voting power.

Greenfield investment and mergers and acquisitions (hereafter M&A) are the two main forms when FDI enters host country's market. The former refers to the direct investment in new facilities or the expansion of existing facilities. Since it creates new production capacity and jobs, transfer technology and know-how, and can lead to the global marketplace, it has become the primary target of a host nation's promotional effects. In the 1950s and 1960s, it was the most popular mode of market entry and is still dominant in the developing world in recent years (UNCTAD 2000).

In contrast, M&A occurs when a transfer of existing assets from local firms to foreign firms takes place. Since the mid-1980s, cross-border M&A has been used increasingly as a major means of entering foreign market (UNCTAD, 1996a, pp7-14). For example, the ration of the value of cross-border M&A to world FDI flows reached over 80 percent in 1999 (UNCTAD 2000).

In China, the definition of inward FDI is narrower than international definition. According to three pieces of law published by China's government[1], only the enterprise in which foreign investor's ordinary share exceeds 25% is considered as a foreign direct investment enterprise. Furthermore, before 2006, data on inward FDI released by China did not include FDI in financial services, as its total amounts were relatively small. But in 2006, they began to include these services, as inflows to them soared.

Greenfield investment is considered as the main means of entering China's market whereas M&A FDI

[1] The three pieces of law are "law of the People's Republic of China on Chinese-foreign equity Joint Ventures", "Law of the People's Republic of China on Chinese-foreign Contractual Joint Ventures", "Law of the People's Republic of China on Foreign-capital Enterprises". All of them have been adjusted many times since the initial publish.

had been only taken 4.96% share in the total value of inward to China until 2001. However, following a series of relaxations on restrictions on M&A-related policy, the case of M&A FDI in China has dramatically increased since 2003 (Han, 2006). One of the most important regulation relaxations is "Interim Provisions on the Takeover of Domestic Enterprises by Foreign Investors" released in 2003, which provides a comprehensive guide for FDI-related M&A.

2: The History of Inward FDI in China

The history of inward FDI into China can be ascended to the 1980s when China's strong political leader Dengxiaoping advocated economic reform in 1978. In the next year, the first FDI-related law, "law of the People's Republic of China on Chinese-foreign equity Joint Ventures", is published. Its release triggered the process of inward FDI into China and also proved the resolution of China's leaders that improved economic reform. The history of inward FDI to China is also the history of China's economy reform. Since the initial year of economic reform till 1992, a series of law and regulations are published to attract FDI into China. Even though inward FDI to China had increased a lot during this period, its geographical and sectoral distribution seriously depended upon the China's political situation and the policy related FDI at that time. For example, the preferential policy for inward FDI is only suitable for some coastal provinces and four special economic regions. It led to a situation that inward FDI heavily distributed on the costal provinces. One of the reasons that China's government only gave the special preferential policy to the coastal provinces may be attributed to the export-oriented policy which aimed to increase foreign currency reserves and prevent the negative impact of FDI on domestic enterprises, e.g. the local content requirement and the export proportion. Another reason may be attributed to the fact that there were still ideological arguments between the reform-preferred group and the conservative group. The situation may be a compromise results between the reform group and the conservative group in China's communist party. Furthermore, even in the reform group, there were also some leaders worrying about that the capitalism-styled economy would overturn the rule of the communist party in China due to a complete open-door policy. Hence, during the initial FDI invitation period, China's government adopted a step-by-step gradual economic reform policy or FDI attraction policy. As for the sectoral distribution of inward FDI in China, labor-intensive industry is the main sector that inward FDI concerned on. During this period, inward FDI mainly came from Hong Kong, Taiwan and Macao because of connections between overseas Chinese and China.

After 1992, China's economic reform and FDI attraction policy were improved to an unprecedented step by Denxiaoping's talk in his travel to south of China. We define the period of 1992 to 2001 as the golden term of inward FDI to China, not only because the value of inward FDI dramatically increased during this period, but also because the quality of inward FDI was improved during this period. Firstly, the special

preferential policy which only had been provided to the coastal provinces was expended to the inland provinces in order to adjust the economic disparity arising from the unbalanced distribution of inward FDI between the coastal provinces and the inland provinces. Secondly, facing a huge amount of inward flow towards FDI, China's government shifted the preferential policy from coastal region to some special industries in order to stimulate inward FDI into agriculture, energy, and infrastructure industry. Furthermore, in order to satisfy the conditions necessary to join WTO, the preferential tax system for inward FDI were gradually removed. As the results of these relaxations on regulations and laws, inward FDI into China appeared new characteristics. The inflow of FDI into the inland provinces had trended upward and the inward FDI received by infrastructure industry and the service industry had taken a relative large share.

In 2002, China achieved the dream of WTO. Under the rules of WTO, the preferential policy towards FDI and the special region was completely removed. In this year, China also became the largest recipient of FDI in the world. The period from 2002 to 2006 can be considered the normal term of inward to FDI. Since in this term, China has been completely embodied into the world economy. It is not necessary and also not possible to establish special preferential policy for inward FDI to China. During this period, China fulfilled its responsibility of WTO and gradually removed the restrictions on inward FDI into some industries. Especially, during this period, China's government released a series of M&A-related regulations which provide comprehensive guide for takeover of domestic enterprises by foreign investors. Because of these relaxations on M&A, M&A FDI has taken a relatively large share in total inward FDI into China.

3: FDI Data Description

This section includes two parts. The first part describes the characteristics of FDI on geographical distribution and on industrial distribution in China. The second part presents the relationship among inward FDI, capital accumulation, employment and wage. All discussions will be advanced with help of graph.

Graph1-1 shows the trend of inward FDI flow from 1983 to 2004. The value of inward FDI flow to China before 1983 is quiet small. Its sum from 1979 to 1984 is only about 41 hundreds million dollars. From this graph, the three steps of inward FDI to China mentioned above can be easily confirmed. In the first step which is from 1978 to 1991, due to the policy restrictions on FDI, the value of inward FDI to China was relatively small. In the second step, namely from 1992 to 2002, inflow of FDI to China dramatically increased to an unprecedented level. China became the largest inward FDI recipient in the world in 2002. After 2002, since China has obtained the ticket for entry of WTO, the confidence of foreign investors to China's open door policy become stronger than before, the growth rate of inward FDI to China

also reached to the highest level in China's history.

Graph1-2 shows the shares of FDI received by agriculture, industry and service sectors in total inward FDI to China from 1997 to 2003. Industry sector received over 70% of inward FDI whereas the share of FDI into service sector fluctuated at the line of 20%. The FDI inflow into agriculture, however, only received 1% in the total inward FDI flow. It is worthy noting that most inward FDI into service sector concentrated on real estate management sector. This kind of speculative FDI may not link to a productivity increase directly.

As mentioned above, the preferential policy toward inward FDI was only provided for the coastal provinces or the eastern provinces[2]. It partly contributed to the situation that inward FDI is heavily located on the coastal provinces whereas rarely did inward FDI flow into the inland region, especially into the western provinces. Graph1-3 indicates the share of FDI received by the eastern, the central and the western provinces in the total inward FDI to China from 1985 to 2003[3]. Obviously, the eastern region is the main recipient of inward FDI in China whereas the share of the FDI into central provinces fluctuates over 10%. The western region is the smallest recipient in these three regions. One of reasons for this unbalanced distribution of inward FDI may be attributed to the earlier preferential policy restricted on the eastern region. Another reason may be linked to the fact that geographically, the central and the western region are far away from seaports of China. It would increase transport cost for the multination firms locating in these two regions.

Even though FDI plays an important role in China's economy take-off, the share of investment in fixed assets by FDI in national total investment in fixed assets is not so large, as Graph1-4 shows. Its largest share during the period of 1981 to 2003 is just over 10% which occurred in 1995, 1996 and 1997. In the eastern region which received most inflow FDI to China, the investment share in fixed asset by FDI is only about 15% from 1997 to 2003. For other two regions, the share did not exceed 10% during this period.

Graph1-6 describes the share of labor employed by FDI in total urban labor forces from 1996 to 2004. It can be found that even in the urban where most FDI enterprises are located on, the number of labor employed by FDI is still small. Its share was only about 3% before 2002. After China joined WTO, the number of labor employed by FDI trended upward and reached to about 4%.

In this section, we discussed the concept of FDI and compared the differences on the definition for foreign direct investment enterprise between the world and China. Also we reviewed the history of FDI invitation in China from 1978 and divided this period into three steps, according to the changes on China's FDI-related policy. Lastly, the characteristics of inward FDI to China are presented with a few graphs.

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[2] The eastern provinces include eleven provices which are Beijing, Tianjin, Hebi, Liaoning, Shanghai, Jiangsu, Zhejiang, Fujian, Shandong, Guangdong, Hainan. All of them have seaports. The nine central provinces are Shanxi, Jilin, Heilongjiang, Anhui, Jiangxi, Henan, Hubei, Hunan, Guanxi. The rest provinces are included into the western regions.

[3] The values from 1981 to 1985 are put together due to their small values.

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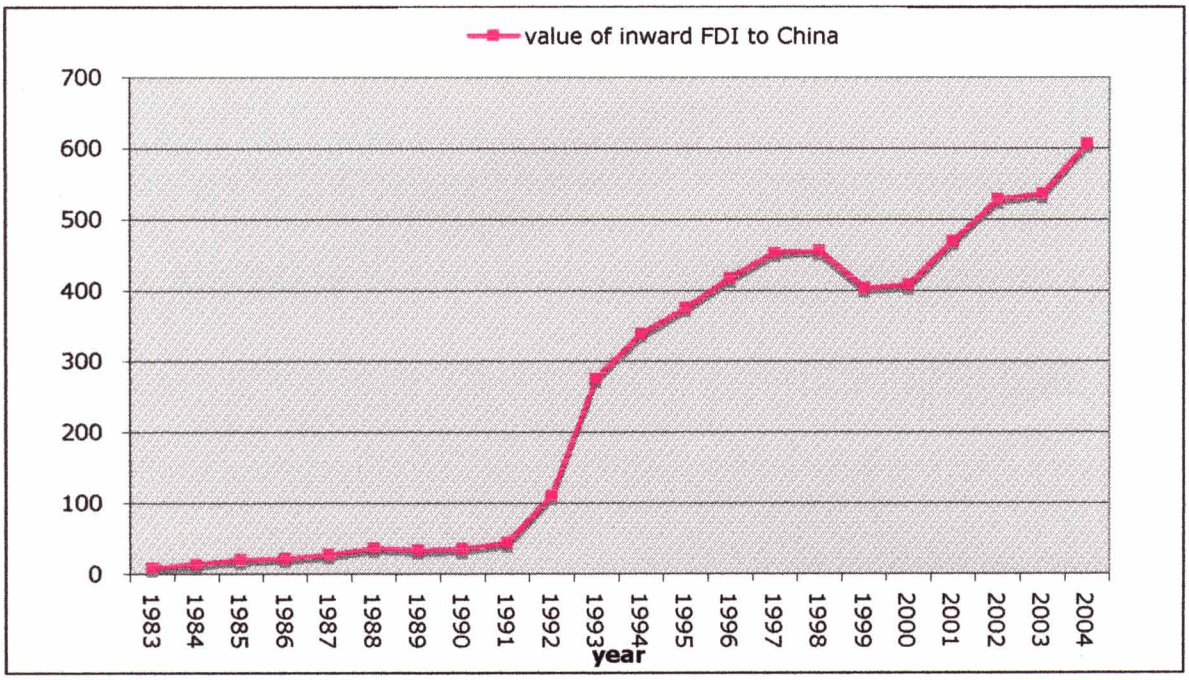
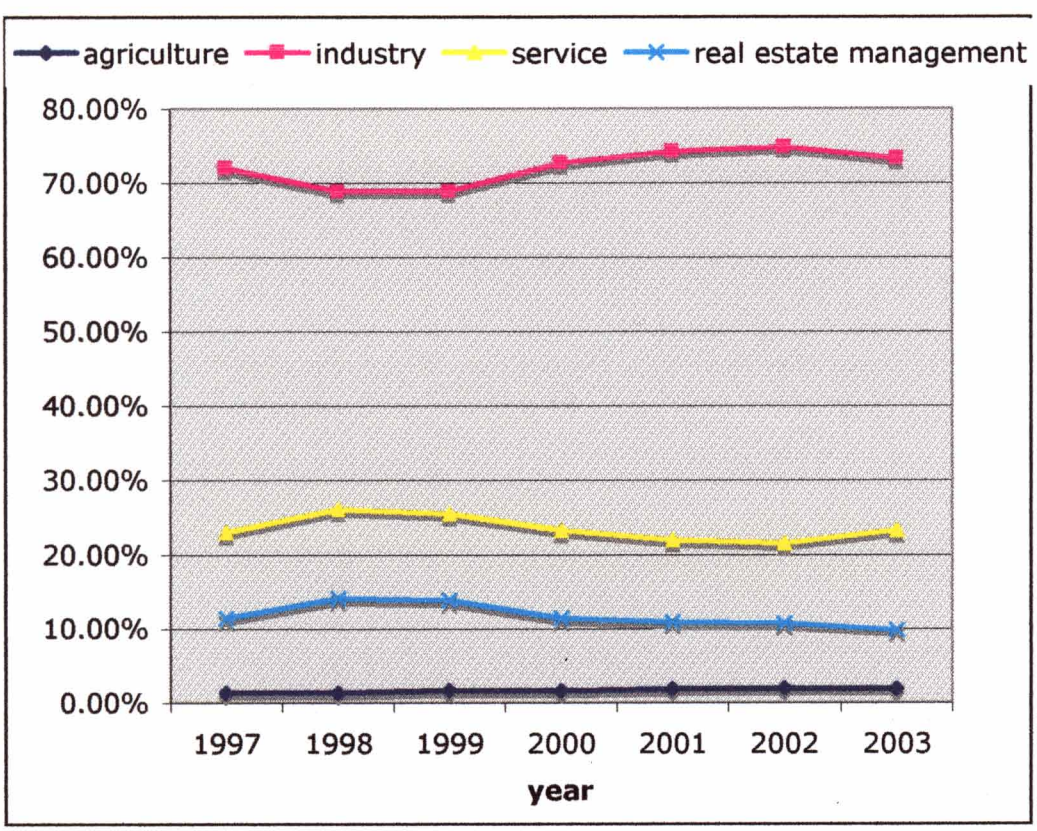
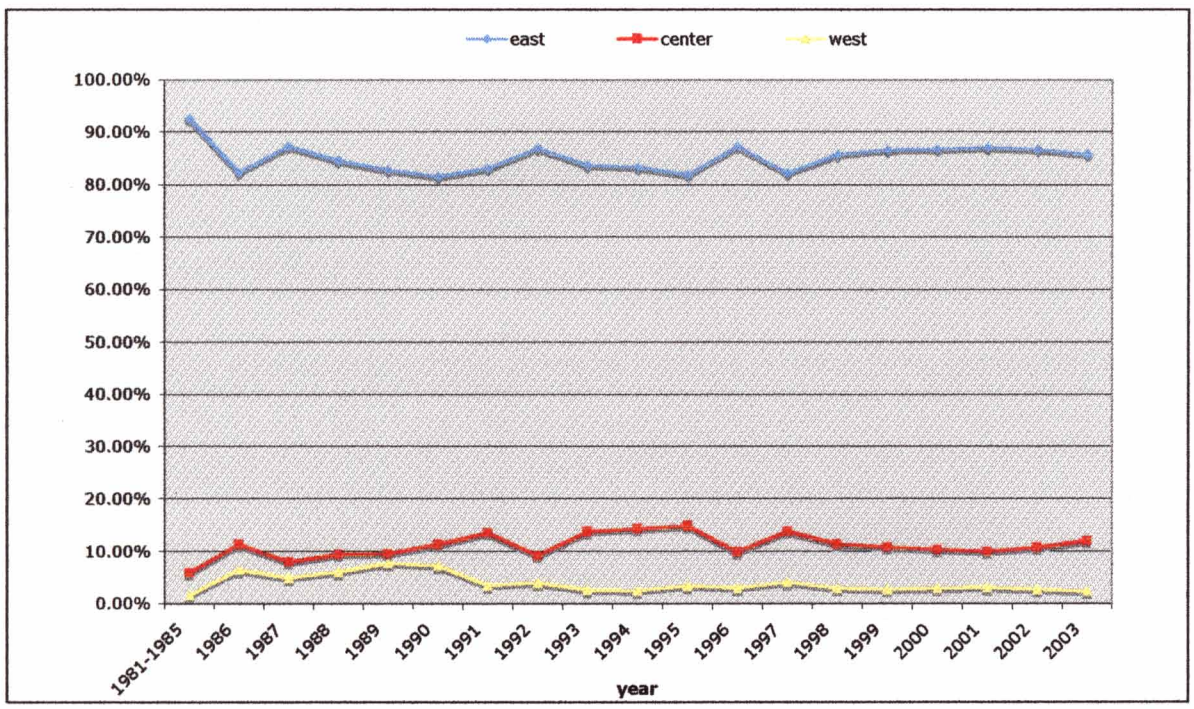
Graph1-1: Value of inward FDI into China from 1983 to 2004



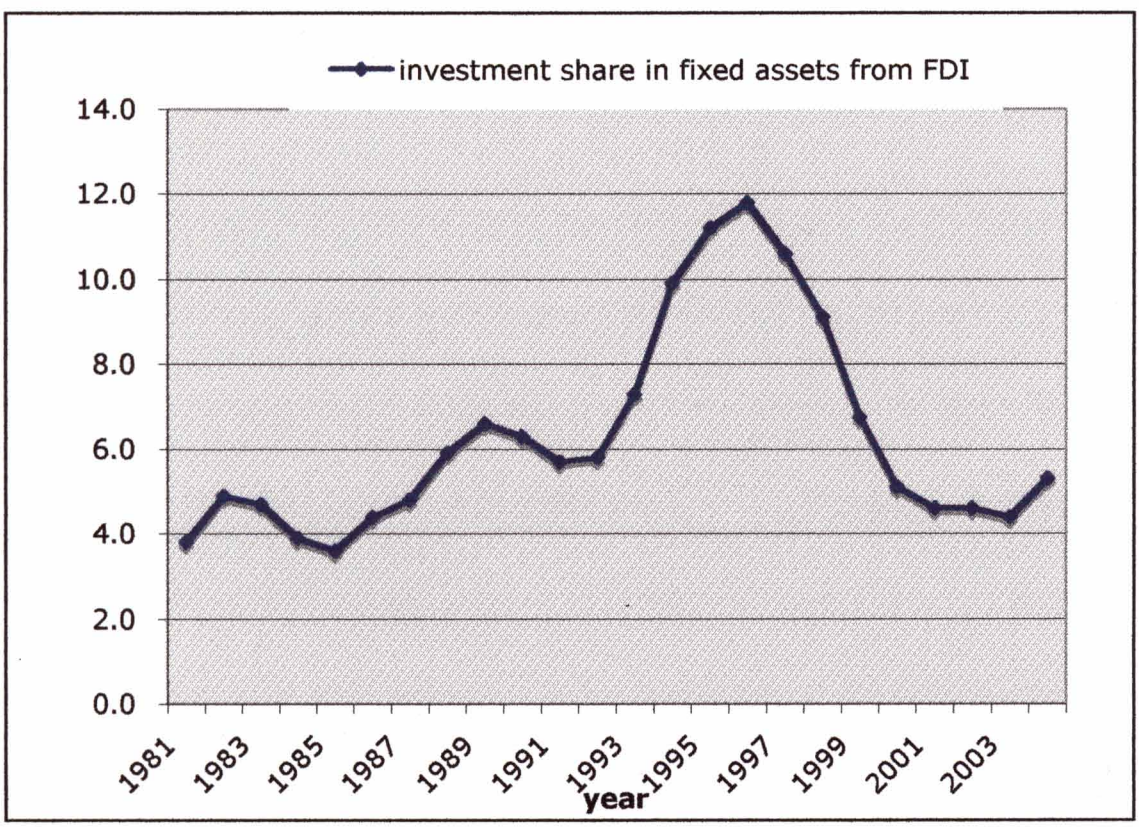
Graph1-2: The shares of FDI received by agriculture, industry and service sectors



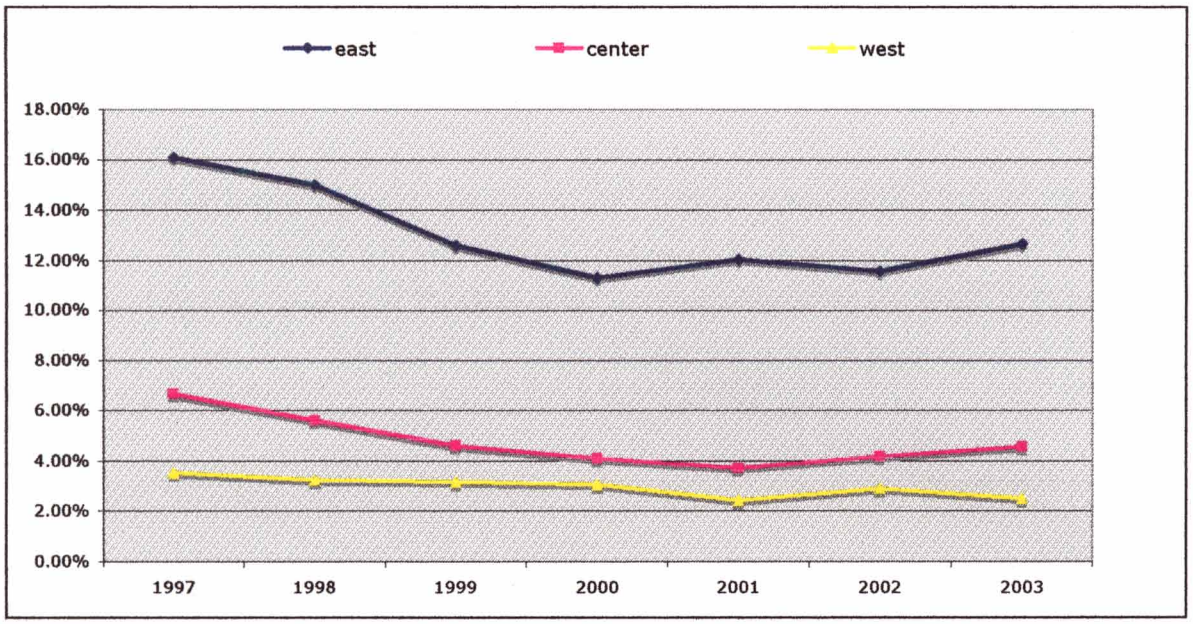
Graph1-3: The shares of FDI received by the eastern, the central and the western region



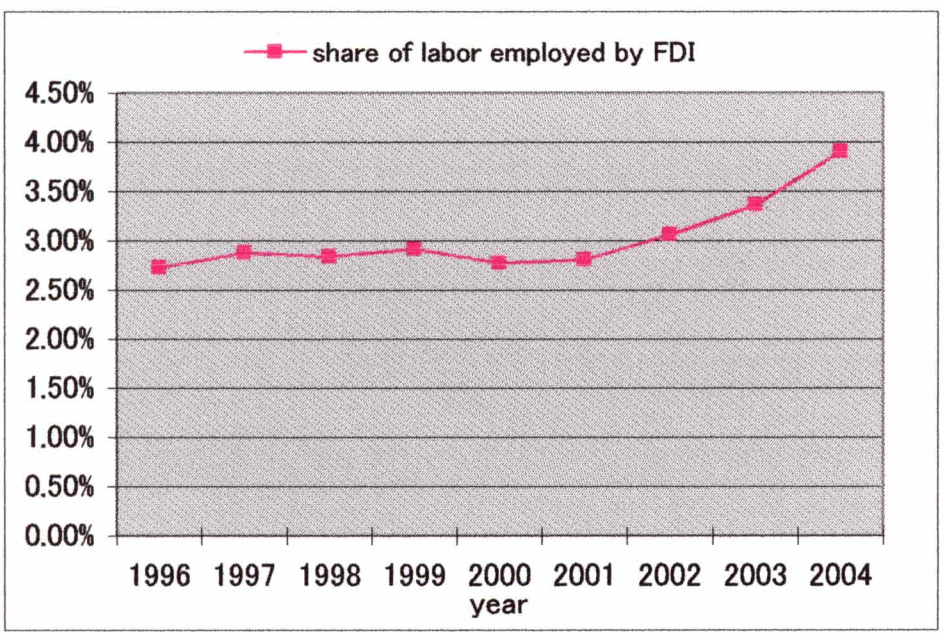
Graph1-4: the share of investment in fixed assets by FDI



Graph1-5: The share of investment in fixed assets by FDI in the eastern, the central and the western region



Graph1-6: Share of labor employed by FDI in total urban labor forces



Chapter 2: The External Effects of FDI in China: A Theoretical and Empirical Analyses based on Threshold Methodology

2.1: Introduction

FDI has been considered as one of the most important growth engines for developing country. Not only does it ease the shortages of capital for a developing country, but also fosters the technological growth of the host country through several technology channels, such as vertical linkages, horizontal linkages, labor turnover and international technology spillovers. However, FDI may squeeze host country's economy by "crowding out" domestic investment and suppressing local entrepreneurship[4]. If one country's economic performance does not reach the threshold condition necessary to benefit form MNEs' technology transfer, the local firms might not improve its technology growth through those channels mentioned above and therefore cannot invest further to compete with multinational firm (hereafter MNEs). Hence, there will be a negative external effect from MNEs towards domestic firm. Obviously MNEs is superior not only on capital but also on sophisticated technology and management know-how in developing country, with which MNEs may monopolize local market and drive indigenous firms out of the local market.

The empirical results on this issue, however, vary across the earlier papers that applied different estimation methodologies with different data. For example, Borensztein and Lee (1998) pooled sixty-nine developing countries' data over period 1970-1989 and found that FDI stimulates domestic investment. Their result, however, is not robust and empirically, it is also inappropriate not including individual effects in their estimation, given too many countries and too long periods embodied into their estimation data. Using a set of cross-section data over sixty-six developing countries, Makki and Somwaru (2004) estimated a growth equation and then concluded that entry of FDI promotes domestic investment, according to the positive coefficient of interaction term between FDI and domestic investment in their estimation equation. However, due to the heteroscadicity arising from cross-sections employed in their paper, the coefficient does not have a significant statistic level.

In contrast, Driffield and Munday's research (1998), which is estimated based on UK's manufacturing firms' data, shows that the presence of FDI in UK manufacturing did squeeze the profits of UK's indigenous firms. Girman and Görg (2001) found evidences that acquisition by FDI reduce the lifetime of UK's plant and employment growth. From the point of view of credit constraint, Harrison and McMillan

[4] Concern has also been expressed over a possible deterioration in the balance of payments due to increased imports and profit repatriation, and over reduced tax revenues as a result of transfer-pricing practices, tax allowance and other financial incentives granted to foreign firms.

(2003) argue that inward FDI browning heavily from domestic bank may crowd local firms out of financial market. This hypothesis is supported by their empirical estimation which is based on panel data of Ivory Coast.

The conflicting empirical result regarding crowding effect of FDI may partly echoed with my proposition that positive impact of FDI on domestic investment may seriously depend upon absorption ability of host country. For those countries in which technological gap between indigenous firms and MNEs is enough large, facing strong competition of MNEs, the domestic firms in those countries may be exacerbated from local market by the presence of MNEs rather than benefit spillover effect from MNEs since the absorption ability of indigenous firms does not meet the threshold necessary to benefit from technology diffusion of MNEs.

As for appropriate threshold variable which evaluate host country's economic performance, the human capital accumulation and infrastructure in recipient side have been emphasized by some researchers such as Borenszteinb et al (1998), Xue (2000). Acemoglu and Zilibotti (1997), Levine et al (2000) argue that financial market constraints in developing country hinder the ability of domestic firms to invest and thus to benefit from the spillover effects of FDI.

Only few papers, so far, have empirically investigated the dependence of FDI's external effect. One of the difficulties may be attributed to the lack of explicit theory background for FDI so that analysist cannot build an appropriate theory model for estimation. Another one, which may be more important, lies on the fact that an appropriate econometric method for evaluation of threshold so far had not been developed and therefore one could not deal with the heteroscadicity problem arising from the panel data employed in her or his estimation.

In contrast, this paper tries to challenge the theoretical difficulties with a model that separate the external effect of FDI from residual of Solow model. In this model, the output of multinational firm is considered as on of the factors that deicide the output of domestic firm. Under a moderate assumption that domestic firm and foreign firm are all price takers and face the same competition conditions, the external effect of FDI can be presented as the product of growth of MNEs' output and the output share of MNEs in GDP. The external effect in empirical equation is defined as the first differential term of domestic firm's output in terms of the output of MNEs. If its coefficient is above zero, there will be a positive external effect of FDI in host country otherwise FDI will play a negative external effect on host country's economy.

The present paper is constructed as follows: Section 2 builds the external effect model. Section 3 reports the estimation results for the model based on the widely used division criterion. In section4, I introduced Hansen's threshold methodology to search thresholds for external effect model and re-estimated the model based on the threshold criterion. Section 5 Concludes.

2.2: The Model

There are two firms in one economy, one is multinational firm, and another one is domestic firm whose output is assumed to be influenced by the multinational firm's output. The production functions for these two firms can be defined as follows:

$$Y_d = D(K_d, L_d, Y_f) \tag{1}$$

$$Y_f = F(K_f, L_f) \tag{2}$$

Where Y, K and L denotes the output, capital and labor, respectively. The subscripts of f and d refer to the multination firm and the domestic firm. If $D_y = \partial D / \partial Y_f > 0$, the entry of the multinational firm into the local market has a positive effect on domestic firm's output otherwise the effect would be negative.

Taking both differential to equation (1) and (2) in terms of time, we obtained the following equation:

$$\begin{cases} \dot{Y}_d = D_k \dot{K}_d + D_l \dot{L}_d + D_y \dot{Y}_f \\ \dot{Y}_f = F_k \dot{K}_f + F_l \dot{L}_f \\ \dot{Y} = \dot{Y}_d + \dot{Y}_f \end{cases} \Rightarrow \dot{Y} = D_k \dot{K}_d + D_l \dot{L}_d + D_y \dot{Y}_f + F_k \dot{K}_f + F_l \dot{L}_f \tag{3}$$

Under the assumption of that two firma are price taker and face the same wage and capital rate, we have:

$$\dot{Y} = \frac{r\dot{K}_d}{P} + \frac{w\dot{L}_d}{P} + \frac{D_y Y_f \dot{Y}_f}{Y_f} + \frac{r\dot{K}_f}{P} + \frac{w\dot{L}_f}{P} \tag{4}$$

Putting conditions of $\dot{K} = \dot{K}_d + \dot{K}_f$, $\dot{L} = \dot{L}_d + \dot{L}_f$ and equation (4) together, we obtained:

$$\frac{\dot{Y}}{Y} = \alpha \frac{\dot{K}}{K} + \beta \frac{\dot{L}}{L} + \gamma \frac{Y_f \dot{Y}_f}{Y Y_f} \tag{5}$$

where α and β denote the shares of the capital and the labor in GDP and are identical for each region during the observation period. Our concerns lie on the term $\gamma = D_y$, which present the external effect arising form the entry of the multination firm into the locket market. In order to account the possible heteroscadicity of the panel data, firstly, we start from a general equation which has an individual effect,

$$\left(\frac{\dot{Y}}{Y}\right)_{it} = c + \mu_i + \alpha \left(\frac{\dot{K}}{K}\right)_{it} + \beta \left(\frac{\dot{L}}{L}\right)_{it} + \gamma \left(\frac{Y_f \dot{Y}_f}{Y Y_f}\right)_{it} + \varepsilon_{it} \tag{6}$$

Where i and t refer to the cross-section and the year in the panel data employed in this paper, respectively.

2.3: Data and Estimation Results

Due to the lack of the data for national capital at province level in China, equation (5) is estimated with industry panel data of China's 29 provinces over 2000 to 2003, which is taken from various *China Statistic Yearbooks*[5]. All variables have been adjusted with their corresponding indices before estimation.

Table 1: Unit Root Tests on Variables

Y			K		
	Intercept	none		Intercept	None
LLC	-10.614***	5.829	LLC	-28.039***	-6.114***
IPS	-5E+154***		IPS	-2.E+155***	
ADF	71.459***	26.32	ADF	146.378***	80.569**
PP	92.142***	23.322	PP	164.040***	77.634**
L			F		
	Intercept	None		Intercept	None
LLC	-7.848***	-6.188***	LLC	-20.569***	-3.761***
IPS	-9.e+154***		IPS	-5.e+155***	
ADF	81.017**	113.161***	ADF	153.761***	91.991***
PP	93.365***	122.524***	PP	168.217***	89.968***

Note: "*", "**", "***" show 10%, 5% and 1% significant level, respectively.

The panel unit test results for the variables are shown in Table 1, which suggests that all variables are stationary at the widely used significant level.

Before applying Hansen's threshold methodology to search the threshold necessary to benefit from FDI, the estimation based on the widely used division criterion for China was executed firstly. This division criterion, which normally separates China into three regions: coastal region, central region and western region, has been quiet often used by many papers on FDI research in China (Cheung and Lin 2004, Zhang and Felmingham 2001). As for the division criterion, apart from district reason and economic development level, the most important reason, as Zhang and Felmingham noted, is that obviously those provinces which fall into the same region have received similar amounts of FDI. According to Zhang and Felmingham, the total amounts of inward FDI in the eastern region, in which each province's FDI amounts exceed $500 millions, shares over 80% of total inward FDI towards China over 1983 to 1998. In contrast, the amounts of FDI in the central region and the western region account for only 17% and 1.3%, respectively. In Graph 1 of this chapter: the provinces in eastern region, central and western region are indicated as black, white and gray color, respectively. The amounts of FDI in each region decrease from eastern to western in sequence.

[5] According to *China Statistic Yearbook*, FDI flows towards industry of China accounts for 77% of total inward FDI into China over year 2000 to 2003. The data employed in estimation is available from the website of National Bureau of Statistics of China: http://www.stats.gov.cn/english/statisticaldata/yearlydata/.

Table 2: Estimation Results (based on the widely used division criterion)

	Nation		The Eastern Region	
	Fixed OLS	Fixed GLS	Fixed OLS	Fixed GLS
C	0.093***	0.097***	0.097***	0.084***
α	0.333***	0.301***	0.144	0.098
β	0.025	0.097*	0.413***	0.453***
γ	0.853***	0.855***	0.885***	1.066***
	The Central Region		The Western Region	
	Fixed OLS	Fixed GLS	Fixed OLS	Fixed GLS
C	0.095***	0.109***	0.102***	0.121***
α	0.283*	0.226**	0.367*	0.215***
β	-0.0167	0.067	0.143	0.069
γ	0.670*	0.481***	0.737	0.04

Table 2 reports the estimation results of equation (5) based on the widely used division criterion. Firstly, the coefficients of the capital, α, for each region are all significant and ranged from about 0.2 to 0.3 except for the eastern region, in which the coefficient of capital seems to be smaller than expected and is not significant. On the other hand, the labor's coefficients which varied from 0.025 0.453 in the different estimations are almost not significant. The only exception is the eastern region whose labor's coefficient is relatively large and is significant at 1% level. The differences on the size and the significance between the labor and the capital's coefficients across the three regions may be attributed to these regions' different economic development level. In the eastern region where economic reform is improved faster than other regions and has a relatively strong economic performance, an increase in capital in this region does not necessarily lead to a significant growth. However, an increases in labor in this region seems significantly contribute to the growth, according to the estimation results. This may simply indicates the fact that the eastern is lack of the labor to maintain continuous economic growth.

Compared with the strong effect of labor in the eastern region, the capital in the other two regions played a relatively big role. The coefficients of the capital remain at about 0.2 and are all significant. It shows that an increases in physical investment will lead an improvement on the growth in these two regions.

What we concern is the coefficient of the interaction variable of the share of FDI in GDP and the growth rates of FDI's output, which is defined as $\partial D/\partial Y_f$ and presents the external effect arising from the entry of FDI into the host country's market. As the result shows, for every region, γ has the largest value and has a

relatively high significant level, regardless of the employed estimation method. The only exception is the western region in which the coefficient is not stable and is insignificant. However, its sign is still positive as the coefficient in the other two regions. This at least embodies two folds of meanings. Firstly, it shows that the entry of FDI into China has significantly boost the production of domestic firm, namely there does exist strong positive external effect from multinational firm to domestic firm since the coefficient of external effect term is the largest one among the three factors contributing to growth of China. On the other hand, the differences on the role of FDI across three regions is not so obvious as we supposed previously. It is because that the sign of the coefficients in three estimations for three regions are all above zero. The expected negative external effect in the central or the western region did not occurred.

The results in Tables2 may not conflict with the previous research's conclusion that the external effect of FDI depends upon the absorption ability of host country. In the case that each region in China during the observation object has reached to the threshold necessary to benefit the external effect of FDI, it is hardly to expect that in one of regions there will be a negative external effect coefficient. Compared with the huge disparity of the distribution on the capital among these three regions in China, the human capital averagely distributes among the eastern, the central and the west regions. The human capital is one of the most important decision factors for the absorption ability related to the external effect of FDI.

It seems that we have found the answer for the external effect of FDI in China. However, it is not true. Since our estimation results seriously depend upon the ambiguous division criterion, we cannot deny the misleading possibility due to the wrong estimation results which may be caused by the predefined division criterion. Hence, in the next sections, we will apply Hansen's threshold method to deicide the optimal division criterion and will re-estimate equation.

2.4: Threshold Model

2.4.1: Estimating Threshold Value

In this paper, per capita GDP is considered as a threshold variable to measure the level of the local economic development. Empirical analyses are based on Hansen's earlier research and we will start describing the procedure from one threshold model.

In case of one threshold model, linear estimation equation (6) becomes a nonlinear equation, one of the available forms for this non-linear equation is:

$$\left(\frac{\dot{Y}}{Y}\right)_{it} = c + \mu_i + \alpha\left(\frac{\dot{K}}{K}\right)_{it} + \beta\left(\frac{\dot{L}}{L}\right)_{it} + \gamma_1\left(\frac{Y_f\dot{Y}_f}{YY_f}\right)_{it}(py_{it} \le v) + \gamma_2\left(\frac{Y_f\dot{Y}_f}{YY_f}\right)_{it}(py_{it} > v) + \varepsilon_{it} \quad (7)$$

where, py, $\hat{v}$ denotes per capita GDP and the estimated threshold, respectively.

Firstly, by subtracting the period mean of equation (7) from equation (7), we can "wipe out" the

individual effects: μ_i, and then rearrange the panel data set based on the sequence of the threshold variable py. Secondly, by applying OLS to the differenced equation (7) $nt-4$ times with $nt-4$ sets of data, we can obtain a column vector which have $nt-4$ squared residual sums in its column. The minimum element in the column vector is our concern and the corresponding value of the threshold variable is decided as the estimated threshold value.

Define $\left(\dot{Y}/Y\right)_{it}=y_{it}$, $\left(\dot{K}/K\right)_{it}=k_{it}$, $\left(\dot{L}/L\right)_{it}=l_{it}$, $(Y_f\dot{Y}_f/YY_f)_{it}=fy_{it}$, then the differenced estimation equation is:

$$dy_{it}=\alpha dk_{it}+\beta dl_{it}+\gamma_1 dfy_{it}(py_{it}\le v)+\gamma_2 dfy_{it}(py_{it}>v)+\varepsilon_{it} \quad (8)$$

where

$$dy_{it}=y_{it}-\frac{1}{T}\sum_{t=1}^{T}y_{it},\ dk_{it}=k_{it}-\frac{1}{T}\sum_{t=1}^{T}k_{it},\ dl_{it}=l_{it}-\frac{1}{T}\sum_{t=1}^{T}l_{it},\ dfy_{it}=fy_{it}-\frac{1}{T}\sum_{t=1}^{T}fy_{it} \quad (9)$$

So the sum of the squared residuals of (9) is:

$$S_1(\hat{v})=e(\hat{v})'e(\hat{v})$$

And the least squares estimation of v is:

$$\hat{v}=\arg\min S_1(v)$$

4.2: Testing Threshold Value

One of difficulties of threshold model lies on how to test threshold. That is: since under H_0 the threshold is not identified, classical tests have non-standard distribution. Hansen (1996) suggested a bootstrap to simulate the asymptotic distribution of the likelihood ration test and then infer a p-value for null hypothesis $H_0:\delta_1=\delta_2$ which means that there is not a threshold in equation (7). The likelihood test of H_0 is based on:

$$F_1=\frac{S_0-S_1(\hat{v})}{\hat{\sigma}^2}$$

where S_0 is the sum of the squared residuals for the non-threshold model and $\hat{\sigma}^2$ is the variance estimator of the residual, defined as $S_1(\hat{v})/N(T-1)$. Since under H_0, $\hat{v}$ does not exist, the critical values cannot be tabulated. Following Hansen (1996), I use bootstrap methodology to obtain the p-value of H_0. The iteration times of bootstrap was set at 1000.

For testing the confidence intervals of $\hat{v}$, the best way is to form the non-rejection region using the likelihood ration statistic, which is advocated by Hansen (1999 a). Since in case of one threshold model, the estimated $\hat{v}$ is consistent for the true value v_0 (Chan 1993, Hansen 1999 a). I follow these and calculate the likelihood ratio as:

$$LR_1(\hat{v}) = \frac{S_1(v) - S_1(\hat{v})}{\hat{\sigma}^2}$$

Under the assumption proposed by Hansen (1999 b appendix) and null hypothesis $H_0 : \hat{v} = v_0$, Hansen (1999 b) has proven that $LR_1(\hat{v}) \to \xi$, as $n \to \infty$, where ξ is a random variable with the distribution function.

$$P(\xi \le x) = (1 - \exp(-\frac{x}{2}))^2$$

It is worth noting that there possibly exist two or three threshold values. The estimation and the testing for double or triple thresholds are similar with the estimation of one threshold model and readers can obtain a comprehensive understanding on this issue by refereeing Hansen (1999 b). What I do emphasize here is: as Bai (1997) noted, the second threshold is asymptotic efficient but not the first threshold value since the estimate of the first threshold value is obtained from the model that ignores the presence of the second threshold.

Theoretically, to implement $\hat{v} = \arg\min S_1(v)$, equation (8) should be estimated for $NT - 4$ times. In practical, however, it is numerically intensive when NT becomes large. In this paper, I selected 97 values from 116 threshold observations as the estimated threshold values. They lie at the point of 0.02, 0.04, 0.08, … , 0.98 in the order of the threshold variable, respectively[6].

4.3: The result for Threshold Estimation

Table 3 reports the results based on three assumptions: single threshold, double thresholds and triple thresholds[7]. As for single threshold model, even the estimated single threshold, 0.557, falls inside of the 95% confidence region (0.309~3.012), we still cannot reject the hypothesis of non-threshold since the bootstrap p-value for null hypothesis of $\gamma_1(v) = \gamma_2(v)$: 0.516 is far larger than the widely used significant level. Readers can also confirm that non-threshold cannot be rejected in both double and triple threshold models, according to their corresponding bootstrap *p*-value. The coefficients of the capital growth, however, ranged from 0.141 to 0.153 and are all significant at the widely used significant level. On the other hand, the coefficient for labor growth is insignificant and its value seems to be underestimated.

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[6] It means that the order index of the first estimated threshold values is $116 \times 0.02 = 2.32 \approx 2$ and the second index is $116 \times 0.04 = 4.64 \approx 4$. The procedure will be continued until the last index, which is $116 \times 0.98 = 113.68 \approx 113$.

[7] The program of Gauss for this paper is available for request. Readers can also download Hansen's original Gauss program from his site: http://www.ssc.wisc.edu/~bhansen/progs/progs_threshold.html

Table 3: Threshold Estimation

	Single Threshold Model	Double Threshold Model	Triple Threshold Model
The 1st Threshold Estimate	0.557	0.557	0.557
The 2nd Threshold Estimate		0.490	0.490
The 3rd Threshold Estimate			0.563
p-Value	0.516	0.389	0.589
Confidence Region	0.309~3.012	0.309~3.012	0.309~3.012
α	0.153** (1.628)	0.141* (1.516)	0.153*** (1.663)
β	0.069 (1.131)	0.064 (1.054)	0.071 (1.164)
γ_1	0.018 (when py<0.557) (0.041)	1.562**(when py<0.490) (1.702)	1.607***(when py<0.490) (-0.637)
γ_2	0.724***(when py>0.557) (6.256)	-0.360(when 0.490<py<0.557) (-0.768)	-0.297(when 0.490<py<0.557) (0.637)
γ_3		0.776***(when py>0.557) (6.309)	2.864***(when <0.557py<0.563) (2.282)
γ_4			0.765***(when py<0.563) (6.271)

The results of threshold model are consistent with the earlier results of Table 2 in which all coefficients of the external effect variable are positive and significant except for γ_2 in double and triple threshold estimations. And also all hypothesizes of $\gamma_1(v)=\gamma_2(v)$, $\gamma_1(v)=\gamma_2(v)=\gamma_3(v)$ and $\gamma_1(v)=\gamma_2(v)=\gamma_3(v)=\gamma_4(v)$ can never be rejected according to the bootstrap values. Further, only when *py* is larger than 0.557, the corresponding external term coefficient threshold which ranges from 0.724~0.765, is near the estimated value for the external effect variable in Table 2.

According to the results of Table 2 and Table 3, we can conclude: the external effect of FDI is identical

across the eastern, the central and the western region where entry of the multinational firm into local market does boost the output of the domestic firm. Why does not the external effect of FDI vary across the three regions even if the disparity of economic development among the three regions in China is so serious? The reason may attribute to the fact that the external effect of FDI mainly depends upon the human capital resource and the institution of the local market and so on. However, the differences on these factors among the three regions are not so large that FDI play a different role regarding the external effects. During the observation period, people can freely move in China and all local governments are very eager to invite FDI into their provinces. In fact, it creates a situation that FDI faces the same investment environment across the three regions. Hence, we can not find any evidence supporting the dependence of FDI's external effect on human capital during the observation period[8].

2.5: Conclusion

Starting from a domestic production function embodying the output of multinational firm, this paper built a model in which the external effects of FDI are presented by the output of the growth rate of FDI's and its output share in GDP. Firstly, we estimated the model based on the widely used division criterion. The results show that the external effect of FDI is identical across the eastern, the central and the western region. Apart from this, we also confirm that the labor played a larger role on economy growth than capital in the eastern region whereas the capital contributes more to the growth than labor in the central and the western region. These results indicate the fact that these three regions stand at the different development level.

In the second estimation, we apply Hansen's threshold method to decide whether there is any threshold in China. Per capita GDP is considered as threshold variable. The estimations are carried out under the assumptions that there exist single, double and triple thresholds in the model. The results support the hypothesis of non-threshold. The estimated external effect value is also near the value in the estimation based on the experiential division criterion. The same results can also be founded about the estimated coefficient of labor and capital.

There are two possible explanations why it cannot be found the dependence of FDI's external effect in China. One is that the development level in every region in China has reached to the threshold necessarily to benefit FDI's external effect during the observation period from 2000 to 2003. The second one, which may reflect the same fact as the first explanation, is that the important decision factors for FDI's external effect, such as human capital, institution and son on, are similar across the each region in China. Hence, in order to analyze the dependence of FDI's external effect, it seems to be more appropriate to use a world

[8] Due to the lack of the reliable data, we can not investigate further to analyze the external effect of FDI before year 1998 in China.

panel data instead of a single country's data.

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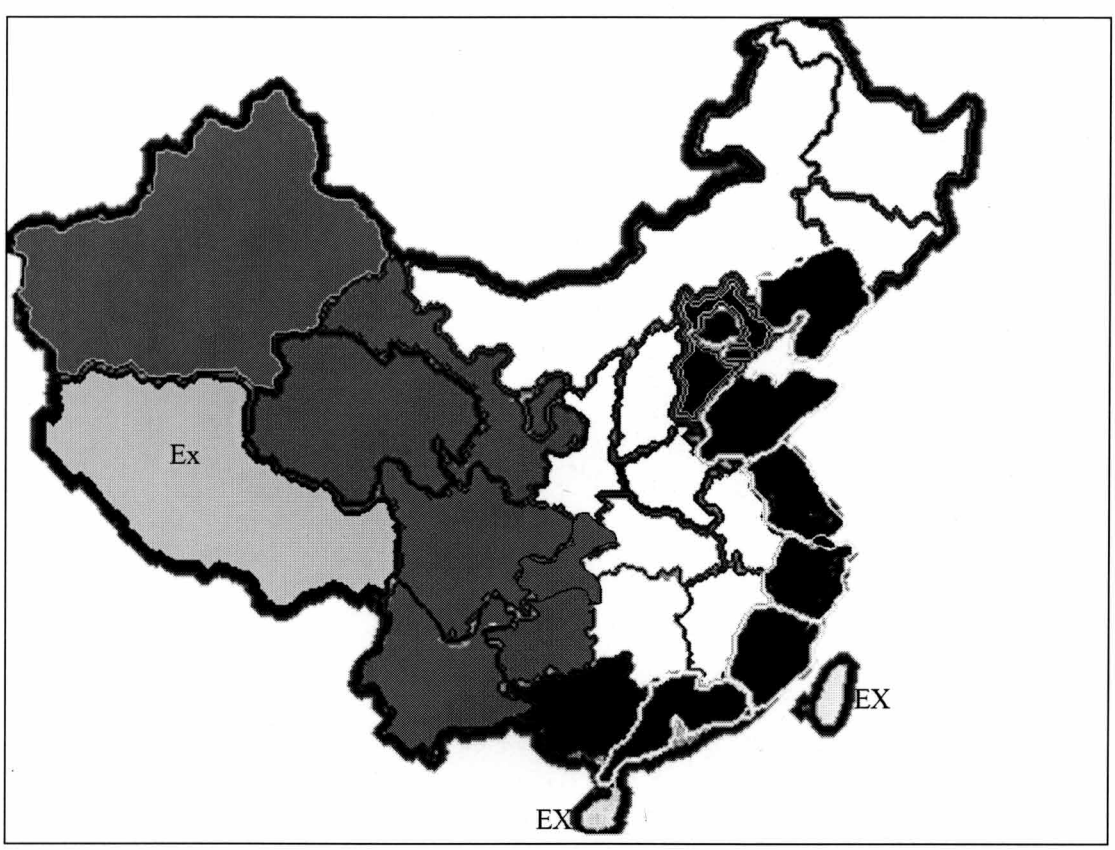
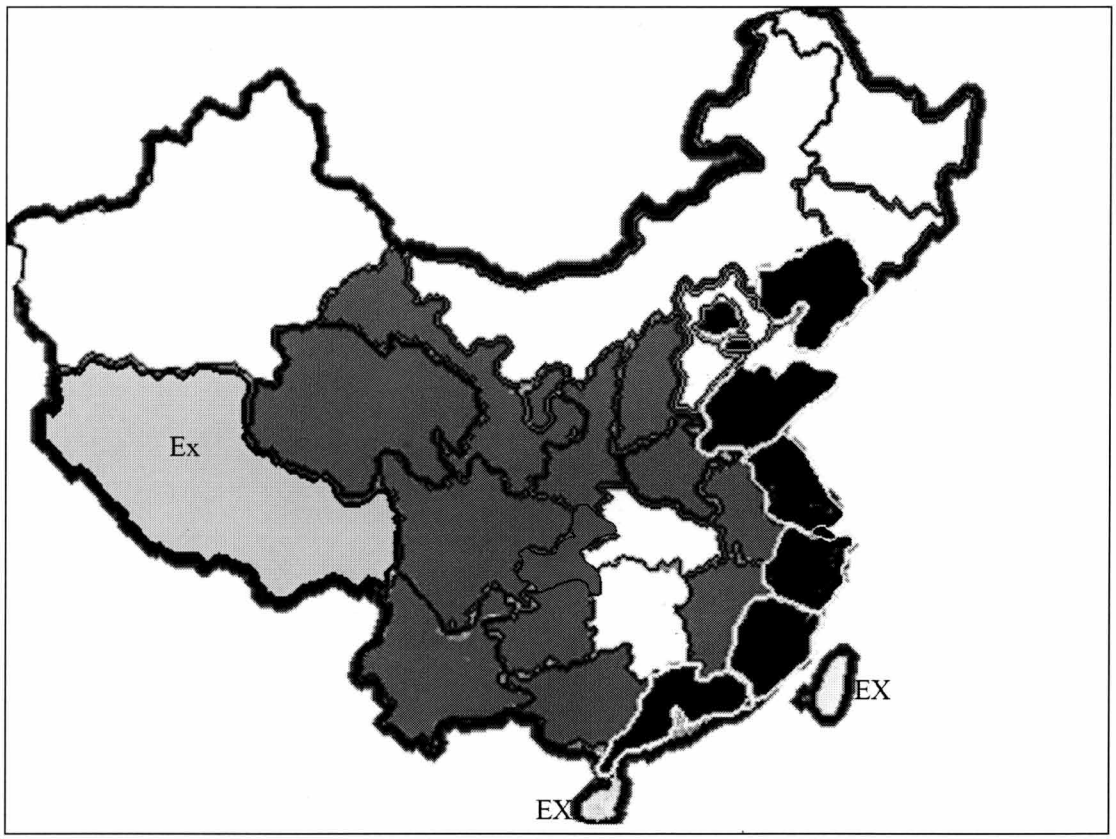
Graph 1: Division Based on the widely used criterion



Graph 2: Division based on the two thresholds



Note: Tibet and Hainan provinces are excluded

Chapter 3: What Causes What in Chinese Economy: Causality Tests based on a Panel VAR Model

3.1: Introduction

Investment and trade are widely considered as two key important forces that drive China's economic growth. In particular, FDI, as a vehicle of foreign technology, has significantly improved the productivity in China. Since most MNEs are more interesting in processing and assembling trade than China's market share, inflow of FDI to China has dramatically increasingly expanded the amount of trade of China. For example, China is the third largest recipient of inward FDI and the third largest trade country in the world during the 2004[9]. By the 2003, the share of imports and exports by MNEs rose to over 50% in national trade, respectively.

Nevertheless, the domestic investment still plays a major role in China's capital formation. According to date from statistic yearbook of China, the investment in fixed assets by stated-owner enterprises and private enterprises covered over 80% to 90% in China's total investment in fixed assets through 1992 to 2003.

Using China 29 provinces' panel data, based on a dynamic panel VAR (vector autoregression) model, this chapter attempts to provide an explicit understanding on the role of FDI, domestic investment and their trade in China.

Most previous papers have focused on the relation between FDI and trade by embodying national imports and exports into a Granger causality model despite the fact that half of trade is achieved by domestic enterprises. In those papers, some suffer from an unreliable data; for example, Xiaohui Liu, Peter Burridge, P.J.N.Sinclair (2002), who used estimated GDP quarterly data to examine the causality relations among economic growth, FDI and exports. Some papers suffer from an inappropriate method, for example, Xiaming Liu and Chengang Wang and Yingqi Wei (2001), Qing Zhang, Bruce Felmingham (2001). Both of them are based on a pooled model, which ignores the heteroskedasticity of panel data. It is well known that OLS estimator is seriously biased for a dynamic panel model with individual effect (Hsiao 2003 p73), which might describe economic phenomenon more delicately than pooled model.

In contrast, the paper has three new characters. Firstly, by dividing China's national investment into three parts including FDI, stated-owner investment and private investment, the paper attempts to describe the different impacts of the three kinds of investment on China's economic growth. In order to avoid an

[9] Data source: World Investment Report 2005, UNCTAD

inconsistent estimation caused by the heteroskedasticity across cross-sections, we employ system generalize methods of moment (SYS GMM), which leads to a consistent and asymptotic efficient estimator in a dynamic panel model. The reminder of this paper is structured as follows: Section 2 describes the econometric method. The empirical results are shown in section 3. Section 4 concludes. Data source is shown in Appendix A.

3.2: Econometric Methodology

1: Selection of Estimation Method for a Dynamic Panel Model

Causality test with panel data presents a problem associated with dynamic panel data analysis. It is well known that in a dynamic panel model the OLS estimator is biased and inconsistent due to the presences of a lagged independent variable and an individual effect in right side of estimation equation. The fixed effect estimator which applies OLS to the transformed equation will be biased of $O(1/T)$ and its consistency will depend upon T being large; see Nickell (1981)[10]. However, the Monte Carlo experiments performed by Judson and Owen (1999) show that the bias in the fixed effect estimator can be sizeable, even when $T = 30$. Arellano and Bond (1991) proposed a generalized method of moments (GMM) procedure that is consistent and more efficient, when N is infinite and T is fixed. In their literature, the orthogonal conditions $E(y_{i,t-2}\Delta v_{it}) = 0$ are considered and the covariance matrix of the differenced disturbances is used to calculate a one-step estimator and a more efficient two-step estimator. However, as Arellano and Bond (1991) noted, compared with the standard error of the two-step estimator, the one-step's standard error is more reliable. An alternative method to address this problem is proposed by Arellano and Bover (1995) who use lagged difference of y_{it} as instruments for equations in levels, in addition to lagged levels of y_{it} as instruments for equations in first differences. Monte Carlo simulations and asymptotic variance calculations show that this extended GMM estimator (hereafter SYS GMM) offers dramatic efficiency in the simulations where the basic first-differenced GMM estimators perform poorly (see Blundell and Bond, 1998). Because the coefficient of the lagged dependent variable increases toward unity and the relative variance of the fixed effect u_i increases. Even though a few econometricians (See Ziliak 1997; Judson and

[10] In one-lagged dependent variable estimation equation without other exogenous variable, the downward bias is approximately equal: $-(1-\beta)/(T-1)$. For the equation with exogenous variable, the direction of bias depend upon the correlation between exogenous variables and $\tilde{y}_{-1}$.

Owen 1999; Kiviet 1995) have noted that the strategy of exploiting all the moment conditions for GMM estimation is not actually recommended for panel data applications (see Hsiao, 2003), since the downward bias can be sizeable in a model with a huge number of moment conditions (see Doran and Schmidt, 2005). However, in a situation where a superior method is not clear the SYS GMM seems to be a relatively safe choice (Bun and Kiviet, 2005). In fact, in a sense that we focus on the estimated standard errors of the coefficient rather than the magnitudes of the estimated coefficient, the SYS GMM performs very well. In order to avoid the downward bias of the standard error in small samples, following Windmeijer (2005), we adjust the variance of the estimators. To explain the econometric procedure employed in this paper, firstly let us consider a simple model only with the first lagged dependent variable, which does not affect the accuracy of the inferences for a multivariable model.

2: Assumption[11]

$$y_{it} = \gamma y_{i,t-1} + u_i + v_{it} \quad (3\text{-}1)$$

$$E\left[u_i\right] = 0,\ E\left[v_{it}\right] = 0,\ \ E\left[v_{it}u_i\right] = 0, \text{ for } i = 1,\cdots,N \ \text{ and } \ t = 2,\cdots,T \qquad (3\text{-}2)$$

And

$$E\left[v_{it}v_{is}\right] = 0 \text{ for } \ i = 1,\cdots,N \ \text{ and } \ \forall t \neq s \qquad (3\text{-}3)$$

Firstly, subtract y_{it-1} from y_{it} to wipe out individual effect u_i and obtain equation (1-2), rewrite it as:

$$\Delta y_{it} = \gamma \Delta y_{i,t-1} + \Delta v_{it} \quad (3\text{-}9)$$

The orthogonality conditions for the first difference equation are shown as:

$$E\left[y_{i,t-s}\Delta v_{it}\right] = 0, \text{ for } \ t = 3,\ldots,T \ \text{ and } \ 2 \leq s \leq t-1 \qquad (3\text{-}4)$$

For the level equation (3-1):

The orthogonal conditions are given by:

$$E\left[\Delta y_{i,t-1}v_{it}\right] = 0, \text{ for } \ t = 3,\ldots,T.$$

This can be expressed as:

[11] The restrictions on the initial conditions and some other conditions that emphasized by Blundell and Bond (1998) are omitted for simplicity.

$$\mathbf{p_i} = \begin{bmatrix} \Delta \mathbf{u_i} \\ \mathbf{u_i} \end{bmatrix}, E\left[\mathbf{Z}_{si}' \mathbf{p}_i\right] = 0$$

Where

$$\mathbf{Z_{si}} = \begin{bmatrix} \mathbf{Z_{di}} & \mathbf{0} \\ \mathbf{0} & \mathbf{Z_{li}} \end{bmatrix} = \begin{bmatrix} \mathbf{Z_{di}} & 0 & 0 & \cdots & 0 \\ 0 & \Delta y_{i2} & 0 & \cdots & 0 \\ 0 & 0 & \Delta y_{i3} & \cdots & 0 \\ \vdots & \vdots & \vdots & \cdots & 0 \\ 0 & 0 & 0 & \cdots & \Delta y_{iT-1} \end{bmatrix}$$

$$\mathbf{Z_{di}} = \begin{bmatrix} y_{i1} & 0 & 0 & \cdots & 0 & \cdots & 0 \\ 0 & y_{i1} & y_{i2} & \cdots & 0 & \cdots & \\ \vdots & \vdots & \vdots & \cdots & \vdots & \cdots & \\ 0 & 0 & 0 & \cdots & y_{i1} & \cdots & y_{iT-2} \end{bmatrix}$$

$\mathbf{Z_{si}}$ is the instrument of SYS GMM, $\mathbf{Z_{di}}$ and $\mathbf{Z_{li}}$ are the instruments for the first-differenced equation and level equation, respectively.

Then the SYS GMM estimator is given by:

$$\hat{\gamma}_s = \left(\mathbf{q}_{-1}' \mathbf{Z_s} \left(\mathbf{Z_s}' \mathbf{Z_s} \right)^{-1} \mathbf{Z_s}' \mathbf{q}_{-1} \right) \mathbf{q}_{-1}' \mathbf{Z_s} \left(\mathbf{Z_s}' \mathbf{Z_s} \right)^{-1} \mathbf{Z_s}' \mathbf{q}$$

Where

$$\mathbf{q_i} = \begin{bmatrix} \Delta \mathbf{y_i} \\ \mathbf{y_i} \end{bmatrix}$$

3: AR Test and Hansen Test

Arellano and Bond (1991) propose a test for the hypothesis that there is no second-order autocorrelation for the disturbance of the first-differenced equation. The test is important because the consistency of the GMM estimator relies upon the fact: $E[\Delta v_{it} \Delta v_{i,t-2}] = 0$, $E[\Delta v_{it} \Delta v_{i,t-1}] \neq 0$, which come from the initial assumption described in section 3.1. Under the null of no autocorrelation the statistic of the test asymptotically distributed as $N(0,1)$, so if the errors in levels were uncorrelated, we would expect AR1 (test for the first order autocorrelation) to be significant, but not AR2 (test for the second order autocorrelation), namely, if the assumption (3-3) was satisfied, a strong first order autocorrelation of the residuals in the first-differenced equation would be expected but not the second order autocorrelation. Therefore, we would expect a low p-value for AR1 and a high p-value for AR2 if the regression model was correctly specified. For more detail we suggest readers consult Arellano and Bond (1991) or Arellano

(2003, p121).

The standard test for the validity of the moment conditions used in GMM estimation procedure is the Hansen test of overidentifying restrictions (Arellano and Bond 1991). Under the null that the moment conditions are valid, the statistic is asymptotic chi-squared distributed with $p-k$ degrees of freedom, where p is the number of the instruments and k is the number of estimated parameters.

Unfortunately, we cannot use the widely used information criterion such as AIC or SIC to determine the optimal lag length for SYS GMM model. Instead we predefined the lag length at three, considering the data frequency of FDI and the short observation period (from 1993 to 2003) in this paper. Even we select a relatively long lag length and therefore partly avoided the estimation misspecification problem, an identical result still cannot be obtained since the result in SYS GMM estimation also depend upon the instrumental variable. As mentioned above, a valid SYS GMM equation require a low AR test value and a high AR test value and its Hansen test value need to be above 10%. We select the appropriate instrumental variable according to these tests' results. In a situation that there are several equations that have valid AR value and Hansen value, we select the equation that has the largest Hansen statistic.

3.3: Empirical Results

1: Data Definition

The observation period is from 1993 to 2003. The variables employed in this paper are indicated as the follows: GDP is the real GDP of 29 provinces. The investment in fixed assets by MNEs, by stated-owner enterprise and by private enterprise is used as proximate variables for FDI, state-owned enterprise investments and private enterprise investments, respectively. Imports and exports are the import and export value of commodities by places of destination or origin in China by region.

2: Panel Unit root

As Hsiao (2003, p108) noted that only the roots of all variables fall outside the unit circle, the GMM estimator is consistent and asymptotic normally distributed when $N \to \infty$. Levin, Lin and Chue (2002 hereafter LLC) have developed a panel unit root test which is based on the assumption that the persistence parameters are common across cross-section. Alternatively, Im, Pesaran and Shin (1997 hereafter IPS) relax Levin and Lin's strong assumption of homogeneity on the autoregressive parameter and allow the parameter to vary freely across the cross-section. However, implicit in IPS test is the assumption that T is

the same for all cross-sectional and that the same lag length is used for all the ADF regressions for individual series. Maddala and Wu (1999 hereafter MW) suggest using Fisher's (1932) results to derive the test that combine the *p*-value from individual unit root test. Basically, LLC test is based on pooled regressions, since it allows homogeneity in the autoregressive parameter. On the other hand, MW test and IPS test, which are based on the heterogeneity of the autoregressive parameter, amount to a combination of different independent tests. To my knowledge, so far there has not a unit root test dominating applied research. Therefore, we tested all logarithmic variables used in this paper and found that all of them are stationary as Table 1 shows.

Table 1: Panel Unit Root Test

LLC				IPS			
	Trend and intercept	**Intercept**	**None**		**Trend and intercept**	**Intercept**	**None**
Ly	-9.068***	3.302	55.978	***Ly***	-1.098	9.339	-
Lf	-15.275***	-9.978***	4.599	***Lf***	-2.515***	-5.049***	-
Ls	-9.258***	0.774	12.508	***Ls***	-1.586*	5.535	-
Lp	-11.209***	-1.879**	11.641	***Lp***	-3.300***	2.48	-
Lim	-10.398***	0.778	16.155	***Lim***	-2.329***	5.659	-
Lex	-11.514***	-2.23	26.346	***Lex***	-2.472***	4.29	-
ADF				**PP**			
	Trend and intercept	**Intercept**	**None**		**Trend and intercept**	**Intercept**	**None**
Ly	97.382***	36.163	1.544	***Ly***	109.023***	83.072**	0.005
Lf	93.295***	131.381***	28.519	***Lf***	121.521***	155.558	31.147
Ls	91.464***	35.909	6.483	***Ls***	115.196***	55.794	3.521
Lp	120.233***	51.266	1.574	***Lp***	135.318***	74.936*	0.673
Lim	99.786***	20.669	2.481	***Lim***	118.560***	22.406	2.132
Lex	93.367***	25.243	0.889	***Lex***	115.497***	52.704	0.378

Note: □ ADF test is based on the ADF test of the individual time series data. PP test is based on the PP test of the individual time series data.

□: "*", "**", "***" refer to 10%, 5%, 1% significant level, respectively.

3: Empirical Results and Discussion

The dynamic model consists of six variables: GDP, FDI, state-owned enterprise investment, private enterprise investment, imports and export. These variables, after taking logarithm, are abbreviated to *Ly, Lf, Ls, Lp, Lim, Lex*, respectively in estimation equation. The causality regression equation can be described as

follows[12]:

$$\begin{bmatrix} Ly \\ Lf \\ Ls \\ Lp \\ Lim \\ Lex \end{bmatrix} = c + \begin{bmatrix} u_i^{Ly} \\ u_i^{Lf} \\ u_i^{Ls} \\ u_i^{Lp} \\ u_i^{Lim} \\ u_i^{Lex} \end{bmatrix} + \begin{bmatrix} \Phi_{11}(L) & \Phi_{12}(L) & \cdots & \Phi_{16}(L) \\ \Phi_{21}(L) & \Phi_{22}(L) & & \Phi_{26}(L) \\ & & & \\ & & \ddots & \vdots \\ \Phi_{61}(L) & & \cdots & \Phi_{66}(L) \end{bmatrix} \begin{bmatrix} Ly \\ Lf \\ Ls \\ Lp \\ Lim \\ Lex \end{bmatrix} + v_{it} \quad (4\text{-}1)$$

Where, u_i, v_{it} and other variables are all satisfied with the assumptions from (3-2) to (3-7). $\Phi_{mn}(L)$ is a lag operator. The idea of the multivariate Granger causality approach is: if $\Phi_{mn}(L)$, e.g, $\Phi_{12}(L)$ are jointly significantly different from zero, it is said that *Lf* Granger causes *Ly*. Empirical results are reported in Table 2.

Table 2: Causality Results

	Ly	***Lf***	***Ls***	***Lp***	***Lim***	***Lex***
Ly		0.09	7.13*	3.92	11.50***	3.29
Lf	15.63***		2.2	1.38	5.94	9.29**
Ls	2.56	1.64		13.73***	12.02***	8.63**
Lp	21.23***	6.78*	10.56**		3.39	20.19***
Lim	19.67***	4.18	5.1	5.75		7.92**
Lex	0.31	1.16	8.79**	2.43	13.8	
Iv	*iT-6 to iT-7*	*iT-2 to iT-3*	*iT-7 to iT-9*	*iT-3 to iT-5*	*iT-6*	*iT-2 to iT-9*
AR1	0.059	0.032	0.044	0.016	0.034	0.021
AR2	0.736	0.184	0.601	0.681	0.104	0.52
Hansen	0.136	0.128	0.347	0.294	0.533	0.067
Lag	3	3	3	3	3	3

Note 1: The first row shows dependent variables and the first column shows independent variables. Therefore, from the second column to the sixth column, cumulative coefficients of regression equations are tabulated vertically. The values in the table denote the chi-squared statistic for lagged coefficients. AR, Hansen test results, lag length and those instruments used in estimations are shown in the last four rows.

2: The instrument used in this paper is indicated as *iT-m*. Here *T* refers to the last yearly data of each cross-section and *m* denotes its lagged term's number from *T*. For example, in regression of *Ly*, "*iT-6 to iT-7*" are used as instruments, which means: two instruments, iT-6 and iT-7 terms, are used for the calculation of the corresponding orthogonality conditions in regression of *Ly*.

[12] It is worth noting that all independent variables are treated as exogenous variables except for the lagged dependent variables, namely, thy are not correlated with the error terms.

i): Regression results for GDP

The regression equation for GDP presents a considerable problem of which factor promotes China's economy growth effectively. With instruments from *iT-6* to *iT-7*, it is found three causality relations which run from FDI, private enterprise investment and imports to GDP, respectively.

It is not surprised that FDI and private enterprise investment played a positive role on China's economy. Compared with the inefficient stated-owner enterprises, these two kinds of enterprises have a high productivity and therefore significantly contribute to the recent China's economy growth. On the other hand, state-owned enterprise investments have not any significant dynamical causal impact on GDP growth.

Although there are strong theoretical reasons to believe that in an open economy imports can contribute to economic growth through several channels such as, productivity (Grossman and Helpman 1991), human capital, domestic firms' innovation (MacDonald, 1994), and so on. In this paper, the significant causality relation from imports to GDP may not necessarily refer to that positive effect mentioned above since imports also have a direct negative effect on GDP growth. Provided the fact that the accumulative coefficient of imports is above zero, we may conclude that imports does play a positive role on China's economic development[13]. It is worthy noting that the accumulative coefficients of FDI and private enterprise investment are also above zero.

There are several indirect channels through which exports affect economical growth[14]. Firstly, exports allow poor country with narrow domestic markets to benefit from economies of scale in a sense of comparative advantage (Helpman and Krugman, 1985). Baldwin (1992) and Mazumdar (1996) contribute to the theoretical analysis of trade and growth by linking international trade to Solow's neoclassical growth model.

Secondly, by exporting abroad, a developing country can obtain necessary foreign exchange to import capital goods and intermediate goods with which a developing might increase domestic enterprises' productivity.

In addition, exports could force a poor country to improve efficiency in resource location and, in particular, to increase capital utilization owing to competition in world market. Lastly, exports facilitate the diffusion of technical knowledge through learning-by-doing (Grossman and Helpman, 1991).

However, we could not find any evidence related to the dynamic impact from exports to China(s GDP growth.

[13] A variable's accumulative coefficient refers to the sum of the lagged variables' coefficient in estimation equation.
[14] The direct effect of exports on growth, which exports are a component of GDP, fall outside the discussion of the present paper since Granger causality test focus on the dynamic relation rather than instantaneous relation.

ii): Regression results for FDI

With the instruments from *iT-2* to *iT-3*, it is found that there is one causality relation which runs from private enterprise investment to FDI. However, the chi-squired statistics for the lagged coefficients of *Lp* is only slightly significant at 10% level.

The weak causal link form private enterprise investments to FDI may reflect the fact that the increase of private enterprises has contributed the investment environment's improvement and therefore has become an attractive factor for FDI location.

Regression for FDI highlights a problem of which factor significantly attracts inflow FDI to China. A few papers on this issue have confirmed the positive role of GDP on destination of FDI by embodying contemporary GDP into right side of regression equation (Frank S.T. Hsiao et al[15] 2004; Leonard K. Cheng[16] et al 2000). However, as the result above shows, since FDI significantly contributes to GDP growth in a positive way the positive coefficient of instantaneous GDP does not necessarily mean GDP can be treated as one of the determinants of FDI. As the result of the noncausality relation from GDP to FDI shows, an increase of GDP does not significantly associate with an increase in the amount of inward of FDI to China.

Theoretically, exports and imports are considered as sufficient proximate variables for openness when one consider location of FDI. It is because that an export promoting strategy is likely to both attract a higher volume of FDI and promote more efficient utilization than an import substituting strategy (Bhagwati 1994). The positive impact of trade on the location of inflow FDI to China is also confirmed in an instantaneous regression by a few researchers such as Wenhui and Wei (2005). However, according to the results of this paper, neither imports nor exports during period *t* Granger-cause the inflow of FDI of period *t*+1. It is because that this paper did not embody the ration of trade to GDP into the regression equation as did the previous papers.

iii): Regression results for the state-owned enterprise investment

With instruments from *iT-7* to *iT-9*, it is found three causality relations which run from GDP, private enterprise investment and exports to state-owned enterprise investment, respectively.

It is not difficult to explain the positive causal link from GDP to state-owned investment, which simply means that a fast growing county have to reinvestment to maintain a continuous growth. However, the evidence for this hypothesis is not strong since the significant level is only 10%.

The positive causal link form private enterprise investment to state-owned enterprise investment shows that the former did has a dynamical impact on the later. The positive scenario is that the increase on private

[15] This paper suffers from a bias arising from correlation between the lagged dependent variable and residual.
[16] This paper use Sargan test to check the endogeneity of the variables, which is inappropriate. Also the authors firstly calculate the value of AR 1 test and AR 2 test in the first-differenced equation and then use the value to evaluate the validity of SYS GMM specification, which is not correct.

fro China's economy growth. Provided the fact that FDI import materials from outside and export their products abroad, it is not surprising that there a causal link form imports to exports.

3.4: Conclusion

By examining the causality relations among GDP, FDI, state-owned investment, private investment, imports and exports in China, the present paper try to obtain a comprehensive understanding of the relation among economic growth, trade and FDI China.

The results of the present paper confirmed the impact of FDI, the private investment and imports on Chinese economic growth.

In contrast to the results that market size has a significant impact on location of FDI in case of China, I could not find a significant relationship between GDP of period t and FDI of period $t+1$, which means that the previous result may suffer from the employment of the contemporary data of FDI and GDP in their regression equation. It is because that according to the results of the paper, FDI significantly contributes to GDP growth.

As for the relations among the three kinds of investment, the increase in private investment has a slight impact on the inward FDI in China. The evidence for this hypothesis is not so strong. On the other hand, there is a two-way causality relation between state-owned investment and private investment, which may mean that they enhanced each other. Further, we did not find any evidence to support the hypothesis that inward FDI crowded out state-owned investment at national level.

The results of causality relations between trade and investment reflect the characteristic of the export-oriented of China's economy. The three kinds of enterprises, MNEs, state-owned enterprises and the private enterprises, all of them aimed to export their products to the world market. Among them, only an increase in state-owned enterprises raised the imports into China whereas GDP also had an impact on imports.

Appendix: Data Source

All data are from the corresponding tables of *China Statistical Yearbook* except for the indices of imports and exports, which are from the unpublished data of China Customs.

Real GDP of China's 29 provinces are calculated with the data of nominal GDP and their corresponding GDP index.

The data of investment in fixed assets are taken from Table 6-4. The investment in fixed assets by MNEs is the sum of the investment in fixed assets by foreign funded economic units and economic units with funds from Hong Kong, Maccao and Taiwan. The stated-owner investment is the sum of the total investment of the stated-owner units and the collective-owned units. The total private investment is the sum of other units.

The nominal data of exports and imports are taken from or calculated with the Table 17-12: *Value of Imports and Exports Goods of Foreign-funded Enterprises by Region* and the Table 17-11: *Import and Export Value of Commodities by Places of Destination or Origin in China by Region.* The exports and imports indices used to calculate the real value of imports and exports are from China's Customs. The original import and export indices are quarterly Paasch index except for the index of 2003, which is quarterly Fsher index and therefore, the yearly indices of exports and imports are obtained by taking the arithmetic average to these quarterly indices.

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Chapter 4: TFP and FDI in China

4.1: Introduction

There are lots of papers analyzing total factor productivity (TFP) in China and a common conclusion in these papers is that: China has achieved at least a respectable TFP growth during the reform period. However, few papers investigate which factor leads to the improvement in TFP growth of China. The present paper estimated the TFP growth rates of China's industrial sector with an approach different from the approach used by the earlier researchers. By accessing the causal link between the growth rate of TFP and FDI growth rates in China, this paper argues that the increasing TFP growth rates in China has become a sufficient attractive factor for FDI.

The concerns of those earlier papers are focused on the comparison of TFP growth rates between the prereform and the reform period. Borensztein and Ostry (1996) estimated TFP growth rates at 0.7% and 3.8% for the period 1953-1978 and the period 1979-1994, respectively. They argue that the true underlying productivity growth, in a sense of technical progress, is substantially lower due to the overestimated growth which arisen form the insufficient deflation of industrial output. They conclude that TFP growth in reform period comes from the process of relocation and the improvement in material incentives. Yong (2000) adjusted the data published by National Bureau of Statistics China (NBS) and found that TFP growth of China in period 1978-1998 is not so striking but respectable. He also speculated the accuracy of the industrial output data and the deflator reported by individual firms. Wang and Yao (2003) considered human capital as one of the independent production factor and estimated the average growth rates at 2.41% and 2.08% for the TFP growth and the human capital during the period 1978-1999.

Instead of the primary approach which employed the growth rate of capital and labor to estimate TFP, Nazrul (et al 2006) applied a different dual approach which is based on the growth rates of wage and the return to capital. They confirmed the high TFP growth rate during the reform period and noted that there has been some slowdown in TFP growth rate in recent years.

It is worth noting that the earlier papers mentioned above are all based on the assumption of perfect competition and the constant return to scale. Further, those papers are all treated deviation of output growth rate from the product of the growth rate of labor, capital and their corresponding share in GDP as the TFP growth rate. The present paper, however, estimates TFP growth based on growth equation regression and considers the regression residuals as the TFP growth and does not need the assumptions of perfect competition and constant return to scale. The only condition is that the elasticity of labor and capital to output are identical during the investigation period from 2000 to 2004.

The discussion of this paper is organized as follows: Section 2 simply describes data and provides the methodology of TFP estimation. In section 3, data source and TFP estimation results are reported. The

causal link between FDI and TFP is investigated in section 4. Section 5 concludes.

4.2: Data Description and the Methodology

Figure 1-3 describes the growth rate of output, capital and labor in industrial sector for nation and the eastern region and the inland region during the period from 2000 to 2004. Basically, the growth rate trends of the output and the capital remain at a high level whereas the labor growth rate for three parts all increased at very lower speed (minus value in case of nation from 2000 to 2001). It may indicate that the unit labor requirement in industrial has decreased in recent years. The eastern region has the highest growth rate on output and labor.

The approach for TFP estimates can be expressed as follows:

$$Y = F(K, L, TFP) \quad (1)$$

$$dY = \frac{\partial F}{\partial K} dK + \frac{\partial F}{\partial L} dL + \frac{\partial F}{\partial TFP} dTFP$$

$$\frac{dY}{Y} = \frac{\partial F}{\partial K}\frac{K}{Y}\frac{dK}{K} + \frac{\partial F}{\partial L}\frac{L}{Y}\frac{dL}{L} + \frac{\partial F}{\partial TFP}\frac{TFP}{Y}\frac{dTFP}{TFP}$$

$$\hat{Y} = \alpha\hat{K} + \beta\hat{L} + \gamma\frac{dTFP}{TFP} \quad (2)$$

$$\frac{dTFP}{TFP} = \frac{\hat{Y}}{\gamma} - \frac{\alpha}{\gamma}\hat{K} - \frac{\beta}{\gamma}\hat{L} \quad (3)$$

where Y, K, L and TFP are defined as output, capital, labor and total factor productivity, respectively, $\hat{Y}$, $\hat{K}$ and $\hat{L}$ denote their corresponding growth rates, α, β and γ denotes $\frac{\partial F}{\partial K}\frac{K}{Y}$, $\frac{\partial F}{\partial L}\frac{L}{Y}$ and $\frac{\partial F}{\partial TFP}\frac{TFP}{Y}$.

In those earlier TFP-related papers which assumed perfect competition and constant return to scale, α and β represent the capital and labor share in output and are time-varied variables that are subject to $\alpha + \beta = 1$. With their corresponding data in national account, the residuals of the equation (3) are considered as TFP growth by those papers.

However, as you can see, if one assumed a general production function instead of the predefined Cobb-Douglas production functions, we still need $\gamma = 1$ in order to consider the residuals as TFP growth rates even under the assumption of perfect competition and constant return to scale. With a few unrealistic assumptions and some problems arising from China's statistics data, it is difficult to obtain the reliable TFP estimates with the traditional TFP estimation approach.

For these reasons, this paper use the following estimation equation (4) to estimate TFP under the

assumption that α and β are constant during the estimation period.

$$\hat{Y}_{it} = c + c_i + \alpha \hat{K}_{it} + \beta \hat{L}_{it} + \mu_{it} \quad (4)$$

Firstly, we estimated equation (4) and then treated the residual $\hat{\mu}_{it}$ as the proxy for $\gamma\left(\frac{dTFP}{TFP}\right)_{it}$. Since the purpose of this paper is to investigate the causality relation between TFP and FDI, the relation between tow variables will not be affected by the employment of $\gamma\left(\frac{dTFP}{TFP}\right)_{it}$ instead of $\left(\frac{dTFP}{TFP}\right)_{it}$ in the later analysis of causality.

4.3: TFP Estimation

Due to the lack of capital stock data on national account, the analysis focused on China industry sector which has a relatively reliable data, especially for capital stock. The investigation is restricted from 2000 to 2004 and covers 29 provinces of China[17].

The industrial output, the capital stock and labor employed by industrial sector are from the chapter "Industry" in various China yearbooks and have been adjusted with their corresponding indices: Ex-Factory Price Indices of Industrial Products for industry output, Price Indices of Investment in Fixed Assets for capital stock. FDI data is taken from chapter "Foreign Trade and Economic Cooperation"and is also adjusted with Price Indices of Investment in Fixed Assets. The wage data which is employed to confirm the accuracy of the estimated TFP is from Chapter "Employment and Wages" and is adjusted with: Ex-Factory Price Indices of Industrial Products.

Before estimation, the stationarity of growth rate of all variables are checked with panel unit root tests and the results are reported in Table 1. All growth rates are stationary under various panel unit root tests except for $\hat{Y}$, whose unit root hypothesis can only be rejected on LLC and PP test. Since there is not a panel unit root test dominating empirical investigation, we will not consider the unit root problem arising from $\hat{Y}$.

Due to the short period of available data, it is difficult to define an estimation equation that each province has different coefficients during the investigation period. Instead of that, we start our discussion from equation (4) and only test whether the unobserved cross-section varied individual effect c_i is random effect or fixed effect. We omitted the time-varied individual effect e.g. c_t since embodying it into the equation may eliminate the time-related TFP growth rates from residuals.

The random model assumes that c_i is not correlated any independent variables. Its estimation basically is based on general least squared method. The fixed effect model which assumes c_i is correlated with

[17] We have to use panel data to deal with the significance problem arising from the short investigation period.

independent variable is estimated with within group method. Under the null hypothesis $H_0: E\left[c_i \middle| \mathbf{x}_{it}\right]=0$ ($\mathbf{x}_{it}$: independent variable vector), the random effect estimates are BLUE, consistent whereas the fixed effect estimates are consistent for both H_0 and $H_1: E\left[c_i \middle| \mathbf{x}_{it}\right]\neq 0$. Basically Hausman test ask if the within group estimators (for fixed effect model) and GLS estimators (fro random effect model) are significantly different (Cheng Hsiao 2003). Under H_0, $m=\hat{\mathbf{q}}'Var(\hat{\mathbf{q}})^{-1}\hat{\mathbf{q}}$ is distributed asymptotically as central chi-square, with K degrees of freedom[18].

Here $\hat{\mathbf{q}}=\hat{\mathbf{a}}_{withingroup}-\hat{\mathbf{a}}_{GLS}$, $\mathbf{Var}(\hat{\mathbf{q}})=\mathbf{Var}(\hat{\mathbf{a}}_{withingroup})-Var(\hat{\mathbf{a}}_{GLS})$, $\hat{\mathbf{a}}_{withingroup}$ and $\hat{\mathbf{a}}_{GLS}$ are coefficient vectors of fixed effect and random effects estimators, respectively. Hausman Test result in Table 2 shows that $H_0: E\left[c_i \middle| \mathbf{x}_{it}\right]=0$ can be rejected at 1% significant level, namely, the fixed effect model should be accepted for estimation equation (4).

The estimation results of equation (4) are tabulated into Table 3. As you can see, when we alert the assumption from homoscedasticity to heteroscedasticity, the estimated coefficients $\hat{K}$ (capital) declined from 0.236 to 0.165 whereas the coefficient of $\hat{L}$ rose from 0.146 to 0.313.

Under the assumption of perfect competition and constant return to scale, the labor share in GDP is considered as the coefficient of $\hat{L}$ by the earlier researchers. In their papers, the national labor share in GDP for reform period, namely the estimated coefficient of $\hat{L}$, range from 0.453 (Hun and Khan, 1997) to 0.536 (Li et al 1993) [19]. Here a similar value for $\hat{L}$ coefficient, 0.513, is also obtained under the assumption of $c_i=c$ and heteroscedasticity. Thus, if one ignored the unobserved time invariant individual effect of each province, he or she can obtain the similar results with the earlier papers. This may partly confirm that the approach employed by the present paper, at least, is the same sophisticated as that of the earlier papers which employ the different estimation approach.

Table 3 also reports the estimation results based on the data of the eastern 10 provinces and the results based on the remained 19 provinces[20]. The pooled eastern 10 provinces have the same economic character and received most inward FDI toward China whereas the remained 19 provinces are belong to the inward region and developed relative slowly. Compared with the inland regions, the elasticity of the capital and

[18] K is the number of the estimated coefficients.

[19] 0.58 for nation and 0.46 for non-agriculture sector (Young 2000), 0.5 (Wang and Yao 2003), 0.52 (Nazrul et al 2006). However, the concerns of the earlier paper are focused on China's national account which embodies agriculture and service sector. The two sectors may have a higher labor compensation share. It is worth noting that the estimated labor share only equals the coefficient of $\hat{L}$ on the condition of perfect competition which seldom exists in real world, especially for a transition economy such as China.

[20] The Hausman Test results for the eastern 10 provinces and the inland 19 provinces show that random effect model is acceptable for the former, and that the fixed model is acceptable for the later.

the labor to output in the eastern region is higher, especially for the labor.

Firstly, we take the residuals obtained from Estimation 1 to Estimation 4 as $\gamma\left(dTFP/_{TFP}\right)$ and then access all relations between the growth rate of between them and FDI. Table 4 reports various TFP growth rates for nation and each region, which are estimated with the different estimation methods. Graph 1~4 describe the trends of these TFP growth rate during the period 2000 to 2004. As for National level, the graphs show its TFP growth rate remains on the upward trend. However, the TFP growth rate in 2001 plunged into the value of -036% to -3.87%, which offset the growth rates of the others years[21]. Compared with the slowly growth rates of the inland region, the TFP growth rate of the eastern region remain at a higher scope, which arranges from 0.50% to 3.76% during the observation period. The excellent TFP performance of the eastern region can also be confirmed from graph 1 to 4 in which the inland region growth rates lies far behind the national level. Unfortunately, the results in this paper cannot be compared with the TFP growth rates estimated by the earlier researchers due to the different observation period and object. For example, Young (2000) conclude that the national TFP growth rate for China is 1.4% during 1978 to 1998. Wang and Yao (2003) estimated an average 2.41% of national TFP growth rate for the period from1978 to 1999. Nazrul (et al 2006) estimated an average 2.98% for the period from 1991 to 2002 with a different dual approach and argue there has been some slowdown in TFP growth rate in recent years.

In order to confirm the TFP growth rates obtained from equation (4), this paper also calculated the TFP growth rates, following the primary which is based on equation (3). The TFP growth rates are reported in Table 5 and Graph 5. Obviously the value is too high to believe.

4.4: Causality Testing

We assume the following equation to access the relation between TFP and FDI. Here GF is defined as the growth rate of FDI inflow to each province of China.

$$TFP_{it} = c + \alpha_l \sum_{l=1}^{p} TFP_{it} + \beta_l \sum_{l}^{p} GF_{it} + \mu_{it} \quad (5\text{-}1)$$

$$GF_{it} = c + \alpha_l \sum_{l=1}^{p} GF_{it} + \beta_l \sum_{l=1}^{p} TFP_{it} + \mu_{it} \quad (5\text{-}2)$$

The results in Table 6 show various causal relations of the growth rate of FDI and TFP growth rates. The TFP growth rates employed here are obtained from the residuals of estimation equation (4) which is applied to different estimation methods. All results lead to the same conclusion that TFP growth rates

[21] Further evidences are needed to investigate the reduction of the TFP in year 2001.

cause FDI but not vice versa except for fixed OLS method in which there is not any causal relation between FDI and TFP.

Even a few papers have found some evidences showing that there are some the positive external effects from FDI to China's national productivity growth during the reform period. The causality results presented here support the reverse hypothesis. That is: the increasing TFP growth has become a new sufficient attractive factor for FDI in recent years. It is quiet natural to assume that FDI in a high productivity economy can benefit a lot from the qualified labor, good economic institution and efficient local firm and so forth. These factors are all accounted into TFP factors in equation (4).

4.5: Conclusion

Starting from Solow model, this paper applied OLS and GLS to the traditional growth accounting analyses and considered the residuals obtained form the regression equation (4) as TFP growth rate.

Due to the limitation on the reliable data source, instead of national account data, this paper employed China 29 provinces' industrial panel data to estimate TFP growth rate. One of the reasons for this is: most FDI inflow into China concentrate on the industrial sector. Omitting other inflow FDI does not significantly affect the final causal investigation.

The estimated average TFP growth rates of China during the observation period is not so amazing as the earlier TFP growth rates estimated by the earlier researchers. Basically the TFP growth rates show an upward trend. However, a large minus growth in 2001 offset other positive growth and led to a zero average growth.

The estimated causality results all direct to the same conclusion that the increasing TFP has caused the inflow FDI to China but no vice versa. It means that high productivity has become a sufficient determinant for FDI location in recent years.

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Table 1: Panel Unit Root Test Roots

Growth	Growth			Capital Stock			Labor			LF		
	Trend&interception	Interception	None	Trend&interception	Interception	None	Trend&interception	Interception	None	Trend&interception	Interception	None
LLC	-20.9***	-4.9***	4.7	-75.7***	-18.7***	-6.5***	-23.0***	1.7	-6.6***	-0.5	-11.5***	-11.1
IPS	-1.2	-0.5		-12.7***	-7.5***		-2.1**	1.62		-0.5	-3.7***	
ADF	60.0	56.4	30.1	121.6***	127.5***	110.6***	75.6*	47.6	108.0***	54.4	85.2***	162.7***
PP	101.7**	68.3	25.9	173.1***	138.9***	111.0***	128.1***	55.4	123.8***	73.5*	92.7***	163.2***

Table 2: Hausman Test

Hausman Test	Chi-Sq. Statistic	Prob.
	19.503	0.0001

Table 3: The Results of TFP Estimation

	Estimation 1		Estimation 2		Estimation 3	Estimation 4
	Nation (common)		Nation (fixed)		Eastern provinces (random)	The remain (fixed)
	OLS	GLS	OLS	GLS	GLS	GLS
c	0.153***	0.170***	0.153***	0.159***	0.172***	0.150***
	(17.096)	(24.771)	(19.029)	(30.440)	(13.302)	(21.789)
$\hat{K}$	0.253***	0.137*	0.236***	0.165***	0.20	0.109
	(2.684)	(1.884)	(2.788)	3.007	(1.397)	(1.569)
$\hat{L}$	0.280	0.513	0.146**	0.313***	0.537***	0.247***
	2.429	(7.334)	(2.290)	(5.116)	(4.239)	3.454
AD R	0.192	0.341	0.307	0.682	0.372	0.521
DW	1.559	1.824	1.947	2.187	2.39	1.965

Table 4: The TFP of Nation and each region (based on the estimation residuals)

	Nation				East				Inland			
	common		Fixed effect		Common		Fixed effect		common		Fixed effect	
	OLS	GLS	OLS	GLS	OLS	GLS	OLS	GLS	OLS	GLS	OLS	GLS
2000	-2.97%	-2.67%	-3.67%	-2.98%	0.29%	0.12%	-2.66%	-1.71%	-4.68%	-4.15%	-4.21%	-3.64%
2001	-3.52%	-3.44%	-3.87%	-3.36%	-2.92%	-4.24%	-5.49%	-5.34%	-3.83%	-3.01%	-3.01%	-2.32%
2002	-0.31%	-1.68%	0.09%	-0.42%	2.65%	1.22%	0.50%	0.53%	-1.87%	-3.20%	-0.13%	-0.92%
2003	2.68%	2.42%	2.80%	3.03%	5.61%	3.70%	3.89%	3.56%	1.14%	1.75%	2.23%	2.76%
2004	4.11%	2.10%	4.65%	3.72%	5.49%	2.83%	3.76%	2.96%	3.38%	1.72%	5.12%	4.12%

Table 5: The TFP of Nation and each region (the primary approach)

	nation	east	inland
2000	7.74%	10.58%	8.28%
2001	6.20%	9.91%	5.88%
2002	9.74%	13.05%	10.56%
2003	9.82%	15.34%	9.49%
2004	15.05%	18.72%	17.08%

Table 6: Causality relation between TFP and FDI

		Common				Fixed			
		OLS		GLS		OLS		GLS	
		Independent Variable				Independent Variable			
		TFP	GF	TFP	LF	TFP	GF	TFP	GF
Dependent Variable	TFP		8.106***		18.205***		6.217		14.376***
	GF	1.769		2.356		4.697		7.286	
	lag length	2		2		4		4	

Note: TFP denotes growth rate of TFP whereas LF indicates logarithm transformation of FDI inflow to each provinces.

Figure 1: Growth Rate of China's Industry Outtput

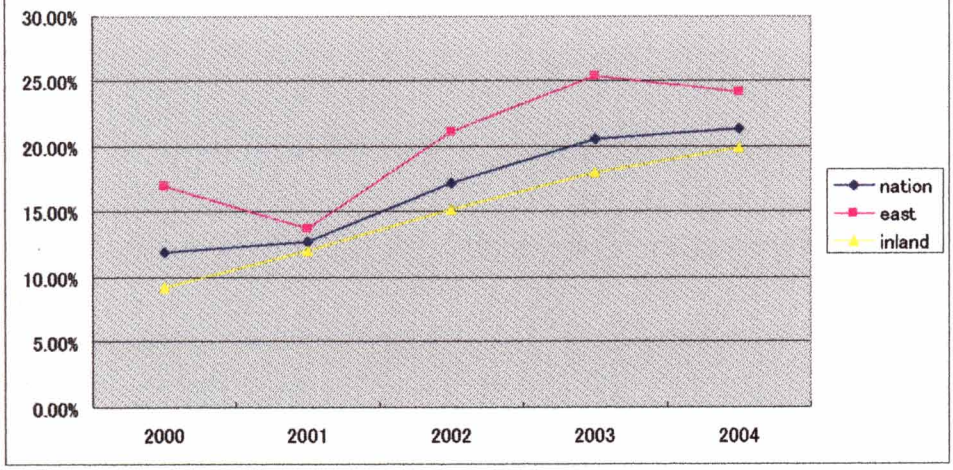


Figure 2: Growth Rate of China's Industry Captial

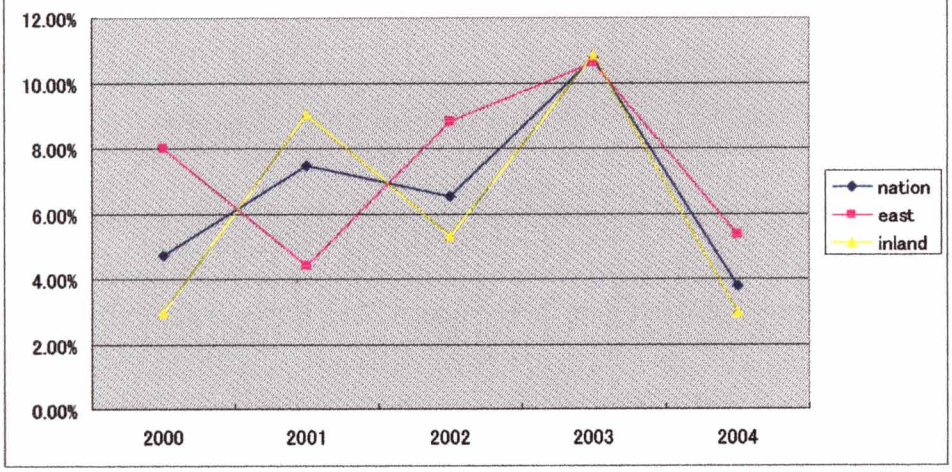
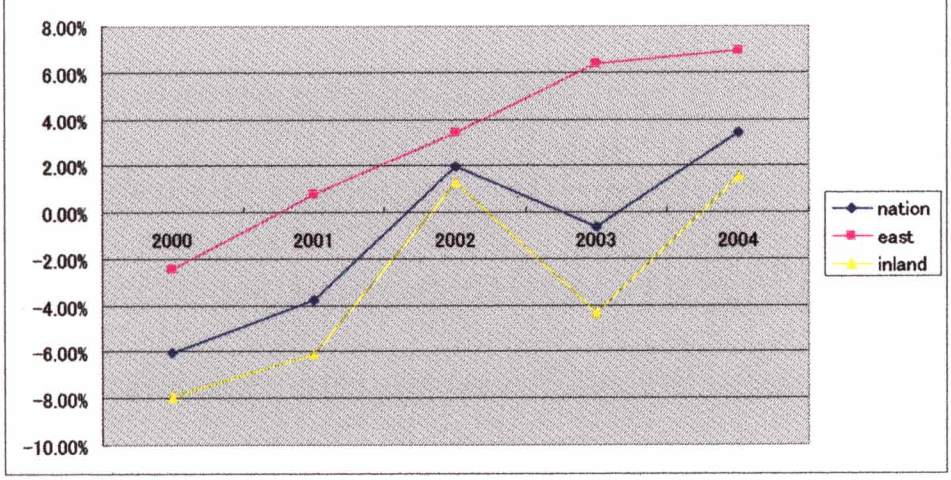
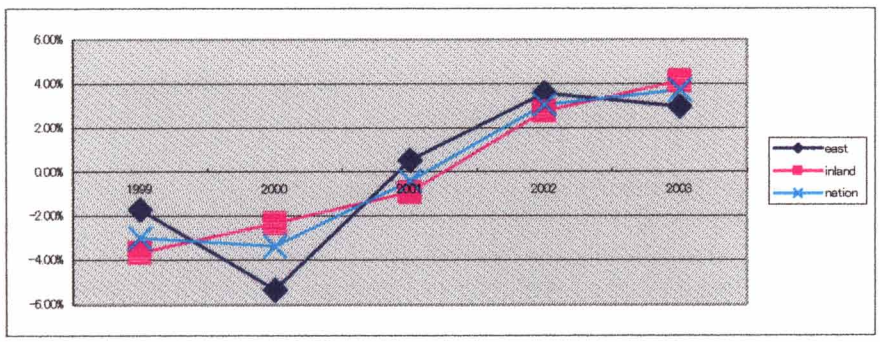


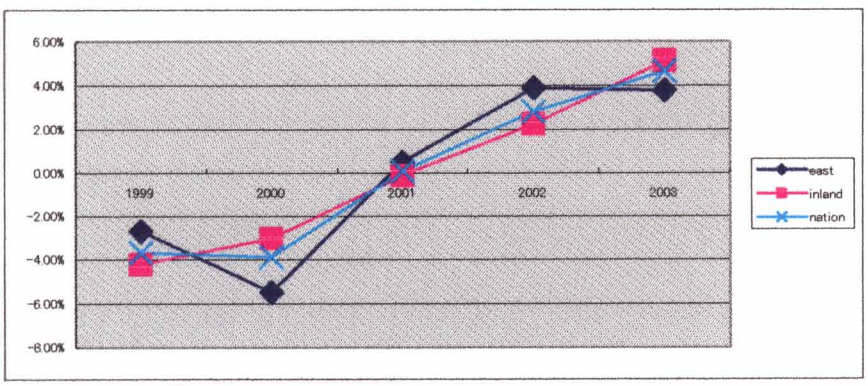
Figure 3: Growth Rate of China's Industry labor



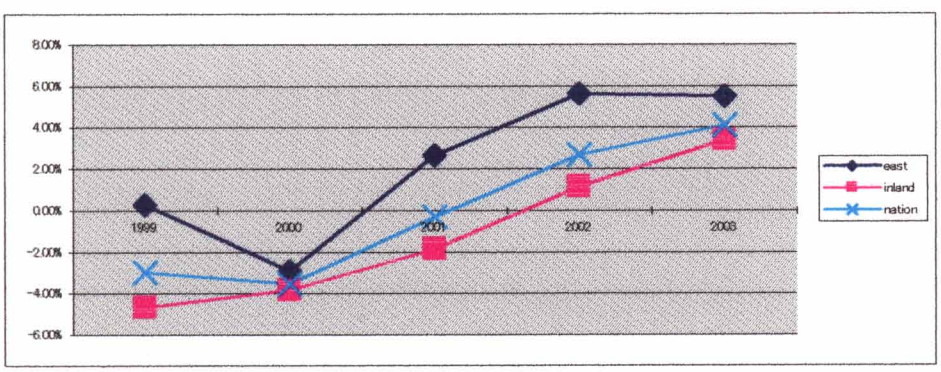
Graph 1: The TFP Growth Trends of each Region and Nation (fixed OLS)



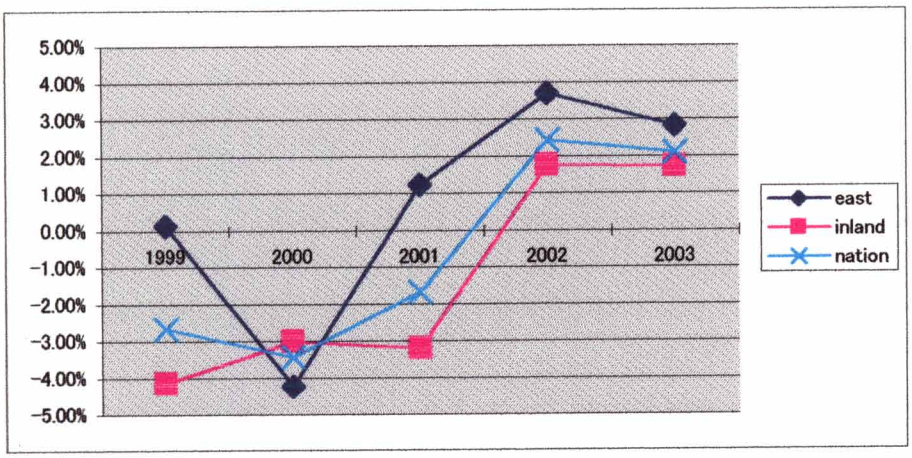
Graph2: The TFP Growth Trends of each Region and Nation (fixed GLS)



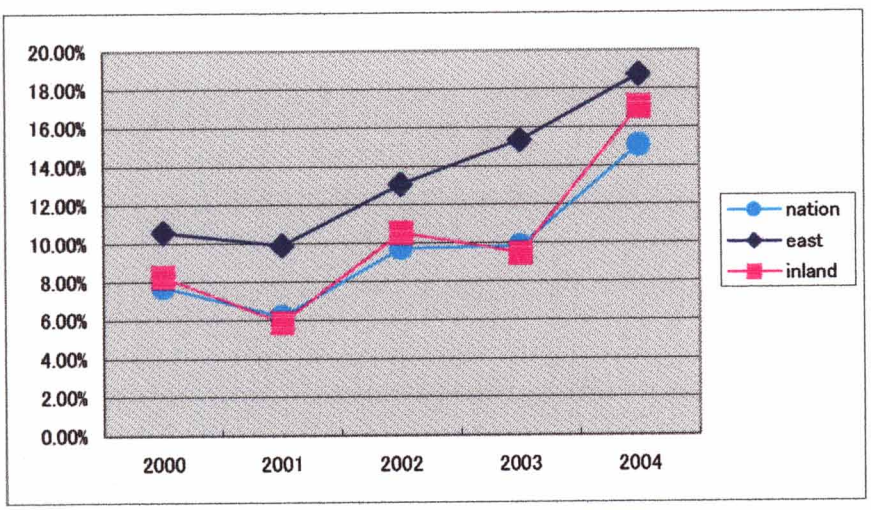
Graph 3: The TFP Growth Trends of each Region and Nation (Common OLS)



Graph 4: The TFP Trends of each Region and Nation (Common GLS)



Graph 5: The TFP Trends of each Region and Nation (the primary approach)



Chapter 5: Conclusion and Prospect for The FDI of China

5.1: Results Review

In Chapter one, we reviewed the history of the inward FDI to China since 1978 until now and divided this period into three terms: initial term, golden term and normal term. During the initial term, the value of the inward FDI to China was relatively small and its distribution was restricted on the coastal region due to the preferential policy at that time. In the golden term, following the improvement on economic reform, the value of inward FDI to China reached to an unprecedented level. In 2002, China became the largest recipient of inward FDI in the world. The preferential policy was shifted from coastal region to some special industries. In the normal term, due to the entry of China to WTO, China gradually removed the preferential policy and the restrictions on FDI and released a series of regulations for the M&A behavior of FDI. Since then the case of M&A to domestic enterprises by FDI has marked a striking increase.

In the second part of Chapter one, we presented the main characteristics of inward to China, which distributed unevenly across geographical regions and industries, and took a relatively small share on total investment in fixed asserts and on labor employment.

Starting from a domestic firm's production function that embodies the output of multinational firm as one of its production input factors, chapter 2 built a model in which product of multinational firm's production growth and its share in GDP presented external effect of foreign direct investment. Using an experiential division criterion and a threshold division criterion for China's 29 provinces' panel data, we estimated this model twice and found the strong evidences supporting the hypothesis of non-threshold regarding the external effect of FDI in China. The results, however, do not necessarily deny that FDI's external effect depends upon economic level of host country.

Chapter 3 examines the causal relationships among GDP, FDI, the state-owned enterprise investment, the private enterprise investment, imports and exports in China. Using panel data from China's 29 provinces over the period from 1993 to 2003, based on a dynamic panel model, the paper finds a series of results. Some of them are different from the findings of the previous papers. The Econometric techniques for dynamic panel model applied to panel unit root test and SYS GMM estimation which leads to a consistent and asymptotic efficient estimator.

With the industrial panel data of China's 29 provinces, Chapter 4 estimates the TFP growth rates of the industrial sector during the period from 2001 to 2004 and found that the TFP growth rates in recent year is respectable but not striking. By accessing the causal link of growth rates between the inflow of FDI and the TFP growth rates, this paper found a one way causality relationship that runs from TFP growth to the growth of inflow of FDI but not vice versa. This paper argues that the

increasing TFP growth rate has become a sufficient attractive factor for FDI.

5.2: Prospects for The FDI in China

It is quiet difficult to exactly predict how FDI in China will change in the future. Its trend strongly depends upon economic growth path of China in the future and also the FDI-related policy taken by China's government. There will be many new characteristics to be appeared in the future. Here I only discuss two possible characteristics which have been observed by many economists.

The first one is related to the case of M&A taken by MNEs. Its number has increased at a very fast speed following some relaxations on M&A. As mentioned in Chapter 1, in 2002, China's government released the first regulation that provided a definitive guide for the foreign investors' behavior of M&A. From 2003, the inward FDI into China that took M&A form has covered a remarkable share in total inward FDI into China. During this period, some take-over to China's superior domestic enterprises by MNEs has caused caution that whether the take-over will damage China's economy.

Those domestic enterprises that are taken over by MNEs are almost state-owned enterprises. They normally have a better economic performance and most of them had taken a large share in domestic market. Hence, the problem is: will M&A of MNEs lead to loses of national wealth. MNEs is obviously superior to domestic enterprises not only on technology but also on scale, normally they will take vital voting power in the new enterprise. Consequently, the spillover effect concerned by China's government may not occur so easily as they expected.

Economic security is another argument raised from M&A by foreign investors. A few worry that some important industries will be controlled by MNEs. It will be harmful to country's economic security. Of course, most concerns regarding the M&A of MNES come from the crowding-out effect arising from the monopoly of MNEs in some industries. That is: many domestic enterprises will be crowded out from domestic market, facing strong competition from MNEs. It will consequently cause an increase in unemployment rate.

Even though there are so many controversies regarding M&A, China's government insists on the open policy toward M&A of MNEs. They quoted statistic data and argued that from January to July in 2005, M&A- related inward FDI only took 7% in the total inward FDI of the same period. They concluded that compared with USA and UK, the scale of M&A in China is quiet small. However, a definite fact is that China's economic development level obviously differ form USA or UK. They cannot compare China with these developed countries.

In 2006, China's government published the second M&A-related regulations, which remove more restrictions on take-over by foreign investors. Thus, a predictable increasing trend on M&A will be a

definite new characteristic of inward FDI to China in the future.

In recent years, outward FDI of China has become a hot issue in the news. Even though its amount is small compared with the developing country, the growth rate is striking. China's outward FDI mainly aims to expand market, to absorb technology and to secure the natural resource necessary for fast economic growth such as gas material and so forth. They normally take M&A form to enter the foreign market. Compared with the conditions faced by those MNEs that take over China's domestic enterprises, the outward FDI of China usually are blocked by some political reasons in developed countries. However, given the country's rapid economic development and the Government's interest in encouraging outward FDI, Chinese investments abroad can be expected to increase further. As Karl P. Sauvant (Director of UNCTAD's Investment Division) said: "Chinese enterprises are at the threshold of becoming major foreign direct investors in Asia and beyond."