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# Three Essays on FDI in China

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# THREE ESSAYS ON FDI IN CHINA

by

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# THREE ESSAYS ON FDI IN CHINA

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Foreign Direct Investment (FDI) has contributed a great deal to China's extraordinary growth by injecting capital into the economy, creating jobs, transferring technology and knowledge, enhancing trade, bringing in competition for local enterprises, improving the quality of local labor and intermediate goods suppliers, and connecting China's gradually opening economy to the global market. For over a decade, China has been the second largest recipient of inward FDI in the world behind the United States. In 2009, China received $95 billion, which is 8.5% of the world's total. However, the large amount of inward FDI has been unevenly distributed across Chinese provinces, with around 80% annual inward FDI flowing into the coastal region of China. Central authorities of China have been making efforts in directing FDI from the eastern coast to farther inland.

This dissertation analyzes the regional determinants of FDI inflows into Chinese provinces and intends to fill certain gaps in the literature and provide new directions in this strand of research.

After the introductory chapter that provides a general overview of FDI inflows in China, three self-contained essays follow. The first essay analyzes the changing agglomeration effect of FDI in China. Empirical evidence supports a weakening agglomeration effect of FDI over the years, and it suggests that at present FDI is not agglomerating. In addition, this research empirically points out the changing relative importance in market size as an FDI determinant over the years.

The aims of the second essay are to examine the interdependence of Chinese provinces and to provide empirical evidence for the recent general equilibrium theory of multinational enterprises. Using two spatial models, I find that despite the competing pattern of FDI across provinces, not all surrounding provinces' endowments display competing effects. Actually some surrounding provinces' endowments have complementary effects. Evidence suggests that Export-Platform and Pure-Vertical forms of FDI dominate the aggregate FDI inflows into China.

As some past studies have shown concerns regarding the feedback of FDI on GDP and the wage rate, the third essay constructs a simultaneous equations model to further explore this issue. Above all, the empirical results relieve our worry about the simultaneity problem, since FDI has delayed effects on both GDP and the wage rate.

# ACKNOWLEDGEMENTS

I am greatly indebted to all my dissertation committee members for nurturing my enthusiasm and bringing out my potentials in academic research. My advisor, Dr. Van den Berg has great knowledge and enthusiasm in the fields of development and international economics and has constantly inspired my research ideas and efforts. Dr. Cushing stood by my side all along the PhD study, guiding and supporting me. Like many other students, I always credit Dr. Fulginiti for getting me on the research path. Dr. Schmidt and Dr. McGarvey lay me a good foundation on econometrics, which enables me to pursue all the interesting applied research. Dr. Ramsay, being a great mentor and friend, has constantly encouraged me to pursue my excellence. He always read my research and provided timely feedbacks. I have been so fortunate to have you all and thank you for everything.

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# Chapter One: Brief Introduction on FDI in China

## 1. Timeline of China's opening process[1]

Since the late 1970s, China has gradually opened up its economy to the outside world. The opening-up process during the past three decades can be classified into six stages: (1) establishment of the pilot special economic zones; (2) further opening up of coastal cities; (3) further expansion of the already opened coastal regions; (4) the development and opening up of Pudong New Area in Shanghai; (5) opening up nationwide; (6) accession to the WTO.

The first stage was the establishment of the pilot Special Economic Zones (SEZs[2]). In July 1979 and May 1980 the Party Central Committee and State Council decided to establish Shenzhen, Zhuhai, Shantou in Guangdong Province, and Xiamen in Fujian Province as SEZs. They formed the experimental base for China's opening policy. SEZs have made good use of the special favorable policies provided by the central government and their geographical, lingual, and cultural advantage of being close to Hong Kong, Macao, and Taiwan. SEZs have actively participated in international competition and cooperation, and developed export-oriented economies. SEZs were also the first to open financial and other service industries to foreign investment, and they are still the most concentrated areas of foreign investment.

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[1] Mostly based on Jian Chang's article 'The historical process of China's opening up'.
[2] Special Economic Zones are usually abbreviated as SEZs.
[3] Please refer to Marshall (1920), Krugman (1991), Fujita et al. (1999) for more on agglomeration economies.

[2] Special Economic Zones are usually abbreviated as SEZs.

The second stage was the further opening up of coastal cities to FDI and trade. In May 1984, the Party Central Committee and State Council, after reviewing the experience of the SEZs, decided to further liberalize the following 14 coastal port cities of Dalian, Qinhuangdao, Tianjin, Yantai, Qingdao, Lianyungang, Nantong, Shanghai, Ningbo, Wenzhou, Fuzhou, Guangzhou, Zhanjiang, Beihai City. Compared to the average level of development of China at that time, each of these 14 cities had a relatively solid industrial foundation with industrial workers, technical talents, advanced science and education, as well as a history of contact with the outside world. Opening up these cities, along with the establishment of economic and technological development zones, has developed the entire coastal region.

The third stage was the further expansion of the already opened coastal regions. In February 1985, the Yangtze River Delta, the Pearl River Delta, Xiamen-Zhangzhou-Quanzhou Triangle in south Fujian and the Bohai regions were opened for the coastal economic open zones. These areas, which include a total of 41 cities and 218 counties, formed a coastal belt with a population of more than 200 million.

The fourth stage was the development and opening up of the Pudong New Area in Shanghai. On June 2, 1990, the Party Central Committee and the State Council decided to further liberalize and develop the Pudong New Area. Pudong was given the special preferential policies similar to those of SEZs. The Lujiazui Financial and Trade Zone, Jinqiao Export Processing Zone, Waigaoqiao Free Trade Zone, and Zhangjiang Hi-Tech Park were established in the Pudong New Area.

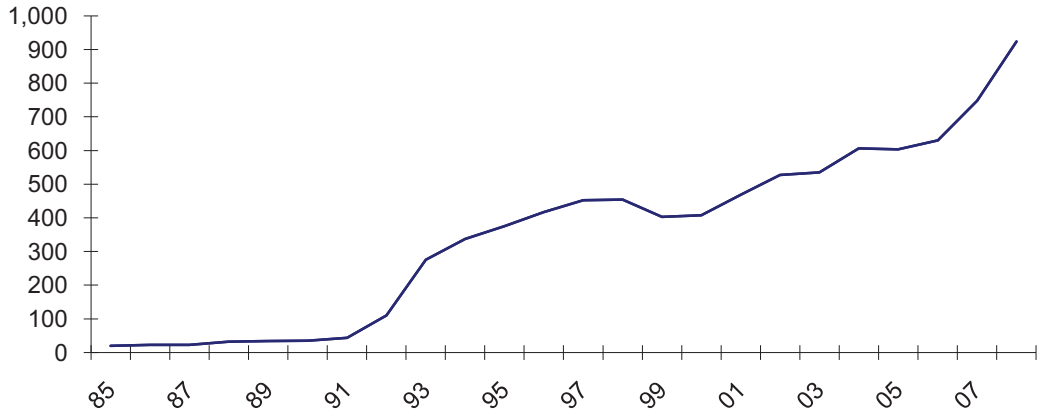
The fifth stage was the nationwide opening to trade and investment. In 1992, 13 border cities, six cities along the Yangtze River, and 18 inland provincial capital cities were opened up. 32 state-level economic and technological development zones, 52 high-tech development zones, 13 free trade zones, and 34 ports were approved.

The sixth stage was the accession to the WTO. Hence, opening to the outside world entered a new phase. In November 2001, in the Qatari capital of Doha, the 4th Ministerial Conference approved China's accession to the WTO. Since 2001, China's opening has moved from limited market opening into a full market opening, from the old pilot-based policy-oriented opening into a broad opening under a formal legal framework.

## 2. **FDI in China**

Since the opening of China to international trade and investment in the late 1970s, foreign direct investment in China increased gradually during the 1980s and experienced a surge since early 1990s. Figure 1 shows the growth. By 1993, China had become the largest recipient of FDI in the developing world and, second only next to the United States globally. From 1979 to 2008, the cumulative amount of FDI flowing into China had reached US$852.6 billion. The source, mode of entry, and type of FDI in China has been changing over the years.

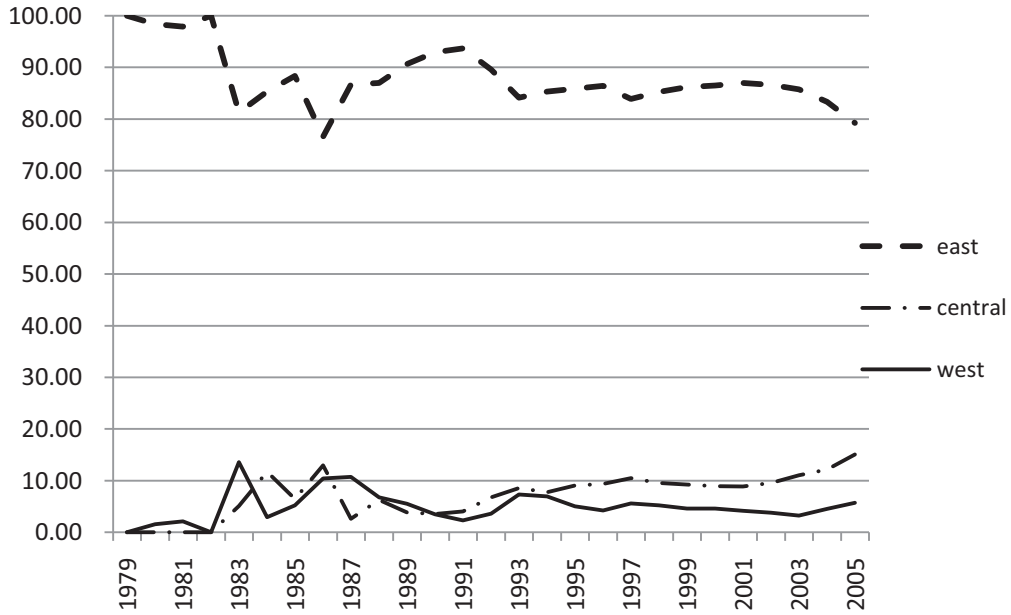
***Figure 1 FDI inflows into China 1985-2008 (in $100 million)***




Source: Statistical Yearbook of China, 2009 issue.

## 2.1. **FDI Distribution by Provinces**

***Figure 2 FDI inflows by Region (%)***




We can see from Figure 2 that the FDI inflows has been unevenly distributed, with Eastern China receiving more than 80% of total FDI inflows throughout the years.

Central China steadily attracted an increasing share during the 1990s and has achieved even faster growth after 2000. In contrast, since 1993, Western China had received a declining share of FDI until the past few years.

***Figure 3 FDI inflows by Province in Southeastern China***

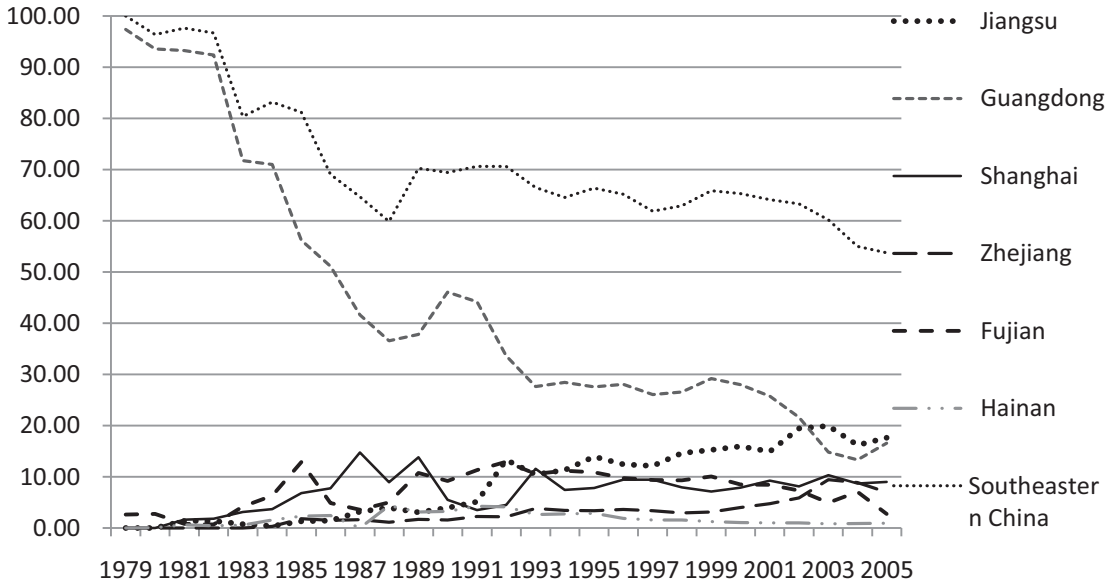



Figure 3 plots the FDI inflows into each province of Southeastern China from 1979 to 2005. Southeastern China has been receiving more than half of all FDI into China. From 1979 to the early 1980s, Guangdong and Fujian were the first two provinces opened up. Most FDI flowing into China was from Hong Kong. Nearly all FDI went to Guangdong Province due to its geographical proximity to Hong Kong. When the coastal cities were opened, Shanghai (one of the self-administered municipalities) quickly became one of the top receivers of FDI. In the 1980s, Jiangsu gradually improved its

attractiveness to FDI in the 1980s, and stood out at the beginning of the 1990s. Since then Jiangsu steadily climbed up the ranking of FDI receivers, and now has even surpassed Guangdong as the largest recipient of FDI in China. In contrast, Hainan as a fifth special economic zone, only achieved noticeable improvement in the 1990s, and then vanished from the top 10 receiver list.

***Figure 4 FDI inflows by Province in Northeastern China***

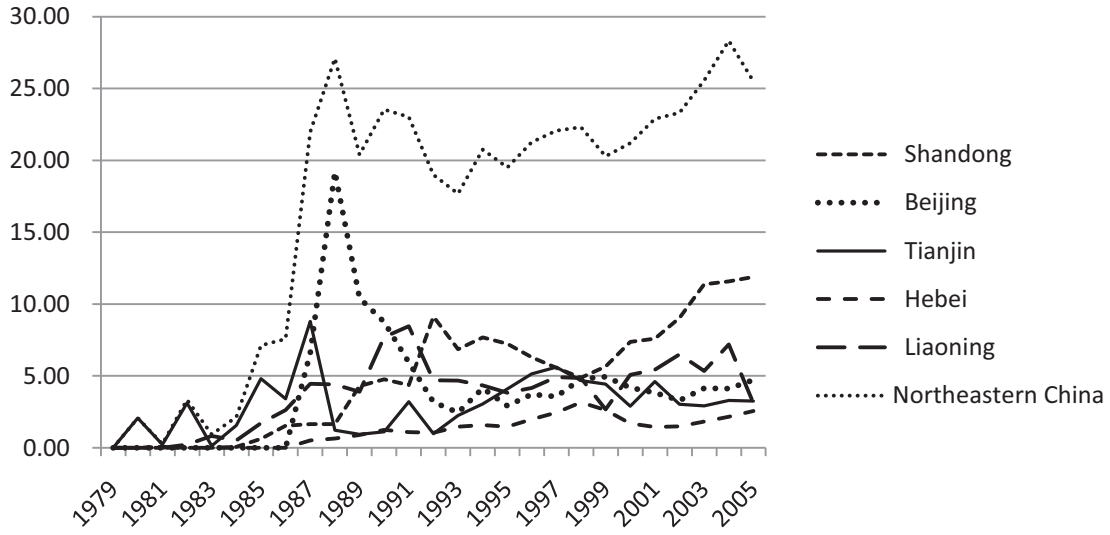



Figure 4 plots the FDI inflows into each province of Northeastern China from 1979 to 2005. Northeastern China comes in second to Southeastern China in receiving FDI. In the 1980s, Tianjin (one of the self-administered municipalities) received most of the FDI to this region. Between 1986 and 1989, FDI into Beijing (capital of China, 80 miles away from Tianjin) surged and took over Tianjin's place. Beijing drew away much of FDI from its nearby municipality (Tianjin). Liaoning rose after Tianjin in early 1980s,

and steadily improved its attractiveness to FDI. Shandong rose later than most other provinces in this region, but grew very fast and has now become the top receiver of FDI in this region. Hebei has constantly remained at the bottom in this region.

***Figure 5 FDI inflows by Province in Central China***

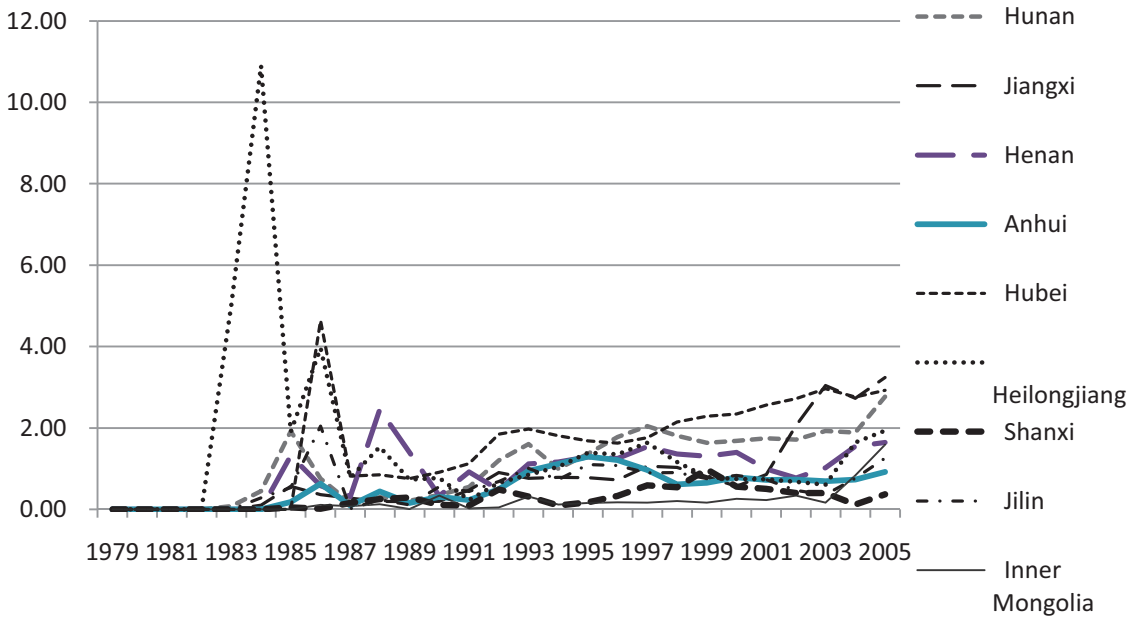



Figure 5 depicts FDI inflows into the provinces of Central China. In the 1980s, Central China received the least amount of FDI. But since the mid-1990s, this region has steadily attracted a larger share, and especially during recent years, has grown very fast, leaving Western China far behind. Heilongjiang performed well in the early 1980s and was overtaken by the southern provinces of Hunan and Hubei. Overall Southern provinces have attracted more FDI than Northern provinces.

***Figure 6 FDI inflows by Province in Western China***

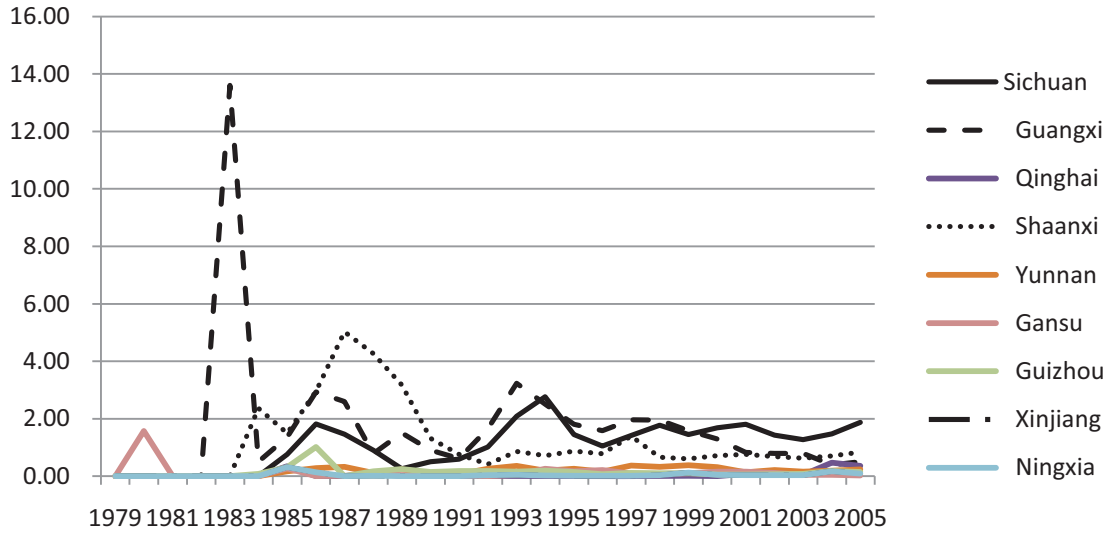



Figure 6 depicts FDI inflows into the provinces of Western China. FDI inflows into this region is dominated by the top three performers (Guangxi, Shaanxi, and Sichuan) that account for more than 95% of the total inflow. Some studies have classified Guangxi as an Eastern Coastal province, because a small part of this province is on the coastline and one of the 14 open coastal cities in 1984 is located in this province. But this study places Guangxi into Western China, as its geographical location and endowments are more similar to Western China's provinces. Not surprisingly, around 1984, Guangxi performed best in this region. But very quickly, its leadership position was taken over by Shaanxi (a northwestern province) during 1985-1990. During the 1990s, Guangxi rose again to the top place in this region, but it has fallen back since the late 1990s. Sichuan has steadily improved its attractiveness to FDI and remained the largest recipient of FDI in the West since 2000.

### 2.2. FDI inflows by Industries

***Table 1 FDI inflows (contracted value) by Sector in 1995***

| Sector | # of Projects | Value (USD) |
|---|---|---|
| Farming, Forestry, Animal Husbandry, Fishery and Water Conservancy | 903 | 173,578 |
| Industry | 27,687 | 6,164,763 |
| Construction | 944 | 191,836 |
| Transportation, Postal and Telecommunications Services | 268 | 169,698 |
| Commerce, Food Services, Material Supply and Marketing | 1,851 | 342,665 |
| Real Estate, Public Residential and Consultancy Services | 3,279 | 1,783,542 |
| Tourist Hotel | 171 | 95,377 |
| Health Care, Sports and Social Welfare | 174 | 83,741 |
| Education, Culture and Arts | 162 | 34,496 |
| Scientific Research and Polytechnical Services | 275 | 27,775 |
| Others | 1,468 | 156,059 |
| National Total | 37,011 | 9,128,153 |

Source: Statistical Yearbook of China 1996 issue

Over the years, China has increasingly opened up more industries to FDI, and the regulations on prohibited, restricted, and encouraged industries were amended four times (in 1992, 1997, 2004, and 2007). Accordingly, along with China's domestic economic development, the amount and share of FDI received by each industry has changed over time. Table 1 and Table 2 provide a sharp contrast.

***Table 2 Foreign Direct Investment (actual value) by Sector in 2008***

| Sector | Number of Projects (unit) | Value (USD 10,000) |
|---|---|---|
| Agriculture, Forestry, Animal Husbandry and Fishery | 917 | 119,102 |
| Mining | 149 | 57,283 |
| Manufacturing | 11,568 | 4,989,483 |
| Production and Supply of Electricity, Gas and Water | 320 | 169,602 |
| Construction | 262 | 109,256 |
| Transport, Storage and Post | 523 | 285,131 |
| Information Transmission, Computer Services and Software | 1,286 | 277,479 |
| Wholesale and Retail Trades | 5,854 | 443,297 |
| Hotels and Catering Services | 633 | 93,851 |
| Financial Intermediation | 25 | 57,255 |
| Real Estate | 452 | 1,858,995 |
| Leasing and Business Services | 3,138 | 505,884 |
| Scientific Research, Technical Service and Geologic Prospecting | 1,839 | 150,555 |
| Management of Water Conservancy, Environment and Public Facilities | 138 | 34,027 |
| Services to Households and Other Services | 205 | 56,992 |
| Education | 24 | 3,641 |
| Health, Social Security and Social Welfare | 10 | 1,887 |
| Culture, Sports and Entertainment | 170 | 25,818 |
| Public Management and Social Organizations | 1 | |
| International Organizations | | 6 |
| Total | 27,514 | 9,239,544 |

Source: Statistical Yearbook of China 2009 issue

***Figure 7 FDI inflows by Three Basic Sectors***

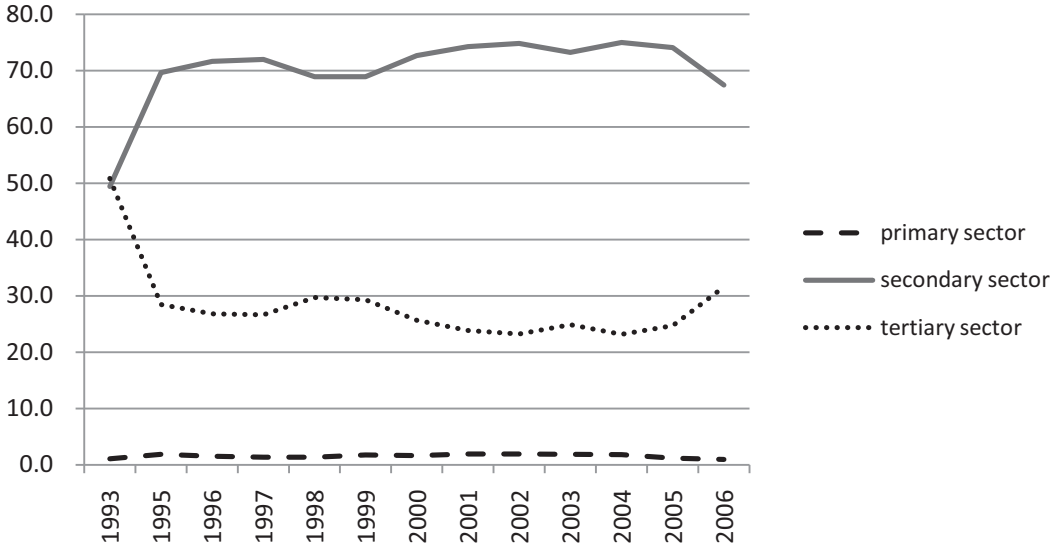



Figure 7 categorizes the industries into three basic sectors, primary, secondary, and tertiary sectors and plots the change in share of FDI inflows received by each sector over time. Agriculture, forestry, animal husbandry and fishery services are classified into the primary sector. The secondary sector includes construction, mining and quarrying, manufacturing, production and supply of water, electricity and gas. The tertiary sector includes transportation, storage and post, wholesale and retail, hotel and catering services, financial, real estate, and other services. The primary sector has been receiving a very small share of total FDI, just 1 to 2 percent. The secondary sector has had the predominant share, with manufacturing predominant. China's gradual opening policy initially only allowed export-oriented FDI except for off-shore oil exploration and the real estate sector. Not until 1992 did China open its domestic market. The regulations on

prohibited, restricted, and encouraged industries were amended four times. By the end of 2006, there remained very few restrictions. The tertiary sector share was starting to rise in 2006. With recent years' relaxation of restrictions on the financial sector and other industries in the tertiary sector, this sector's share is expected to rise even more.

### 2.3. FDI inflows by Source Economies

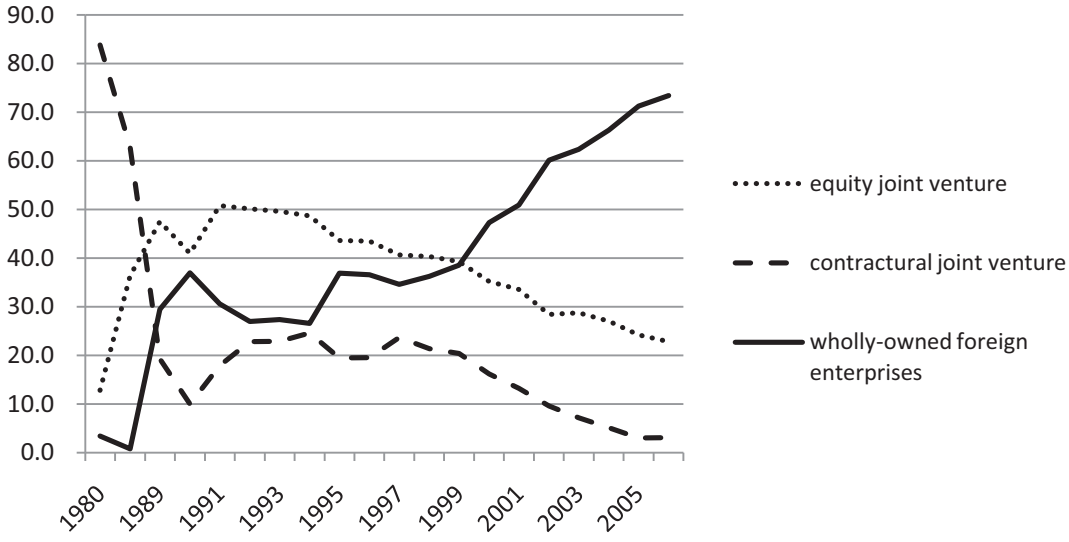
Before the mid-1990s, FDI from Hong Kong accounted for a predominant share (over 50%) of total FDI inflows in China. Since 1993 its share has been declining, and had dropped to around 32% by the end of 2006. Tuan and Ng. (2003) explain the dominance of FDI from Hong Kong when China was first opened up. First, in the late 1970s, Hong Kong was suffering domestically from increasingly high labor costs and was losing its competitiveness in the world market. China's opening up with its export-promotion policy, large cheap labor pool, and cheap land use pulled in FDI from Hong Kong, mostly in labor-intensive manufacturing. Second, in 1978, China first opened up two provinces: Guangdong and Fujian. Guangdong is bordered with Hong Kong, shares the same language and culture, and is home to many people from Hong Kong. For similar reasons, other newly industrialized countries in Asia have had significant shares of FDI inflows to China as well, such as Taiwan and Singapore. Like the FDI from Hong Kong, these other inflows of FDI were for export-oriented and labor-intensive industries.

Since 1992, when China opened its domestic market, FDI from developed countries has increased faster than FDI from Hong Kong and Taiwan. FDI from developed countries is more technology and capital intensive, and it more often targets

the domestic Chinese market. For this type of FDI, labor cost is still a consideration, but China's potential domestic market, the quality of its labor force, and its infrastructure are more important determinants.

### 2.4. FDI inflows by Entry Mode

***Figure 8 FDI inflows by Entry Model***




Equity Joint Enterprises are joint investments by a Chinese party and a foreign party, with financial information calculated in the same currency. The two parties share in the distribution of investment profits, risks and carry out the liquidation according to the ratio of investment amount.

Contractual Joint Enterprises are joint investments by a Chinese party and a foreign party. The two parties share distribution of investment profits, risks, and carry out liquidation based on contractual agreement instead of the ratio of investment amount.

Wholly Foreign-Owned Enterprises are entirely foreign-owned investment, in which foreigners obtain investment profits, take all risks, operate the business, and carry out liquidation.

Joint exploration is the abbreviation of maritime and overland oil joint exploration. It is a widely adopted measure of economic cooperation in the international natural resources field. The striking features are high risk, high investment and high reward. The joint development is often divided into three steps: exploitation, development, and production. Compared with the other three means mentioned above, joint cooperation accounts for a small ratio of all Chinese FDI inflows.

Contractual joint ventures were the predominant form of FDI into China in the early 1980s. Starting the late 1980s, however, the share of contractual joint ventures has been declining, with equity joint ventures replacing contractual ones. Wholly-owned foreign enterprises are beginning to appear and take an ever-increasing share. Since the late 1990s, wholly-owned enterprises have become the predominant form of FDI. By the end of 2006, the share of wholly-owned foreign enterprises had reached 73.4%.

Note: From the above-mentioned pattern of FDI distribution across regions, sectors, source economies, and entry mode, we can tell that it would be best to use disaggregate data to examine the FDI distribution in China. For example, as the determinants of FDI from different source countries are expected to be different, disaggregate data would enable analysis of the distribution of FDI from each source economy. Similarly, as different industries put different degrees of importance on different regional determinants, disaggregate data by industry can reveal more accurate

information and inference. This approach is also consistent with the recent trend in the Chinese FDI distribution literature, in which authors have used disaggregate data by source economies, by industry, and by entry mode. Unfortunately, due to the limited access to Chinese data, this research is restricted to aggregate data. Future research will hopefully permit broader analysis.

# Chapter Two (First Dissertation Essay): Does FDI Agglomeration Pattern Change Over Time In China?

## 1. Introduction

Industrial activities agglomerate through the mechanisms of knowledge spillovers, specialized labor, and specialized intermediate goods suppliers[3]. Recently the agglomeration of FDI has received increasing attention. Head and Ries (1996) have built a model for agglomeration of foreign manufacturing investment in China through the mechanism of specialized intermediate inputs suppliers, and they use city-level data to reveal that foreign firms prefer cities where other foreign firms are located. Kinoshita and Mody (2001) point out the importance of private information to investment in emerging economies. Foreign investors suffer from a condition of adverse asymmetry in information costs compared to domestic firms, according to Mariotti and Piscitello (1995), and one of the lowest information-cost areas is the area where more FDIs have been accumulated. The information spillovers or sharing among foreign investors can also lead to agglomeration of FDI. It is also worth mentioning that Wheeler and Mody (1992) suggested that the self-reinforcing aspect of FDI begins to operate only after a certain economic development threshold has been reached.

In addition to the centripetal forces that attract more FDI to the concentrated locations, centrifugal forces will operate when a certain level of clustering is reached. Fujita et al. (1999) identified the main centrifugal forces resulting in the dispersion of

[3] Please refer to Marshall (1920), Krugman (1991), Fujita et al. (1999) for more on agglomeration economies.

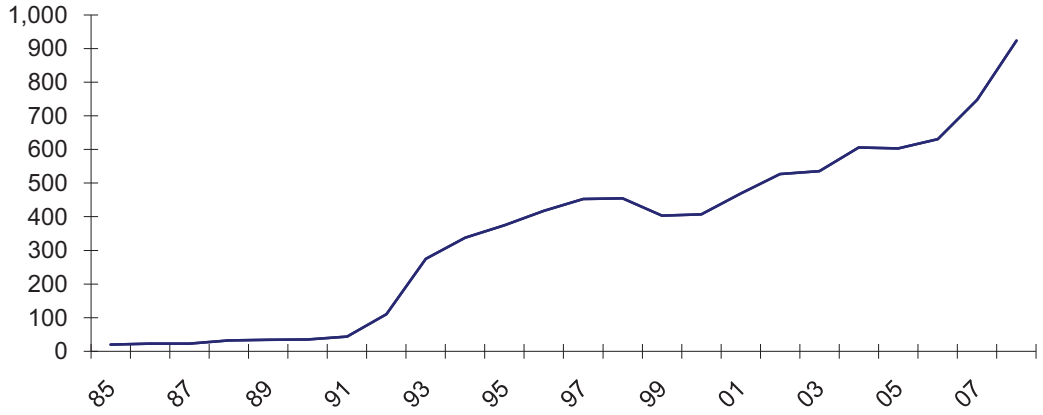
industrial activities in space, which are immobile factors and congestion diseconomies. Cheng and Kwan (2000) proposed the idea of an equilibrium stock of FDI that is determined by a region's endowments.

The empirical literature on FDI determinants or location choices of multinational enterprises has recognized the importance of the agglomeration effect of FDI and included it as a determinant. In much of the literature, strong agglomeration is found, i.e. centripetal forces are empirically proved. See, for examples, Wheeler and Mody (1992), Head et al. (1999), He (2002), Campos and Kinoshita (2003), Crozet et al. (2004), and Du et al. (2008). Most studies are at the regional level such as the states of the U.S., provinces of China, and regions of France. Campos and Kinoshita (2003) provide a notable exception in that they study 25 transition economies. As a sharp comparison, the only recent study that did not find evidence of agglomeration of foreign investors is Guimaraes and Figueiredo (2000), which studied the location of FDI in Portugal.

As far as I am aware, the changing agglomeration effect of FDI has not been subject to any empirical analysis. This essay uses China as the object of study and shows how the centripetal and centrifugal forces associated with FDI clustering change over time. China presents itself as a good natural experiment during the past three decades. When China started to initiate the opening policy in 1979, FDI inflows into the country was virtually zero. As shown in Figure 1, FDI inflows increased very slowly during the 1980s, yet it has surged since the early 1990s. As the economy grew and developed at an extraordinary rate, it also successfully attracted an important share of world FDI inflows. By the end of the 1990s, China had become the second largest recipient of world FDI.

Within only 30 years, China has experienced noticeably different stages of development and FDI attraction.

***Figure 1 FDI inflows into China 1985-2008 (in $100 million)***




Source: Statistical Yearbook of China, 2009 issue.

This essay uses a panel data of 29 Chinese provinces from 1992 to 2008 and empirically examines the changing agglomeration effect of FDI. When the coefficient for FDI agglomeration is assumed constant over the observation period, similar result is found as past studies on China, i.e. there is a strong agglomeration effect of FDI. In other words, the cluster of foreign enterprises has a strong positive influence on a province's FDI attractiveness. However, empirical results show that in the late 1990s, the centripetal forces are getting weaker and centrifugal forces are getting stronger. In recent years, the agglomeration effect of FDI has almost vanished.

The rest of the essay is organized as follows. The next section provides details on the regional view of FDI inflows over time. Section 3 contains a discussion of the

variables, data, and model. I present the empirical results in the section 4. Section 5 concludes the essay.

## 2. Regional View of FDI inflows over Years

Since China opened its economy to FDI in 1979, it experienced distinct stages of FDI attraction. Table 1 and Table 2 summarize the data on realized FDI inflows in the 29 Chinese provinces for different periods of the past three decades. During 1979-1992, the two provinces (Guangdong and Fujian)[4] that were first opened obviously took the lead in attracting FDI. These two provinces are followed in rank by three other coastal provinces (Shanghai, Jiangsu, and Beijing, respectively). In this stage, good endowments (like infrastructure, industrial base, and quality labor) in large municipalities and opening policies/incentives appear to be decisive factors for FDI attraction. The other top ten provinces in receiving FDI during this time period are all coastal[5] provinces. Overall, the Coastal Region received a dominating share of 91.6%. For all other time periods, the top FDI receivers are still coastal provinces. From 1979 up to 2002, the top four positions were constantly dominated by Guangdong, Fujian, Jiangsu, and Shanghai. The initial opening timeline and FDI policies have had far-reaching effects. Head and Ries (1996) showed that the agglomeration effect greatly magnified the impact of China's initial FDI policy.

[4] In July 1979 and May 1980 the Central Party Committee (CPC) and State Council decided to establish Shenzhen, Zhuhai, Shantou in Guangdong Province, and Xiamen in Fujian Province as Special Economic Zones (SEZs).

[5] After reviewing the experience of the SEZs, in 1984 the CPC and State Council decided to further liberalize the 14 coastal port cities, and further expanded the already opened coastal regions in 1985.

From Table 2, it should also be noted that starting with the period 2003-2005, Guangdong has lost its leading position to Jiangsu. Also, Fujian dropped to sixth in rank, and Shanghai has dropped to seventh. Two northeastern coastal provinces have risen in receiving FDI. Shandong rose to third, and Liaoning rose to fifth. Another important observation is that some provinces adjacent to coastal China have become more attractive for FDI. Jiangxi rose in rank from nineteenth to tenth, Hubei from fifteenth to eleventh, and Hunan from eighteenth to twelfth. These changes are also captured in Table 3. Over the years, the share of FDI inflows received by the Southeast Coast has continuously declined while the share received by the Northeast Coast has risen. Central China has continuously received an increasing share. The observations from Table 1 through Table 3 seem to reveal that during recent years the centrifugal forces have pushed the FDI (relative share instead of absolute amount) away from the initially concentrated region (Southeastern China), and the nearby regions (Northeastern China and Central China) were the immediate beneficiaries.

***Table 1 Realized FDI inflows by Province (US$ million in 1982 Prices)***

| | 1979-92 | 1993-95 | 1996-98 | 1999-2002 | 2003-2005 | 2006-2008 |
|---|---|---|---|---|---|---|
| Beijing | 1,599 | 2,875 | 4,121 | 6,242 | 5,834 | 8,752 |
| Tianjin | 529 | 2,507 | 5,560 | 9,148 | 4,927 | 9,320 |
| Hebei | 311 | 1,356 | 3,456 | 3,080 | 3,096 | 4,351 |
| Shanxi | 69 | 136 | 513 | 837 | 391 | 1,887 |
| Inner Mongolia | 21 | 249 | 181 | 410 | 1,430 | 3,637 |
| Liaoning | 873 | 3,330 | 4,814 | 8,776 | 9,918 | 14,991 |
| Jilin | 104 | 757 | 998 | 977 | 856 | 1,473 |
| Heilongjiang | 214 | 831 | 1,428 | 2,613 | 2,481 | 3,527 |
| Shanghai | 2,505 | 7,214 | 10,385 | 11,789 | 12,913 | 13,977 |
| Jiangsu | 1,743 | 9,450 | 13,851 | 22,902 | 27,813 | 35,892 |
| Zhejiang | 505 | 2,818 | 3,428 | 6,424 | 13,265 | 16,424 |
| Anhui | 80 | 908 | 960 | 1,053 | 1,081 | 4,353 |
| Fujian | 2,721 | 8,703 | 9,865 | 12,100 | 11,081 | 14,114 |
| Jiangxi | 129 | 621 | 983 | 1,535 | 4,062 | 5,309 |
| Shandong | 1,291 | 5,727 | 5,774 | 11,043 | 16,594 | 16,479 |
| Henan | 247 | 1,022 | 1,415 | 1,397 | 1,763 | 4,939 |
| Hubei | 291 | 1,449 | 1,933 | 3,373 | 3,886 | 4,718 |
| Hunan | 159 | 1,022 | 1,926 | 2,398 | 3,325 | 5,487 |
| Guangdong | 10,768 | 22,198 | 27,933 | 38,187 | 25,700 | 28,344 |
| Guangxi | 310 | 1,942 | 1,922 | 1,491 | 765 | 1,161 |
| Hainan | 901 | 2,446 | 1,752 | 1,433 | 1,280 | 1,750 |
| Sichuan | 336 | 2,568 | 1,811 | 2,381 | 2,267 | 5,626 |
| Guizhou | 38 | 134 | 100 | 100 | 152 | 206 |
| Yunnan | 44 | 213 | 298 | 349 | 325 | 809 |
| Shaanxi | 405 | 652 | 978 | 984 | 1,084 | 1,943 |
| Gansu | 5 | 170 | 134 | 173 | 65 | 151 |
| Qinghai | 4 | 24 | 66 | 188 | 456 | 454 |
| Ningxia | 4 | 42 | 24 | 79 | 110 | 82 |
| Xinjiang | 50 | 128 | 87 | 81 | 90 | 231 |

***Table 2 Realized FDI inflows by Province***

| | 1979-1992 | | 1993-1995 | | 1996-1998 | | 1999-2002 | | 2003-2005 | | 2006-2008 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | share | rank | share | rank | share | rank | share | rank | share | rank | share | rank |
| Beijing | 6.1 | 5 | 3.5 | 7 | 3.9 | 8 | 4.1 | 9 | 3.7 | 8 | 4.2 | 9 |
| Tianjin | 2.0 | 9 | 3.1 | 10 | 5.2 | 6 | 6.0 | 6 | 3.1 | 9 | 4.4 | 8 |
| Hebei | 1.2 | 13 | 1.7 | 14 | 3.2 | 9 | 2.0 | 11 | 2.0 | 13 | 2.1 | 16 |
| Shanxi | 0.3 | 22 | 0.2 | 25 | 0.5 | 22 | 0.6 | 22 | 0.2 | 24 | 0.9 | 20 |
| Inner Mongolia | 0.1 | 26 | 0.3 | 22 | 0.2 | 24 | 0.3 | 23 | 0.9 | 17 | 1.7 | 17 |
| Liaoning | 3.3 | 8 | 4.1 | 6 | 4.5 | 7 | 5.8 | 7 | 6.3 | 7 | 7.1 | 5 |
| Jilin | 0.4 | 20 | 0.9 | 19 | 0.9 | 18 | 0.6 | 21 | 0.5 | 21 | 0.7 | 22 |
| Heilongjiang | 0.8 | 17 | 1.0 | 18 | 1.3 | 16 | 1.7 | 12 | 1.6 | 14 | 1.7 | 18 |
| Shanghai | 9.5 | 3 | 8.9 | 4 | 9.7 | 3 | 7.8 | 4 | 8.2 | 5 | 6.6 | 7 |
| Jiangsu | 6.6 | 4 | 11.6 | 2 | 13.0 | 2 | 15.1 | 2 | 17.7 | 1 | 17.1 | 1 |
| Zhejiang | 1.9 | 10 | 3.5 | 8 | 3.2 | 10 | 4.2 | 8 | 8.4 | 4 | 7.8 | 4 |
| Anhui | 0.3 | 21 | 1.1 | 17 | 0.9 | 21 | 0.7 | 19 | 0.7 | 20 | 2.1 | 15 |
| Fujian | 10.4 | 2 | 10.7 | 3 | 9.2 | 4 | 8.0 | 3 | 7.1 | 6 | 6.7 | 6 |
| Jiangxi | 0.5 | 19 | 0.8 | 21 | 0.9 | 19 | 1.0 | 15 | 2.6 | 10 | 2.5 | 12 |
| Shandong | 4.9 | 6 | 7.0 | 5 | 5.4 | 5 | 7.3 | 5 | 10.6 | 3 | 7.8 | 3 |
| Henan | 0.9 | 16 | 1.3 | 16 | 1.3 | 17 | 0.9 | 18 | 1.1 | 16 | 2.3 | 13 |
| Hubei | 1.1 | 15 | 1.8 | 13 | 1.8 | 11 | 2.2 | 10 | 2.5 | 11 | 2.2 | 14 |
| Hunan | 0.6 | 18 | 1.3 | 15 | 1.8 | 12 | 1.6 | 13 | 2.1 | 12 | 2.6 | 11 |
| Guangdong | 41.0 | 1 | 27.2 | 1 | 26.2 | 1 | 25.2 | 1 | 16.4 | 2 | 13.5 | 2 |
| Guangxi | 1.2 | 14 | 2.4 | 12 | 1.8 | 13 | 1.0 | 16 | 0.5 | 22 | 0.6 | 23 |
| Hainan | 3.4 | 7 | 3.0 | 11 | 1.6 | 15 | 0.9 | 17 | 0.8 | 18 | 0.8 | 21 |
| Sichuan | 1.3 | 12 | 3.2 | 9 | 1.7 | 14 | 1.6 | 14 | 1.4 | 15 | 2.7 | 10 |
| Guizhou | 0.1 | 25 | 0.2 | 26 | 0.1 | 26 | 0.1 | 27 | 0.1 | 26 | 0.1 | 27 |
| Yunnan | 0.2 | 24 | 0.3 | 23 | 0.3 | 23 | 0.2 | 24 | 0.2 | 25 | 0.4 | 24 |
| Shaanxi | 1.5 | 11 | 0.8 | 20 | 0.9 | 20 | 0.6 | 20 | 0.7 | 19 | 0.9 | 19 |
| Gansu | 0.0 | 27 | 0.2 | 24 | 0.1 | 25 | 0.1 | 26 | 0.0 | 29 | 0.1 | 28 |
| Qinghai | 0.0 | 28 | 0.0 | 29 | 0.1 | 28 | 0.1 | 25 | 0.3 | 23 | 0.2 | 25 |
| Ningxia | 0.0 | 29 | 0.1 | 28 | 0.0 | 29 | 0.1 | 29 | 0.1 | 27 | 0.0 | 29 |
| Xinjiang | 0.2 | 23 | 0.2 | 27 | 0.1 | 27 | 0.1 | 28 | 0.1 | 28 | 0.1 | 26 |

***Table 3 Realized FDI inflows by Region***

| | 1979-1992 | 1993-1995 | 1996-1998 | 1999-2002 | 2003-2005 | 2006-2008 |
|---|---|---|---|---|---|---|
| Northeast Coast[6] | 17.5 | 19.4 | 22.2 | 25.3 | 25.7 | 25.6 |
| Southeast Coast[7] | 69.5 | 61.8 | 61.4 | 60.3 | 57.8 | 51.7 |
| Hainan&Guangxi | 4.6 | 5.4 | 3.4 | 1.9 | 1.3 | 1.4 |
| Central China[8] | 5.0 | 8.6 | 9.7 | 9.6 | 12.3 | 16.8 |
| Western China[9] | 3.4 | 4.8 | 3.3 | 2.9 | 2.9 | 4.5 |

## 3. Data, Model, and Variables

The dataset is a balanced panel consisting of 29 provinces[10] of China from 1992 to 2008. The data are collected from various issues of the Statistical Yearbook of China and the Provincial Statistical Yearbook. Statistical yearbooks report no FDI data for Xizang (Tibet), and thus Tibet is excluded from the analysis. For the sake of consistency, Sichuan and Chongqing[11] are re-aggregated. The dependent variable is the annual realized amount of FDI flowing into a province converted[12] into constant US dollars.

As the FDI data in this study is not disaggregated by industry or source countries, the amount of inflow into a region is expected to be primarily determined by a number of host characteristics, and thus the model will be as follows:

[6] Include Liaoning, Beijing, Tianjin, Hebei, and Shandong.
[7] Include Jiangsu, Shanghai, Zhejiang, Fujian, and Guangdong.
[8] Include Inner Mongolia, Heilongjiang, Jilin, Shanxi, Henan, Hubei, Hunan, Anhui, and Jiangxi.
[9] Include Sichuan, Guizhou, Yunnan, Shaanxi, Gansu, Qinghai, Ningxia, and Xinjiang.
[10] Including three centrally administered municipalities (Beijing, Tianjin, and Shanghai) and autonomous regions.
[11] In the statistical yearbooks, Chongqing is treated as part of Sichuan province before 1997 and as a separate region since 1997. Even if Chongqing is currently a centrally administered municipality like Beijing, Tianjin, and Shanghai, for the sake of consistency in this analysis, Chongqing is still treated as part of Sichuan Province.
[12] The deflator for FDI is the U.S. producer price index of industrial commodities published by Bureau of Labor Statistics, U.S.A. (base year 1982)

$$FDI = f(host\ variables)$$

The model to be estimated is specified in log-linear form because according to Blonigen et al. (2007) a log linear form leads to well-behaved residuals given the skewness common to FDI data and allows for interactions of the underlying linear forms of the variables. There are several alternative estimation methods for pooled cross-section and time-series data. In this analysis, I choose fixed-effects estimation for the following considerations: (1) As we see from previous studies, new determinants are continuously identified and estimated as significant, so this type of study is prone to the variable omission problem. Region effects can control for the potential endogeneity problem arising from omission of variables, especially if the omitted variables vary little over time. (2) The explanatory variables are such macroeconomic variables as GDP, wage rate, and degree of reform that are highly possible to be correlated with the unobserved region effects (or omitted variables), which makes both pooled-OLS and random-effects estimations inappropriate. (3) This study covers almost all regions in China, which makes fixed-effects more appropriate than random-effects estimation.

### 3.1. Agglomeration Effect of FDI

An important factor affecting FDI location choice is the agglomeration of FDI. All studies on China that include this variable have unanimously confirmed the strong agglomeration effect (for example, He, 2002; Li and Park, 2006; Havrylchyk and Poncet, 2007; and Du et al., 2008). The focus of this research is to empirically examine the change in this effect over years.

China had sealed itself off from the rest of the world for three decades. During the early years of China's opening, the country was little known to the outside world. The information costs faced by foreign investors were extremely high. Much more uncertainty and risk were involved in investing in such a transitional and socialist economy. The existence of operational foreign enterprises, let alone successful ones, offered one of the few positive signals about the local area to potential foreign investors. Existing foreign firms have constantly confronted local authorities for more suitable infrastructures and institutions. As a developing country, China did not have enough resources to improve all of its provinces at the same pace. Pressures from foreign firms did greatly speed up local improvements. Head and Ries (1996) also painted a vivid picture of how new foreign firms could access good-quality intermediate input suppliers at much lower cost if they entered a FDI clustering area. In addition, information sharing among foreign investors, technology spillovers among foreign enterprises, and a larger pool of qualified labor[13] add to the attractiveness of an area with a large number of foreign enterprises. With these centripetal forces of FDI, therefore, China's initial opening policies and its special treatments given to the Coastal Region (especially the Southeastern Coast) had not just given the region a one-time advantage, but also led the region into a virtuous cycle in attracting more subsequent FDI.

From 1979 to 1991, the FDI inflows in China grew gradually. By the end of 1991, the total amount of realized FDI was $25.1 billion. For that period of time, no one had to worry about the congestion diseconomies. In the following year, nearly half of this

[13] FDI increases local labor quality or the pool of skilled labor through on-the-job and/or overseas training.

amount was received. In 1993, $27.5 billion was received. The FDI inflows have surged since then. By the end of 2008, the total FDI inflows amounted to $852.6 billion. A predominating share of over 80% has been constantly utilized by Coastal China (refer to previous section). Centrifugal forces of FDI clustering could have started to work in recent years, considering the large amount of FDI inflows and the high concentration in the Coastal Region. In addition, labor migration restrictions led to insufficient agglomeration according to Au and Henderson (2006). We often see evidence of centrifugal forces from news of China. Many multinational enterprises located in Southeastern China are complaining about rising wages and some have relocated to inland areas.

In this study, I use the number of foreign enterprises in a province as a proxy for agglomeration or clustering of FDI and allow its coefficient estimate to change over four time periods (1992-1997, 1998-2002, 2003-2005, and 2006-2008). In this way, I will examine the changing agglomeration effect of FDI.

### 3.2. Control Variables

Control variables are drawn from past studies, including market size (real provincial GDP), population, labor cost adjusted by productivity, road transportation infrastructure, agglomeration of industrial activity, and degree of internal economic reform. Higher real provincial GDP (or larger market) reflects purchasing power and should attract horizontal FDI, which is used in almost all past studies. But a large population can dilute the effect of market size. Hence, I follow Blonigen et al. (2007) and

control for population. Population is expected to have a negative impact on FDI attractiveness. Holding GDP constant, the larger the population, the less the purchasing power a region has. Higher labor costs mean higher production costs that deter FDI. Past studies have identified the need to control for productivity or labor quality when estimating the effect of the wage rate on FDI, so here I use a productivity adjusted wage rate to measure labor cost. Multinational enterprises' activities necessarily involve transportation, and better transportation infrastructure attracts FDI. Agglomeration of industrial activity implies better upstream and downstream linkages and should attract FDI. Market mechanisms and established legal infrastructure are crucial to the operation of MNEs, thus MNEs are expected to favor regions with higher degree of reform. Even if nearly all previous studies include a policy variable, this study does not. The reason is that measures of this variable (even in its best form of a policy index) used in past studies have little or no year-to-year variation, especially after 2000. With the more recent dataset used in this study, a policy variable will be overwhelmed by fixed effects. With the inclusion of fixed-effects, the exclusion of a policy variable should not result in any serious omitted variable bias. The measures, data sources, and expected effects of these host variables are provided in Table 4.

***Table 4 Description of Variables***

| Variable name | Variable description | Data source | Expected sign |
|---|---|---|---|
| Foreign Direct Investment (FDI) | Aggregate annual FDI inflows into each Chinese province in 1982 US dollars[14] | Statistical Yearbook of China and Provincial Statistical Yearbooks | Dependent variable |
| Labor Cost (WAGE) | Average provincial nominal wage rate of staff and workers divided by labor productivity (where labor productivity is the ratio of output and the number of workers) | Statistical Yearbook of China | - |
| Market Size (RGDP) | GDP of a province deflated by GDP deflator, 100 million yuan | Statistical Yearbook of China | + |
| Population (POP) | The total number of persons in a province | Statistical Yearbook of China | - |
| Road transportation infrastructure[15] (ROAD) | Total length of paved road per unit land mass, km/10000km2 | Statistical Yearbook of China | + |
| Agglomeration of industrial activity (AGGLY) | Percentage of industrial output in total GDP | Statistical Yearbook of China | + |
| Degree of reform[16] (MARFA) | The share of non-state-owned units in total investment in fixed assets. | Statistical Yearbook of China | + |
| Agglomeration of foreign enterprises (RFE) | The total number of registered foreign enterprises at the end of the year | Statistical Yearbook of China | + |

## 4. Empirical Results

I conduct the econometric estimation with a fixed-effects model, controlling for province- and time-specific effects. The results of the model are shown in Table 5. The

[14] To convert FDI into constant dollars, I use as the deflator the U.S. producer price index of industrial commodities published by Bureau of Labor Statistics (based year 1982).

[15] I experiment with three alternative measures for transportation infrastructure with the final choice of the second: (1) the total lengths of roads per unit of land mass; (2) the total lengths of high grade paved roads per unit of land mass; and (3) the total lengths of railway per unit of land mass.

[16] Fan et al. (2000) points out the significant regional disparity concerning the progress of internal economic reform and the reform can be viewed from five major areas (size of the government; growth of the non-state sector and the reform of the state-owned enterprises; inter-regional trade barriers and price controls; factor-market development including factor mobility; legal frameworks). It is impossible to construct a comprehensive index to reflect the degree of reform for my sample years due to data unavailability, so this study follows the common practice like in Havrylchyk and Poncet (2007) and uses the share of non-state investment to measure the degree of reform.

table displays three different specifications. The first specification does not allow the coefficient of any variable to change over time. The second and third specifications allow changes in the coefficient for the clustering of foreign enterprises over four time periods. The third specification also allows changes in the coefficient of market size. Overall, the models performed well, as evidenced by the $R^2$ and Adjusted $R^2$. All variables have their expected sign.

Specification 1 reports that the coefficient estimate for the number of foreign enterprises is positive and statistically significant. The agglomeration of foreign enterprises or FDI is an important determinant for FDI inflows over the entire observation period 1992-2008. Relating to the key focus of this study, Specification 2 and 3 provide the relevant information. The three interaction terms of foreign enterprises clustering and time period are all negative and statistically significant, providing evidence that, since the late 1990s, the agglomeration effect of FDI has diminished. Additionally, the statistical significance and the absolute value of coefficient estimate of the interaction terms increases over the three time periods, signaling the continuously weakening centripetal forces and strengthening centrifugal forces over years.

As the outside world knows more about China through trade, FDI, and tourism, the information cost of investing in China is reducing. As China's domestic institutions and infrastructures have significantly and constantly improved, especially based on the commitment to move toward a market economy, the uncertainty and risk of investing is getting lower as well. Hence, the centripetal forces have become less strong. On the other hand, local governments are making great efforts to improve their local investment

environment, and thus many more areas have arisen as possible investment destinations. The centrifugal forces have become stronger, which disperse FDI away from the congested areas. Better transportation infrastructures from inland to coastal decreases foreign investors' favoritism toward the east coast. The high-speed railroad, which permits existing rail to be enhanced for freight transport in near future, is an example of how better transport will cause FDI to spread away from the coastal areas.

Another interesting observation is that when market size is controlled for by allowing varying coefficients over time in specification 3, the weakening agglomeration effect of FDI is more potent. Other things equal, a province with 1% more foreign enterprises attracted 0.448% more FDI during 1992-1997, 0.32% more FDI during 1998-2002, 0.224% more FDI during 2003-2005, and only 0.068% more FDI during 2006-2008. During recent years the agglomeration effect of FDI has almost vanished. In other words, the centripetal and centrifugal forces now almost exactly offset each other.

Market size (using real provincial GDP as a proxy after controlling for population) has a positive and significant coefficient as reported in specifications 1 and 2. However, as China gradually opened its domestic market and transitioned from a poor country to the world's second largest economy, the local market had a changing influence upon foreign investors' location decision. As shown in specification 3, the local market is not a statistically significant determinant during 1992-1997. But the interaction terms are all positive and significant, with ever increasing value and significance over time, suggesting increasing importance of market size. During 2006-2008, we can see that other things being equal, a province with a 1% larger market tends to attract 1.366% more FDI.

Many foreign investors have come into China for its low labor costs and we might expect labor cost to be a determining factor. Yet the coefficient is not statistically significant, which is consistent with some of previous studies such as Head and Ries (1996) and He (2002). The argument Guimaraes and Figueiredo made for Portugal can be applied to the case of China too, i.e., labor cost may well be a determinant of the decision to locate in China as opposed to other countries, but it is not a statistically significant factor in the decision to pick a province.

Transportation infrastructure is found to be insignificant in previous studies. In this study, road transportation shows significance in specification 1 and 2, but not significant in specification 3. A better measure of transportation in future studies could lead to consistent significance for this variable. Here, I use the density of paved roads as a proxy for the sake of data availability from 1992, even if expressway or highway density is a better measure. The degree of internal reform has a positive influence, but it has a varying significance over the three specifications. The poor measure, due to data unavailability, may be a reason for its variability. Agglomeration of industrial activity is a significant determinant, which is consistent with other agglomeration studies.

***Table 5 Empirical Results***

| | Specification 1 | | Specification 2 | | Specification 3 | |
|---|---|---|---|---|---|---|
| Constant | 21.885 | (5.397)*** | 18.951 | (4.613)*** | 29.037 | (6.806)*** |
| lnRFE | 0.412 | (4.090)*** | 0.454 | (4.384)*** | 0.448 | (4.362)*** |
| DUM98-02*lnRFE | | | -0.067 | (-1.782)* | -0.128 | (-1.821)* |
| DUM03-05*lnRFE | | | -0.120 | (-2.952)*** | -0.224 | (-3.422)*** |
| DUN06-08*lnRFE | | | -0.142 | (-3.293)*** | -0.380 | (-5.008)*** |
| lnRGDP | 0.855 | (3.868)*** | 1.024 | (4.224)*** | 0.471 | (1.625) |
| DUM98-02*lnRGDP | | | | | 0.346 | (1.869)* |
| DUM03-05*lnRGDP | | | | | 0.517 | (2.665)*** |
| DUN06-08*lnRGDP | | | | | 0.895 | (4.244)*** |
| lnPOP | -2.595 | (-5.227)*** | -2.375 | (-4.907)*** | -3.094 | (-5.287)*** |
| DUM98-02*lnPOP | | | | | -0.422 | (-3.147)*** |
| DUM03-05*lnPOP | | | | | -0.585 | (-4.000)*** |
| DUN06-08*lnPOP | | | | | -0.763 | (-4.837)*** |
| lnWAGE | -0.338 | (-1.531) | -0.297 | (-1.331) | -0.148 | (-0.654) |
| lnROAD | 0.123 | (2.001)** | 0.126 | (1.912)* | 0.101 | (1.347) |
| AGGLY | 0.017 | (2.559)*** | 0.013 | (1.864)* | 0.019 | (2.590)*** |
| MARFA | 0.009 | (2.609)*** | 0.006 | (1.724)* | 0.001 | (0.317) |
| Observations | 493 | | 493 | | 493 | |
| $R^2$ | 0.943 | | 0.945 | | 0.947 | |
| Adjusted $R^2$ | 0.937 | | 0.938 | | 0.940 | |

Notes: t-stat in parentheses; * significant at 10%; ** significant at 5%; *** significant at 1%.

## 5. Conclusion

This paper provides new evidence on the factors that influence the amount of FDI inflows into a Chinese province. The most important finding is the diminishing agglomeration effect of FDI in China. Coastal areas' FDI clustering no longer exerts as strong a pull for subsequent FDI. Policy makers will find it easier than a decade ago to direct FDI away from the highly concentrated coastal areas to the inland.

The significantly varying coefficients found for the clustering of foreign enterprises and market size in this study provide an important piece of advice for future

research on FDI in China. China develops at an astonishingly fast speed. In only two decades, the country evolved through several development stages. When pooling data together over a long period of time, researchers need to carefully design the empirical model to capture the fundamental development milestones in China.

This study sheds some light on the general picture of FDI agglomeration in China. But, because data availability restricts the analysis to using aggregate data, further research is called for. Future studies with more disaggregated data by sector and by source country can provide more accurate and insightful information.

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# Chapter Three (Second Dissertation Essay): Third-Region Effects on Inbound FDI: Evidence from Chinese Provinces

## 1. Introduction

The last three decades have seen extraordinary growth in Foreign Direct Investment (FDI) in the world and an increasing role of Multi-National Enterprises (MNEs) in globalization. China, as the second largest recipient of world FDI, has identified FDI as one of the driving factors for its spectacular economic growth. Local governments and authorities actively compete against one another in attracting FDI. A large and growing number of studies have examined the FDI determinants in China. A short list of recent studies include: Head and Ries, 1996; Wei et al., 1999; Coughlin and Segev, 2000; Cheng and Kwan, 2000; Tung and Cho, 2001; He, 2002; Fung et al., 2005; Gao, 2005; He, 2006; Li and Park, 2006; Havrylchyk and Poncet, 2007. However, none of the past studies has taken into account the interdependence of regions implied by the recent MNE theory[17].

The recent theoretical works on MNE have departed from the two-country framework[18] and emphasized the importance of third countries. For example, Yeaple (2003) uses a three-country model to analyze why a MNE might follow a complex

[17] Coughlin and Segev (2000) is the only study on China that uses spatial econometrics. But their spatial modeling is not based on the recent MNE theory; instead, it relies exclusively on spatial tests. As a result, only a spatial error is included in the spatial modeling. With cross-sectional data, they find a positive coefficient for the spatial error and also find that the inclusion of spatial error does not change their parameter estimates from Ordinary Least Squares (OLS) estimation.

[18] Markusen (1984) and Helpman (1984) initiated the development of formal MNE theory and relied on a two-country framework. Markusen (1984) developed a general equilibrium model and suggested a pure horizontal motivation of MNE that aims for host country's market. Helpman (1984) developed a general equilibrium model and suggested a pure vertical motivation of MNE that aims for a host country's cheaper productive factors.

integration strategy. He advises empirical research that complex integration strategies of MNEs create dependence between FDI into one country and the characteristics or policies of its neighbors. Dependence of this nature has important implications for the FDI structure across countries. Grossman et al (2006) use a three-country model to examine a rich array of complex integration strategies of a MNE that maintains its headquarters in the parent country and sets up its vertical chain of production in one or more locations. Ekholm et al. (2007) use a three-region model to analyze the Export-Platform MNE whose output is sold in third countries.

Blonigen et al. (2007) and Baltagi et al. (2007) were the first two empirical studies on FDI determinants to derive hypotheses on spatial linkages from the recent MNE theory. They use spatial models to provide empirical evidence for the theory. Both studies examine the US outbound FDI into host countries throughout the world. Their studies are followed by Garretsen and Peeters (2007), who examine the Dutch outbound FDI, Ledyaeva (2009), who examines the FDI in Russia, and Poelhekke and van der Ploeg (2009), who expand the set of common FDI determinants with urban agglomerations.

Building on Blonigen et al. (2007), this essay fills the gap in the empirical literature on FDI determinants in China by incorporating the interdependence of regions. My major contribution includes extending the hypotheses and spatial modeling in Blonigen et al. (2007). I include more third country/region characteristics in the hypotheses and separate the spatial lag (that reveals the resulting FDI structure across regions) and third regions characteristics into two spatial models. Moreover, this is the

first study to provide information on how neighbor characteristics affect a particular region's attractiveness to foreign investors.

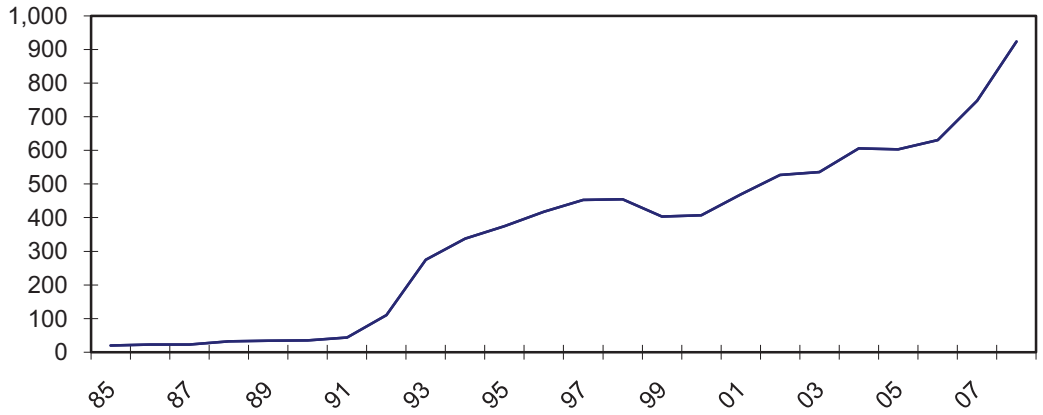
With a sample covering 29 regions (provinces) over the period 1993-2008, this study finds clear evidence of third-region effects. FDI across regions displays a negative spatial relationship, suggesting that most MNEs coming into China do not choose multiple nearby locations to perform their operation. Despite the competing pattern of FDI across regions, not all surrounding regions' endowments have competing (negative) effects. Some regional endowments actually have complementary (positive) effects on other regions' attractiveness for FDI. Putting together the third-region effects, this essay uncovers the motivations of FDI: Pure-Vertical and Export-Platform[19] forms of FDI dominate the aggregate FDI inflows into China.

## 2. FDI in China

Since China's opening to the outside world in the late 1970s, FDI into China increased gradually during the 1980s and surged after the early 1990s. Figure 1 illustrates the pattern. As the second largest recipient of world FDI after the United States, China received $95 billion, 8.5% of the world total in 2009.

[19] This paper studies the Chinese regions, so export-platform FDI here refers to the form of FDI that selects one Chinese region as the production platform to serve not only its own region but also other Chinese regions.

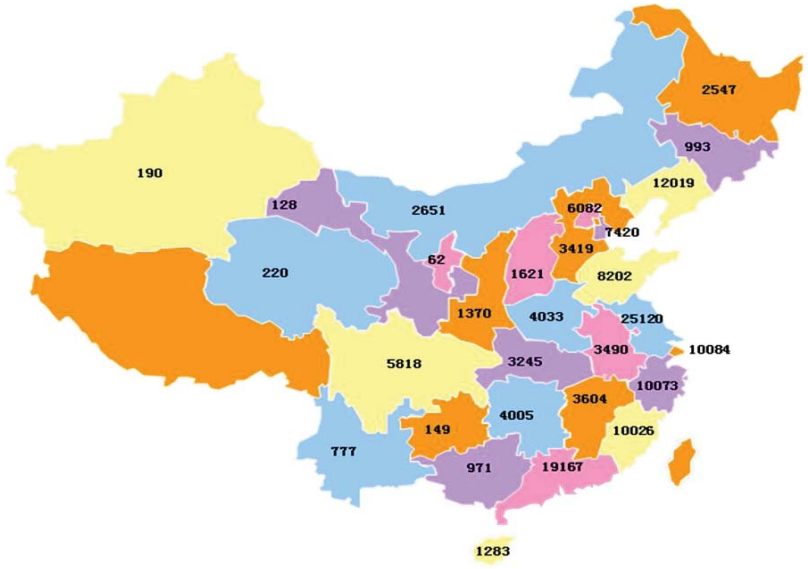
***Figure 1 FDI inflows into China 1985-2008 (in $100 million)***




Source: Statistical Yearbook of China, 2009 issue.

The FDI inflows has not been evenly distributed across regions (provinces) in China. Figure 2 shows the amount of FDI received by each region in 2008. Eastern regions have been receiving a predominating share (about 80%) over the years. The timing of regions open to FDI and preferential policies contributed to its pattern. Eastern China had been opened to foreign investment 10 years earlier than the rest of China, and it received many more preferential treatments. Encouragingly, Central and Western China have shown a trend of increasing shares since the late 1990s. China is geographically a large country, and its diverse regions offer many alternative location choices for MNEs. Each region has its own distinct endowments. Western and Central China are better endowed with natural resources, while Coastal or Eastern China is better endowed with qualified labor forces and transportation infrastructures. China's shift from central planning to a market economy, along with its opening during the past three decades, has allowed its regions to explore their regional comparative advantages. During this process some regions have grown much faster than others.

***Figure 2 FDI inflows into each Chinese region (province) in 2008 (in million US Dollars)***




China is potentially attractive to different forms of MNEs. With its fast growth, nearly 20% of the world's population and noteworthy trade barriers with other countries, China may attract Horizontal MNEs that aim to sell in the Chinese markets to avoid the tariff and non-tariff trade barriers. As in the European Union, such MNEs are likely to choose one or few regions as a platform from which to serve the rest of China. China is also a developing country with abundant low-priced productive inputs, which are attractive features for Vertical FDI. This study also explores the question of whether the Vertical MNEs tend to choose one location or adopt the Complex-Vertical strategy to choose several locations.

## 3. Conceptual Framework

The empirical hypotheses[20] and spatial modeling in Blonigen et al. (2007) are employed by all three subsequent studies (Garretsen and Peeters, 2007; Ledyaeva, 2009; and Poelhekke and van der Ploeg, 2009). This essay builds on Blonigen et al. (2007).

Pure-Horizontal FDI aims for the host's internal market. It usually occurs when the host market is large and trade frictions are high, so that the saved trade costs exceed the additional plant set-up costs. When an MNE with this strategy evaluates a country/region, third countries/regions will have no effect at all, and thus no spatial linkages exist. As for the country/region's own characteristics, its market size and trade frictions with the parent country should have strongly positive effects.

Export-Platform FDI seeks market access, but it also seeks to export to other markets. If the saved trade costs exceed the plant set-up costs in one of the target markets, Export-Platform FDI can occur and will select one target market as a platform to produce and sell to the whole group of target markets. The location choice of one country/region at the expense of others implies a negative spatial relationship of FDI inflows across countries/regions. A negative spatial lag is thus expected in spatial estimation. In addition, surrounding markets' potential should have a strongly positive effect[21], while trade barriers of surrounding countries/regions should have a strongly negative effect. Furthermore, the country/region's own market size and trade frictions with the parent country should be important and positive determinants, following the similar reasoning given above for Pure-Horizontal FDI.

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[20]For more details, please see Blonigen et al. (2007) page 1307.

[21] Note that the surrounding market might not have a positive effect if the border costs among the countries or regions within the group are not about the same, see Blonigen et al. (2007) page 1319 for a detailed discussion.

Pure-Vertical FDI aims to exploit the host's low-priced productive factors. Such a MNE keeps its headquarters in the parent country and sets up its production plant in the host with output shipped back to the parent country. This form of MNE evaluates country/region and selects the host that will provide them with output at the lowest cost. Hence, this form of FDI goes to a country/region at the expense of going into others, which implies a negative spatial relationship of FDI. However, it differs from Export-Platform FDI with regard to the effects of country/region and neighbor characteristics: (1) own market size or surrounding markets' potential should not matter for Pure-Vertical FDI, as the output is shipped back to the parent country; (2) a host's trade cost with the parent country should have a strongly negative impact, as trade cost adds to the total cost of providing the output to the parent country; (3) a host's prices of productive factors such as wage rate should be strong determinants. Prices of productive factors in surrounding countries/regions should matter, because the closer the other regions with cheaper productive factors, the stronger the competition (substitute) effect.

Complex-Vertical FDI also aims for low-priced productive factors. Instead of choosing one host location to produce, a Complex-Vertical MNE fragments its production into several productive activities that are carried out in different host locations, and thus it is capable of exploiting the various kinds of productive resources endowed in different locations. The cooperation among the hosts results in a positive relationship of FDI. In addition to the three implications for the effects of a country/region and neighbor characteristics mentioned above for the form of Pure-Vertical, Complex-Vertical FDI also needs low trade costs between the host and its surrounding countries / regions, as

intermediate goods are sent among affiliates. Different from Pure-Vertical form, the prices of productive factors in surrounding countries/regions should have a complementary effect, due to the hypothesized cooperation.

***Table 1 Empirical Hypotheses for Various Forms of MNE (FDI)***

| | MNE Strategy/FDI Motivation[22] | | | |
|---|---|---|---|---|
| | Pure Horizontal | Export Platform | Pure Vertical | Complex Vertical |
| FDI in Surrounding Regions | 0 | - | - | + |
| Surrounding Markets' Potential | 0 | + | 0 | 0 |
| Surrounding Regions' High Productive Factor Price | 0 | 0 | + | - |
| Trade Barriers with Surrounding Regions[23] | 0 | - | 0 | - |
| Trade Frictions with Parent Country[24] | + | 0 | - | - |
| Own Market Size | + | 0 | 0 | 0 |
| Own Region's Productive Factor Price | 0 | 0 | - | - |

## 4. Empirical models and data

### 4.1. Baseline model

One of the concerns of this study is whether statistical inference or conclusions drawn on traditional FDI determinants are robust to the inclusion of spatial dependence[25].

[22] The strategy adopted by a MNE corresponds to the motivation of FDI. So in this paper, the two terms are used interchangeably.

[23] Due to data availability problem, this study assumes that trade barriers across provinces are at roughly the same level, and do not include this variable. If future study could obtain a good measure for this variable and include it in the analysis, it would be a good extension to this study.

[24] In this current study, I do not include trade frictions with parent country because I am analyzing the FDI inflowss into different regions within one country, the trade frictions with parent country are about the same across regions.

[25] According to Anselin (1988), ignoring the spatial dependence can give rise to econometrics problems of inconsistent or inefficient parameter estimates and invalid statistical inference. So in this paper I'll test for the presence of spatial dependence and use spatial models if the spatial dependence is actually present.

The analysis starts with a traditional fixed-effects[26] model without any spatial dependence. The model is specified in log-linear form because, as mentioned in Blonigen et al. (2007), "such a model leads to well-behaved residuals given the skewness common to FDI data and allows for interactions of the underlying linear forms of the variables." The baseline model is as follows:

$$FDI = \beta_0 + \beta \cdot HostVariables + \varepsilon \qquad (1)$$

Host variables include market size (real provincial GDP), population, labor cost adjusted by productivity, road transportation infrastructure, agglomeration of industrial activity, agglomeration of foreign enterprises, and degree of internal economic reform. A time trend is also included to explain anything that affects all regions equally over time. Most of the host variables are similar to those used in previous studies on FDI determinants in China. Higher real provincial GDP (or larger market) reflects purchasing power and should attract Horizontal FDI, which is used in almost all past studies. But a large population can dilute the effect of market size. Hence, I follow Blonigen et al. (2007) and control for population. Population is expected to have a negative impact, because holding GDP constant, the larger the population, the less the purchasing power a region has. Higher labor cost means higher production cost and deters FDI. Past studies have identified the need to control for productivity or labor quality when estimating the

[26] I choose to use fixed-effects estimation throughout this paper for my panel dataset for the following considerations: (1) As we see from previous studies, new determinants are continuously identified and estimated as significant, this type of study is prone to the variable omission problem. Region effects can control for the potential endogeneity problem arising from omission of variables, especially if the omitted variables vary little over time. (2) The explanatory variables are such macroeconomic variables as GDP, wage rate, degree of reform that are highly possible to be correlated with the unobserved region effects (or omitted variables), which makes both pooled-OLS and random-effects estimation inappropriate. (3) This study covers almost all regions in China, which makes fixed-effects more proper than random-effects estimation.

effect of wage rate on FDI, so here I use productivity adjusted wage rate to measure labor cost. MNE activity necessarily involves transportation, and better transportation infrastructure attracts FDI. Agglomeration of industrial activity implies better upstream and downstream linkages[27] and should attract FDI. Market mechanisms and established legal infrastructure are crucial to the operation of MNEs, thus MNEs are expected to favor regions with higher degree of internal economic reform[28]. Agglomeration of foreign enterprises is used in few of previous studies. It can catch the self-reinforcing effect or agglomeration effect of FDI (i.e., higher level of existing FDI attracts subsequent FDI). This effect of FDI can be explained through lower information costs[29] and positive externalities[30] that FDI generates. Even if nearly all previous studies include a policy variable, this study does not. The reason is that the measures of a policy variable (even in its best form of a policy index[31]) used in past studies have little or no variation over years especially after 2000. With the more recent dataset used in this study, a policy variable will be overwhelmed by fixed effects, and the exclusion of this variable should not impose any omitted variable bias. The measures, data source, and expected effects of these host variables are provided in Table A1 in the Appendix. Note that productivity-

[27]Please refer to New Economic Geography Theory (Krugman, 1991 a, b; Venables, 1993, 1995).
[28] Since 1979, China has carried out the internal economic reform, moving gradually from centrally planned to market economy. Some provinces have proceeded with the economic reform at a faster pace, having a high ratio of private businesses, a better-developed legal infrastructure, and better market conditions, while other provinces still have prevalent government interference, few private enterprises exist, and the legal system is substantially under-developed (Li and Park 2006).
[29]Mariotti and Piscitello (1995), points out that one of the lowest information-cost areas is the area where more FDI has been accumulated. He (2002) mentions that there are information spillovers or sharing among foreign investors.
[30] FDI generates positive externalities on technology, skilled labor, and intermediate goods suppliers.
[31] The measure for FDI policy or incentives used in most studies is a dummy variable with 1 for coastal regions and 0 for inland regions. A few recent studies construct policy index as the measure. For example, Demurger (2002) uses a preferential policy index that is constructed by giving to each province a weight that reflects the type of economic zone that it hosts; He (2006) constructs an index by totaling two sets of policy zones and assigning different weights to them.

adjusted wage rate and agglomeration of foreign enterprises are entered as one-period lags, to avoid the feedback effect from the dependent variable, thus avoiding an endogeneity problem.

### 4.2. Spatial specifications

I use two spatial models to examine the third-region effects. The first is a Spatially Auto-Regressive model with spatially Auto-Regressive errors (SARAR) to examine the resulting FDI structure across regions, as shown in equation (2).

$$FDI = \beta_0 + \beta \cdot HostVariables + \rho \cdot W \cdot FDI + \varepsilon, \quad \text{where} \quad \varepsilon = \gamma \cdot W \cdot \varepsilon + v \qquad (2)$$

W is the spatial weight matrix as discussed in the following sub-section 4.3. The variable $W \cdot Variable$ is the spatially weighted average of all other regions except the region under consideration. For example, if the variable is FDI, $W \cdot FDI$ means the spatially weighted average of FDI flowing into other regions. A positive ρ means that a particular region's FDI inflows increases (decreases) when surrounding regions' FDI inflows increases (decreases). This is the case when MNEs choose several nearby locations to produce in accordance with Complex-Vertical FDI. A negative ρ means that a particular region's FDI inflows decreases (increases) when surrounding regions' FDI inflows increases (decreases), displaying an obvious competition pattern. This is the case when MNEs choose just one location at the expense of choosing surrounding regions.

The spatial lag term $W \cdot FDI$ might not be able to catch all spatial dependence. The spatial error term can exist for several reasons such as common shocks or

transmission of shocks[32], unobserved characteristics that are spatially related[33], and measurement errors[34]. Spatial tests will serve as a supplemental tool in determining whether the spatial error term is still needed in the presence of the spatial lag. If a spatial error term is needed ($\gamma \neq 0$,), equation (2) becomes a SARAR model; if a spatial error term is not needed ($\gamma = 0$), the model is reduced to a pure spatial lag model.

Yeaple (2003) points out that the complete set of FDI determinants includes both country and neighborhood characteristics. To this end, I construct a Spatial Error Model (SEM) consisting of both own region characteristics and spatially weighted third regions characteristics, as follows:

$$FDI = \beta_0 + \beta \cdot HostVariables + \alpha \cdot W \cdot HostVariables + \varepsilon,$$

where $\varepsilon = \gamma \cdot W \cdot \varepsilon + v$ (3)

### 4.3. Spatial weight matrix

W is the spatial weight matrix. There is no specific theoretical guideline for constructing the weight matrix, and usually W is constructed based on how the regions are hypothesized to be spatially related. For a cross-sectional dataset, the weight matrix is a block-diagonal N × N matrix, where N is the number of cross-sections, here denoted as $W_t$ to relate to the weight matrix W used in the panel data setting.

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[32] In the case of China, the provinces under observation are within one country, they are faced with many common shocks, and even the shocks occurring in a particular region can be easily transmitted to other regions

[33] In this study of China, many regional characteristics cannot be quantitatively and accurately measured including China's biased regional development policy, geographical location with its particular endowments like better infrastructure and industrial background, historical external contact with the world, etc, and these unobserved characteristics can be spatially related.

[34] Potential measurement errors associated with geographic data is another cause for spatial error.

$$W_t = \begin{pmatrix} 0 & w_{12} & \dots & w_{1N} \\ w_{21} & 0 & \dots & w_{2N} \\ \vdots & \vdots & \ddots & \vdots \\ w_{N1} & w_{N2} & \dots & 0 \end{pmatrix} \quad (4)$$

A panel dataset is used in this study, so the full weight matrix W is the block-diagonal NT × NT matrix

$$W = I_T \otimes W_t \quad (5)$$

where T is the number of time periods, NT=N*T, $l_T$ is a T ×T identity matrix, and t denotes time period, it can be 1, 2, …, T. In our case, the weight matrix Wt is constructed based on geographical distance and does not vary over time, so it is the same across observation time periods.

Following Blonigen et al. (2007) and Baltagi et al. (2007), the weight matrix is constructed using inverse distance function where the shortest bilateral distance (i.e. the 131 km between Tianjin and Beijing) within the sample receives a weight of unity. Therefore,

$$w_{ij}(d_{ij}) = \frac{131}{d_{ij}} \qquad where\ i \neq j \quad (6)$$

where $d_{ij}$ is the distance between the capital cities[35] of province i and j.

Following the common practice, the weight matrix is standardized so that each row sums to unity.

### 4.4. Sample data

[35] The distances between capital cities are the driving distance found from http://maps.google.com.

The full sample is a panel of annual data for the 29 provinces[36] in China from 1993 to 2008. I choose 1993 as the starting year for the sample data because that year was the first full year after China opened to foreign investment nationwide.

For ease of comparison with past studies, the data for this study is taken almost exclusively from the Statistical Yearbooks of China published annually by the Statistical Bureau of China. Only some FDI data are obtained from the Provincial Statistical Yearbooks due to the discontinued availability of FDI data in the Statistical Yearbooks of China after 2003.

## 5. Empirical Results

### 5.1. Six Model Specifications

Table 2 summarizes the regression results for six model specifications. Columns (1) - (3) present pooled OLS, random-effects, and fixed-effects estimation for equation (1), respectively. Region effects are significant, and the adjusted $R^2$ and log-likelihood clearly show preference of fixed-effects over the other two alternatives. These results suggest that fixed-effects estimation is most appropriate for the current study, and thus fixed-effects is used throughout the analysis.

Spatial tests confirm the need for spatial modeling. Columns (4) and (5) present the estimations of equation (2) – the spatial lag model without the spatial error term (SAR) and with the spatial error term (SARAR). The spatial test result shows that a spatially auto-correlated error term is still needed when a spatial lag is already included, which

[36] All the provinces, autonomous regions, and self-administered municipalities are included except Tibet. I combine the data from Chongqing and Sichuan Province because they have only existed as separate entities since 1996.

points out that SARAR model is more appropriate than SAR model for this dataset. The log-likelihoods show that the model fit increases as it moves from column (3) to column (5), which further suggests that spatial dependence exists and SARAR better takes care of the spatial dependence than SAR. The last specification estimates equation (3) – the spatial error model with spatially weighted exogenous variables, and results are presented in column (6).

## 5.2. Results

### 5.2.1. Own Region FDI Determinants

The comparison of non-spatial estimation (column 3) and spatial estimations (columns 5 and 6) shows that the inclusion of spatial dependence does not change the effects of common determinants qualitatively except for the labor cost, but instead changes them quantitatively. The omission of spatial dependence tends to upwardly bias the coefficients of most determinants and change the significance level of variables.

***Table 2 Estimation Results for Aggregate FDI inflows into Chinese Regions, 1993-2008***

| Explanatory Variables | (1) Specification 1 Pooled OLS | | (2) Specification 2 Random Effects | | (3) Specification 3 Fixed Effects | |
|---|---|---|---|---|---|---|
| | Coef | t-stat | Coef | t-stat | Coef | t-stat |
| **Own Region Characteristics** | | | | | | |
| Agglomeration of Foreign Enterprises | 0.550*** | 5.013 | 0.274*** | 2.578 | 0.233* | 1.765 |
| Productivity Adjusted Wage Rate | -0.109 | -0.918 | 0.014 | 0.061 | 0.205 | 0.748 |
| Road Transportation | 0.072 | 0.483 | 0.309*** | 3.068 | 0.209 | 1.332 |
| Agglomeration of Industrial Activity | 0.178 | 0.463 | 0.839*** | 3.213 | 1.068*** | 5.430 |
| Degree of Reform | 0.939*** | 2.500 | 0.649** | 2.443 | 0.695*** | 2.700 |
| Real GDP | 1.049*** | 2.904 | 1.422*** | 3.944 | 1.628*** | 3.043 |
| Population | -0.647*** | -2.720 | -0.958*** | -3.078 | -3.317*** | -2.994 |
| Time Trend | -0.064** | -1.944 | -0.093*** | -3.038 | -0.083* | -1.852 |
| Log-likelihood | -450.90 | | | | -235.77 | |
| Adjusted R2 | 0.87 | | 0.69 | | 0.94 | |

Notes: * Significant at 10%; ** significant at 5%; *** significant at 1%.

***Table 2 Continued***

| Explanatory Variables | (4) Specification 4 Fixed Effects in SAR | | (5) Specification 5 Fixed Effects in SARAR | | (6) Specification 6 Fixed effects in SEM | |
|---|---|---|---|---|---|---|
| | Coef | t-stat | Coef | t-stat | Coef | t-stat |
| **Own Region Characteristics** | | | | | | |
| Agglomeration of Foreign Enterprises | 0.236*** | 4.500 | 0.259*** | 4.612 | 0.294*** | 4.869 |
| Productivity Adjusted Wage Rate | 0.100 | 0.674 | -0.280* | -1.634 | -0.282 | -1.515 |
| Road Transportation | 0.203** | 2.424 | 0.092 | 1.207 | 0.147* | 1.794 |
| Agglomeration of Industrial Activity | 0.940*** | 4.161 | 0.043 | 0.170 | 0.288 | 1.058 |
| Degree of Reform | 0.679*** | 5.300 | 0.754*** | 5.991 | 0.859*** | 6.129 |
| Real GDP | 1.518*** | 6.178 | 1.321*** | 5.425 | 1.064*** | 4.012 |
| Population | -3.190*** | -5.272 | -3.418*** | -6.248 | -3.372*** | -5.729 |
| Time Trend | -0.091*** | -3.736 | 0.199*** | 3.757 | -0.191** | -2.006 |
| **Third Regions' Characteristics** | | | | | | |
| Agglomeration of Foreign Enterprises | | | | | -0.339*** | -3.213 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Productivity Adjusted Wage Rate | | | | | 1.575*** | 4.981 |
| Road Transportation | | | | | 0.031 | 0.149 |
| Agglomeration of Industrial Activity | | | | | -1.281* | -1.869 |
| Degree of Reform | | | | | -2.063*** | -4.953 |
| Real GDP | | | | | 3.345*** | 3.391 |
| Population | | | | | -2.921 | -0.911 |
| Spatially weighted FDI (spatial lag) | 0.144 | 1.344 | -2.808*** | -16.912 | | |
| Spatial error | | | 0.918*** | 57.398 | -0.371** | -2.170 |
| Log-likelihood | -234.28 | | -221.09 | | -206.79 | |

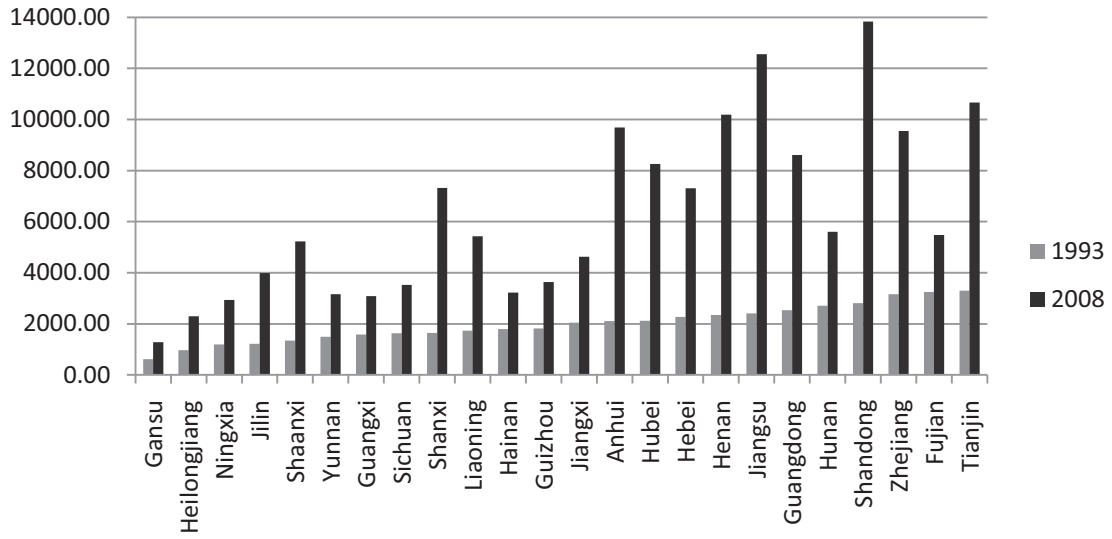
Notes: * Significant at 10%; ** significant at 5%; *** significant at 1%.

After accounting for the spatial dependence through specification (5) or (6), the qualitative effects of the determinants of FDI are consistent with past studies. Real provincial GDP (after controlling for population), road transportation infrastructure, degree of internal reform, agglomeration of foreign enterprises, and agglomeration of industrial activities all have positive effects, while labor cost has a negative impact. We see that market size and degree of reform are the strongest determinants. With all the explanatory variables (except time trend) expressed in natural logarithms, the coefficient of 1.3 for real GDP implies that when real GDP itself increases by 1%, the province will attract 1.3% more FDI. When the degree of reform is increased by 1%, the province can receive 0.75% more FDI. Agglomeration of foreign enterprises and labor cost are two other significant variables. Agglomeration of industrial activities is not statistically significant.

With more recent data, this study differs from past studies in that it finds some significance for road transportation (see column (6)). Conceptually, transportation infrastructure should be important to all forms of FDI, but all past studies on China find it

to be insignificant. This statistical insignificance may be due to the fact that the road transportation route density did not vary much across provinces before 2000, especially if we exclude five outliers shown by the 1993 pattern in Figure 3. A similar pattern for railroad is found. So it is not surprising that past studies found transportation to be statistically insignificant. The variation across provinces has increased in the past decade. The past several years have witnessed significant improvement in China's transportation infrastructure, and widening regional differences, as shown by the 2008 pattern in Figure 3. As we accumulate more years of data in the future, it will be interesting to see if the significance of transportation infrastructure increases further. This finding provides an important piece of advice for policy makers: they should not under-value transportation infrastructure even though most empirical studies on FDI determinants find it to be statistically insignificant.

***Figure 3 Total length of paved road per land mass (km/10000km2), excluding five outliers (top two: Shanghai, Beijing; bottom three: Xinjiang, Qinghai, Inner Mongolia)***




### 5.2.2. Third-region Effects

The spatial lag in column (5) reveals the structure of FDI across regions. This variable is statistically significant at the 1% level. The coefficient of -2.8 suggests that a particular region's FDI inflows decrease by 2.8% when the spatially weighted average of FDI inflows in its surrounding regions increases by 1%. This competing pattern of FDI inflows across regions indicates that most MNEs coming into China do not choose multiple locations. However, despite this competing pattern of FDI, it is not necessarily true that all surrounding regions' endowments display competing effects and draw away FDI. Column (6) reveals that larger market size and better transportation infrastructures in surrounding regions actually enhance a particular region's attractiveness to foreign investors. Surrounding regions' lower labor cost, higher degree of reform, agglomeration of industrial activities, and agglomeration of foreign enterprises draw away FDI inflows

from a particular region. All of the surrounding regions' variables display significant effects, except transportation infrastructure. Both Columns (5) and (6) provide strong evidence of third-region effects.

The variable of agglomeration of foreign enterprises deserves a little more attention. One can see from either column (5) or (6) that own region's agglomeration of foreign enterprises has a positive and statistically significant effect, which indicates that there is a strong self-reinforcing or agglomeration effect of FDI. The surrounding regions' agglomeration of foreign enterprises has a negative and statistically significant effect on a particular region, which suggest that the benefits or positive externalities of FDI agglomeration do not spill over to surrounding regions.

### 5.2.3. Motivations of MNE (FDI) Coming into China

Based on the empirical hypotheses in Table 1, the motivations of FDI can be uncovered from columns (5) and (6) of Table 2. The spatial lag is negative and strongly significant, which is consistent with Export-Platform and Pure-Vertical FDI. The additional finding of strongly significant and positive coefficients for own market size and surrounding markets' potential is strongly suggestive of Export-Platform FDI. This finding also bears on the issue of border costs[37] discussed in Blonigen et al. (2007). When the border costs with third countries/regions are low enough, surrounding markets' potential has a significantly positive effect on the host receiving Export-Platform FDI.

[37] They find negative effect of surrounding markets' potential for their full sample of all countries or sub-sample of all OECD countries that is inconsistent with their hypothesis. With the suggestion that border costs might be the reason (see detailed discussion on this in Blonigen et al., 2007, p. 1319), they use the sub-sample of European OECD countries where border costs are rather low, and find largely expected result.

The positive surrounding markets' potential found in this study also suggests that even if there are implicit trade barriers across Chinese provinces, they are low compared to international barriers.

In addition to Export-Platform FDI, columns (5) and (6) in Table 2 provides evidence for Pure-Vertical FDI. The significant and negative coefficient for own region's labor cost as well as the strongly significant and positive coefficient for surrounding regions' labor cost perfectly match Table 1's sign expectation for Pure-Vertical FDI. This result is not surprising. China is a developing country with abundant low-priced labor and other productive factors, and obviously much FDI is part of foreign firms' verticalization strategies. On the other hand, this study does not find any evidence of Complex-Vertical FDI in China. The spatial lag is not positive and the surrounding regions' low labor cost exerts a strong competing effect instead of complementary effect. So, Complex-Vertical FDI in China appears to be negligible relative to Pure-Vertical FDI.

## 6. Conclusion

This paper includes spatial interactions of regions in analyzing the FDI determinants in China and uses two spatial models to account for third-region effects. A panel dataset of 29 Chinese provinces from 1993 to 2008 is used.

The comparison of the non-spatial and spatial estimations suggests that the inclusion of spatial dependence changes the statistical estimates of traditional FDI determinants quantitatively but not qualitatively. After exploring the reasons for the

insignificance of transportation infrastructure in earlier studies, this study warns policy makers not to under-value the actual importance of transportation infrastructure.

Third-region effects are revealed in both spatial models. The negative spatial lag in SARAR model suggests a competing relationship of FDI inflows into a particular region and its surrounding regions. This indicates that most MNEs coming into China do not choose multiple locations. Although the regions are competing against each other to attract FDI, the spatial error model with all spatially weighted FDI determinants reveals that not all surrounding regions' endowments draw away FDI. Instead, some of neighbors' endowments such as their good transportation infrastructure and market potential can enhance a particular region's attractiveness.

Additionally, this essay also uncovers the motivations of MNEs coming into China. It finds clear evidence of Pure-Vertical and Export-Platform FDI dominating the aggregate FDI inflows in Chinese provinces. Finally, the significantly positive coefficient for surrounding markets' potential in this study provides additional evidence for the border effects as discussed in Blonigen et al. (2007).

Due to data accessibility problems, unfortunately, this study is unable to disaggregate FDI by source country or industry and has to restrict itself to the aggregate FDI inflows into each province. However, it does provide a general picture of third-region effects and China's inbound FDI motivations. Future studies should seek disaggregated data by industry and by source country to provide more detailed and specific analysis for each industry's FDI and each source country's FDI. In addition, with

longer time series available in the future it will be interesting to examine the changing relative importance of FDI determinants after China's entry[38] to the WTO.

[38] In November 2001, in the Qatari capital of Doha, the 4th Ministerial Conference approved China's entry to the WTO, signaling that China's opening to the outside world entered a new phase. Since 2001, China's opening has moved from limited into a full range of market opening, from a unilateral self opening to multilateral opening with all WTO members, and from the old pilot-based policy-oriented opening into one under a formal legal framework.

## APPENDICE

***Table A1 Description of Variables***

| Variable name | Variable description | Data source | Expected sign |
|---|---|---|---|
| Foreign Direct Investment (FDI) | Aggregate annual FDI inflows into each Chinese province in US dollars | Statistical Yearbook of China and Provincial Statistical Yearbooks | Dependent variable |
| Labor Cost (Productivity adjusted wage rate) | Average provincial nominal[39] wage rate of staff and workers divided by labor productivity (where labor productivity[40] is the ratio of industrial output and the number of industrial workers) | Statistical Yearbook of China | - |
| Market Size (Real Provincial GDP) | GDP of a province deflated by GDP deflator, 100 million yuan | Statistical Yearbook of China | + |
| Population | The total number of persons in a province | Statistical Yearbook of China | - |
| Road transportation infrastructure[41] | Total length of paved road per unit land mass, km/10000km$^2$ | Statistical Yearbook of China | + |
| Agglomeration of industrial activity | Percentage of industrial output in total GDP | Statistical Yearbook of China | + |
| Degree of reform [42] | The share of non-state-owned units in total investment in fixed assets. | Statistical Yearbook of China | + |
| Agglomeration of foreign enterprises | The total number of registered foreign enterprises at the end of the year | Statistical Yearbook of China | + |

[39] Here I choose to use nominal wage rate due to the consideration that foreign investors are supposed to care the actual amount of money paid to the workers instead of the real purchasing power of the money meant to the workers.

[40] I attempt two measures for labor productivity with final choice of the former one: one is measured as the value of industrial output divided by the number of industrial workers, the other as the value of total provincial output divided by the total number of workers. The former one functions better than the other one probably because most of the FDI inflows into China concentrates in manufacturing sector.

[41] I experiment with three alternative measures for transportation infrastructure with the final choice of the second: (1) the total lengths of roads per unit of land mass; (2) the total lengths of high grade paved roads per unit of land mass; and (3) the total lengths of railway per unit of land mass.

[42] Fan et al. (2000) points out the significant regional disparity concerning the progress of internal economic reform and the reform can be viewed from five major areas (size of the government; growth of the non-state sector and the reform of the state-owned enterprises; inter-regional trade barriers and price controls; factor-market development including factor mobility; legal frameworks). It is impossible to construct a comprehensive index to reflect the degree of reform for my sample years due to data unavailability, so this study follows the common practice like in Havrylchyk and Poncet (2007) and uses the share of non-state investment to measure the degree of reform.

***Table A2 Descriptive Statistics***

| Variables | Mean | Maximum | Minimum | Standard Deviation |
|---|---|---|---|---|
| FDI | 11.15 | 14.74 | 6.32 | 1.78 |
| Agglomeration of Foreign Enterprises | 8.06 | 11.11 | 2.20 | 1.44 |
| Productivity Adjusted Wage Rate | 6.86 | 7.76 | 5.86 | 0.37 |
| Road Transportation | 7.78 | 10.65 | 5.01 | 1.00 |
| Agglomeration of Industrial Activity | 3.62 | 4.08 | 2.45 | 0.26 |
| Degree of Reform | 3.87 | 4.46 | 2.49 | 0.37 |
| Real GDP | 8.02 | 10.31 | 5.15 | 1.02 |
| Population | 8.10 | 9.38 | 6.15 | 0.81 |

Notes: (1) All variables are expressed in natural logarithms. The number of observations is 464. This is based on a balance panel with N=29 provinces and T=16 time periods.

(2) The descriptive statistics of the variables are based on the data from 1993 to 2008. As one-period lag is applied on productivity adjusted labor cost and agglomeration of foreign enterprises, the descriptive statistics of these two variables are based on the data from 1992 to 2007.

***Table A3 Diagnostic Tests***

| **Redundant Fixed Effects Tests** | | | |
|---|---|---|---|
| Effects Test | Statistic | d.f. | Prob. |
| Cross-section F | 22.76347 | -28,427 | 0.000 |
| Cross-section Chi-square | 423.7995 | 28 | 0.000 |
| **Spatial Tests** | | | |
| Joint LR test in a fixed effects panel data model | | | |
| LR value | 27.959 | | |
| Marginal Probability | 0.000 | | |
| Chi2_2 1% value | 9.210 | | |
| LR test for a SAR when spatially autocorrelated errors are already accounted for | | | |
| LR value | 27.958 | | |
| Marginal Probability | 0.000 | | |
| Chi2_1 1% value | 6.635 | | |
| LR test for spatially autocorrelated errors when a SAR is already accounted for | | | |
| LR value | 26.381 | | |
| Marginal Probability | 0.000 | | |
| Chi2_1 1% value | 6.635 | | |

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# Chapter Four (Third Dissertation Essay): Is Simultaneity a Concern to this Research?

## 1. Introduction

Quite a few empirical studies on the determinants of Foreign Direct Investment (FDI) in China mention the possible simultaneity between the dependent variable FDI and explanatory variables (such as GDP and the wage rate). To avoid the endogeneity problem, some studies lag independent variables by one year to make the regressors predetermined, as for example Fung et al. (2005). Some use instrumental variables, as for example Havrylchyk and Poncet (2007). Most studies have not taken simultaneity into consideration. The question to be addressed in this essay is whether simultaneity plagues the econometric estimations in studies of the determinants of FDI.

There are reasons for being concerned about the simultaneity issue. FDI may influence GDP or the wage rate. Theoretical analysis points out that FDI increases a host region's investment level, and more importantly in developing countries FDI is an important source of human capital augmentation, technological change and spillovers of ideas, which results in improved economic performance of the host region. For China several studies have found a positive influence of FDI on economic growth, for example Berthelemy and Demurger (2000), Liu et al. (2002), Shan (2002), and Yao (2006).

Foreign direct investment influences the local wage rate directly by creating a demand for labor and by offering a more competitive salary than domestic firms. Moreover, as foreign enterprises generate positive externalities on labor productivity

through on-the-job and/or overseas training, we expect that FDI will raise the marginal product of labor and hence the average wage rate in its host region. Ge (2006) uses a panel dataset of Chinese cities to examine the impact of FDI on the urban real wage, and the results show that FDI has a significantly positive effect on the urban real wage. Owen and Yu (2008) use a panel of 29 provinces over the years 1995-2001 and find that the effect of FDI on the wage rate varies by province.

This study employs a simultaneous equation system and empirically reveals the inter-relationships among the three variables (real GDP, wage rate, and FDI). Using a panel dataset of 29 Chinese provinces from 1996 to 2008, this study finds that FDI has an effect on real GDP and the wage rate only after certain time delay, and thus simultaneity should not be a concern for analyzing FDI determinants in a single equation. As found out in this study, internal economic reform has a large positive impact on a province's real GDP and thus should be an important factor explaining China's fast growth. Many growth studies like the ones cited previously failed to take into account the economic reform. Failure to include this important factor might exaggerate the positive effect of FDI on the local economy.

## 2. Constructing a Simultaneous Equations Model

A simultaneous equation model is able to catch the bi-directional effects and uncover many interesting relationships among the endogenous variables. From the system of equations, more information can be revealed for the inter-related variables.

### 2.1. Obtain the GDP Equation

Assume a Cobb-Douglas production function for the economy:

$$Y = AK^{\alpha}L^{1-\alpha} \tag{1}$$

where Y is GDP, A is a constant which measures total factor productivity, K is capital stock[43], and L is labor. Take natural logs of both sides of equation (1) yields:

$$\ln Y = \ln A + \alpha \ln K + (1-\alpha)\ln L \tag{2}$$

Human capital is an important factor in production and is added to equation (2) to provide:

$$\ln Y = \ln A + \alpha_1 \ln K + \alpha_2 \ln HK + \alpha_3 \ln L \tag{3}$$

Where HK stands for human capital and $\alpha_1 + \alpha_2 + \alpha_3 = 1$

Total factor productivity is determined by technical efficiency and technological progress, here I roughly measure total factor productivity by a variable representing technological progress, i.e. the number of patent applications granted in each province, denoted as PAT. Human capital is measured by the labor quality of the population, i.e. the educational attainment of the population, denoted as EDUC. As mentioned before, FDI directly and indirectly can influence GDP, so we add FDI in the GDP equation.

China opened its border and started the internal economic reform at about the same time. Literature on economic growth focuses a lot on the positive influence of China's opening including FDI and exports on its economic growth, while ignoring the

[43] Throughout this research, investment in fixed assets is used to represent the amount of capital wherever capital appears, as it's hard to obtain the measure for the amount of capital and by common practice capital is obtained from investment flows.

other important factor that might have been playing an important role over the past three decades in China's growth. The internal reform has been gradually transforming China from a centrally planned to a market economy. The economic system's transformation surely raised growth to some extent. So here the ownership structure measure of the internal reform (denoted as MARFA) is included in GDP equation.

So I rewrite the equation (3) augmented by the above-mentioned factors. Note that FDI is entered into equation in both current and lagged values, because there might be time lags of the effects on GDP from FDI.

$$\ln RGDP_{it} = \alpha_0 + \alpha_1 \ln PAT + \alpha_2 \ln K_{it} + \alpha_3 \ln L_{it} + \alpha_4 EDUC_{it} + \alpha_5 MARFA_{it} + \alpha_6 \ln FDI_{it} + \alpha_7 \ln FDI_{it-1} + \alpha_8 \ln FDI_{it-2} + \lambda_t + c_i + u_{it} \quad (4)$$

### 2.2. Obtain the Wage Equation

Labor quality is a necessary factor to determine the wage rate by common practice. The capital-labor ratio is in the wage equation, as suggested by neoclassical theory, the marginal product of labor is higher when the capital labor ratio is higher, so the capital-labor ratio should positively influence the wage rate. Because the average wage rate is for a given province, the equation needs other variables that help explain the inequality of wage rates across provinces and not just more individual characteristics like years of working experience. The available choices are industry structure and variables related to FDI. Average wage rates vary across industries. For example, in 2006 the average wage rate in agriculture was as low as 9,430 yuan while the wage rate in financial service industry was 39,280 yuan. Here I use the ratio of number of workers and staff in low paying industries to the number of workers and staff in high paying industries

as a measure for industry structure. As mentioned before, FDI might influence the wage rate in a host region. The effect can be immediate, or it can take time to have an effect, so the current and lagged values of FDI are entered in the equation.

$$\ln WAGE_{it} = \beta_0 + \beta_1 \ln FDI_{it} + \beta_2 \ln FDI_{it-1} + \beta_3 \ln FDI_{it-2} + \beta_4 K/L_{it} + \beta_5 \ln IS_{it} + \beta_6 \ln EDUC_{it} + \lambda_t + c_i + u_{it} \quad (5)$$

The FDI equation is borrowed from previous two essays.

$$\ln FDI_{it} = \gamma_0 + \gamma_1 \ln RFE_{it} + \gamma_2 \ln RGDP_{it} + \gamma_3 \ln POP_{it} + \gamma_4 \ln WAGE_{it} + \gamma_5 \ln RD_{it} + \gamma_6 MARFA_{it} + \gamma_7 AGGLY_{it} + c_i + \lambda_t + u_{it} \quad (6)$$

Equations (4) - (6) comprise the simultaneous equation system for this study. Variables definitions and data sources are provided in Table 1.

***Table 1 Description of Variables***

| Variable abbreviation | Variable name | Variable description | Data source |
|---|---|---|---|
| FDI | Foreign direct investment | Aggregate annual FDI inflows into each Chinese province in 1982 US dollars | Statistical yearbook and provincial yearbooks |
| RFE | Cluster of foreign enterprises | # of registered foreign-funded enterprises at the end of year | Statistical yearbook |
| WAGE | Labor Cost | Average Wage of Staff and Workers divided by labor productivity (where labor productivity is the ratio of industrial output and the number of industrial workers) | Statistical yearbook |
| RGDP | Market size | GDP of a province deflated by GDP deflator, 100 million yuan | Statistical yearbook |
| K/L | Capital labor ratio | Ratio of fixed assets investment to number of workers and staff | Statistical yearbook |
| EDUC | Labor quality | The percentage of population with college or higher degrees | Statistical yearbook |
| RD | Road transportation | Total length of high-grade paved road km/10000km$^2$ | Statistical yearbook |
| AGGLY | agglomeration | Percentage of industrial output in total GDP | Statistical yearbook |
| IS | Industry structure | Ratio of # workers in first industry and retails and wholesale to the # workers in finance and scientific research | Statistical yearbook |

| | | | |
|---|---|---|---|
| MARFA | Degree of reform in ownership structure | The share of non-state-owned units in total investment in fixed assets. | Statistical yearbook |
| PAT | Technological progress | the number of patents applications granted in each province | Statistical yearbook |
| K | Capital | Total investment in fixed-assets | Statistical yearbook |
| L | Labor | Total number of staff and workers | Statistical yearbook |

## 3. Econometric Estimation and Results

I use panel data from 1996-2006 for 29 provinces in China. Tibet is excluded because no FDI has ever been received over years. Chongqing is combined with Sichuan. As discussed in the previous two essays, fixed-effects estimation is the most appropriate for this dataset. The Simultaneous Equation Model (SEM) will reveal more information than a single equation model. Iterated three-stage-least-square estimation is applied to the equation system.

Results from simultaneous equation system are presented in Table 2. The FDI equation in the SEM provides slightly different results from the single equation estimation. The coefficient of the wage rate is positive and significant, which is unexpected. Some past studies find the wage rate to be positive when labor quality or labor productivity is not controlled for. But here the labor cost is adjusted by labor productivity. All other explanatory variables have the expected coefficient signs, but market size and degree of internal economic reform are not as statistically significant as expected.

In the GDP equation, nearly all variables have the expected signs, except the current FDI inflows. The coefficients of capital, labor, human capital, and internal

economic reform are positive and significant. Quite a few growth studies on China do not consider internal economic reform (see as examples Berthelemy and Demurger, 2000; Yao, 2006). The result here reminds researchers of the importance of internal economic reform for China's growth over the past three decades. Surprisingly, the current FDI inflows show an insignificantly negative correlation with GDP. The lagged values of FDI are positive, but also insignificant. But the p-values keep getting larger towards higher-order lagged FDI, which might suggest that there exists a time delay for FDI to have effect on GDP.

In the WAGE equation, labor quality, capital-labor ratio, and industry structure positively influence the average wage rate. Among the positive determinants for the wage rate, the labor quality and the capital-labor ratio are the most important factors. The effects of FDI inflows on wage rate depend on the lag. The current inflow may have a negative impact on the local wage rate, but it is not significant. After one year, the FDI starts to drive up the local wage rate, and this effect is statistically significant. After another year, the effect gradually goes down and becomes insignificant again.

***Table 2 Results from Simultaneous Equation System***

| | Coefficient | Standard Error |
|---|---|---|
| FDI Equation (lnRFDI as dependent variable) | | |
| lnRFE | 0.446 | (0.106)*** |
| lnRGDP | 0.748 | (0.622) |
| lnPOP | -1.084 | (0.838) |
| lnWAGE | 3.411 | (0.880)*** |
| lnRD | 0.072 | (0.108) |
| MARFA | 0.001 | (0.005) |
| AGGLY | 0.025 | (0.007)*** |
| Constant | -0.830 | (0.179)*** |

| | | |
|---|---|---|
| Observations | 319 | |
| $R^2$ | 0.491 | |
| GDP Equation (lnRGDP as dependent variable) | | |
| MARFA | 0.004 | (0.001)*** |
| lnPAT | 0.006 | (0.017) |
| EDUC | 0.016 | (0.003)*** |
| lnL | 0.323 | (0.046)*** |
| lnK | 0.210 | (0.047)*** |
| lnFDI | -0.027 | (0.078) |
| lnFDILAG1 | 0.033 | (0.056) |
| lnFDILAG2 | 0.010 | (0.015) |
| Constant | 0.103 | (0.012)*** |
| Observations | 319 | |
| $R^2$ | 0.973 | |
| WAGE Equation (lnWAGE as dependent variable) | | |
| EDUC | 0.012 | (0.003)*** |
| IS | 0.046 | (0.042) |
| lnK/L | 0.190 | (0.039)*** |
| lnFDI | -0.103 | (0.075) |
| lnFDILAG1 | 0.102 | (0.055)* |
| lnFDILAG2 | -0.024 | (0.016) |
| Constant | 0.015 | (0.004)*** |
| Observations | 319 | |
| R2 | 0.979 | |
| Endogenous variables: lnRFDI lnRGDP lnWAGE | | |
| Exogenous variables: lnRFE lnPOP lnRD MARFA AGGLY dum97 dum98 dum99 Dum00 dum01 dum02 dum03 dum04 dum05 dum06 dum07 dum08 lnPAT EDUC lnL lnK lnRFDILAG1 lnRFDILAG2 IS lnK/L | | |

Notes: standard error in parentheses; * significant at 10%; ** significant at 5%; *** significant at 1%.

## 4. Conclusion

Past studies have expressed concerns regarding the feedback of FDI on GDP and the wage rate. This essay constructs a simultaneous equations model to further explore

the issue. The system does not provide good model fit for estimating FDI determinants, however, it reveals some important determinants for the wage rate and GDP. Above all, the system relieves our worry about the simultaneity problem, since FDI has delayed effects on both GDP and the wage rate. Additionally, this study also provides instruments for GDP and the wage rate if some researchers prefer the IV approach to check for estimation robustness.

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