

The Rise of Chinese Manufacturing Sector: Domestic Ownership Reform and Foreign Direct Investment

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Certificate of Originality

I hereby declare that this submission is my own work and that, to the best of my knowledge and belief, it contains no material previously published or written by another person or material which to a substantial extent has been accepted for the award of any other degree or diploma of the university or other institute of higher learning, except where due acknowledgement has been made in the text.

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Abstract

If China's economic miracle since 1978 is a story of industrialization, then the core of that industrialization is domestic ownership reform and Foreign Direct Investment (FDI). The first "small" part of this paper reviews the whole process of domestic ownership reform since 1978. We reveal that the reason why public ownerships dominated the initial stage of reform is due to the slow "legitimacy building" process of private ownerships. The second "large" part of the paper uses the most updated industry-level data to search for any potential FDI spillover in the manufacturing sector. Our results indicate that: (1) domestic firms indeed benefit from the presence of Foreign Invested Enterprises (FIEs) both in the same industry and in other industries. Domestic firms seem to benefit more from inter-industry spillover; (2) domestic firms who are more technologically lagged seem to benefit less from the presence of FIEs in the same industry; but more from the presence of FIEs in other industries. On the other hand, domestic firms who are less technological lagged seem to benefit more from the presence of FIEs in the same industry while benefiting less from the presence of FIEs in other industries; (3) comparing domestic firms in export-oriented industries to those in import-substituting industries, the latter seem to benefit more from the presence of intra-industry FIEs but less from the presence of inter-industry FIEs; (4) there seems to be little evidence of reverse spillover to FIEs in China which means that the government does not need to worry about any potential "technology sourcing" FDI at this stage.

1. Introduction

China, the most populous country in the world, started its economic reform in 1978. Its continuous and strong economic growth since then has become one of the most widely discussed topics among economists. The manufacturing sector, which consists of more than 8 million enterprises, is the largest sector of the Chinese economy, accounting for 43% of the total GDP and employing 25% of the country's labour force in 2007. From 1990 to 2007, an average of more than half of GDP growth was driven by the manufacturing sector (Table 1). The manufacturing sector is also the largest recipient of Foreign Direct Investment (FDI). More than 60% of total utilized FDI concentrated in the manufacturing sector from 1997 to 2007 (Table 2). The manufacturing sector mainly attracts FDI due to its relatively low labour costs, highly developed infrastructure, large potential domestic markets, and tax incentives (Guo et al. 2005).

The manufacturing sector can be divided into several ownership categories, namely, State Owned Enterprises (SOE), Collectively Owned Enterprises (COE), Foreign Invested Enterprises (FIE), Privately Owned Enterprises (POE) and, other types of enterprises (OE). Since the start of economic reform, the output share of each different ownership category has changed dramatically. For instance, the relative share of SOE in Gross Output Value declined gradually from more than 75% in the early 1980s to less than 30% in the late 1990s (Table 3). On the other hand, other ownerships have seen a steady rise in their shares of Gross Output Value. While there were no POEs in the late 1970s, its output share gradually increased to 1.85% in 1985 then steadily rose to 18% in 1999. FIEs tell a similar story, rising from 7.5% of Gross Output Value in 1993 to 15% by 1999. The output shares of COEs modestly increased during the 1980s and became quite stable in the 1990s, surpassing SOEs after 1994. Starting in 2000, China's National Bureau of Statistics changed its statistical system. As a result, except for SOEs,¹ only enterprises with annual revenue of more than 5 million yuan are included in its annual statistical yearbook. Table 4 tells us the story during the post-1999 period; the share of SOEs continued to decline. A more drastic deterioration

¹ All SOE are still included in NBS statistical yearbook, regardless of its revenue scale.

occurred in the COE sector; its output share decreased from 14.5% in 2000 to 2.5% in 2007. The output share of FIEs moderately increased while there was a soar in the share of POEs. They rose from 6.1% in 2000 to more than 23.2% in 2007. If small-scale POEs were included, the share of POEs was probably on a par with SOEs in 2007 and the share of FIEs had already exceeded SOEs by 2006. Since a large proportion of COEs and POEs were small scale, they were not included in the total Gross Output calculation after 1999, which caused some understatement of their shares. All in all, we see a huge decline in the share of SOEs since start of reform in 1978, while the share of COEs increased gradually up to the mid-1990s and then started to sharply decline up to now. The shares of POEs and FIEs, which once did not even exist in the late 1970s, has increased dramatically and accounted for more than half of total output in 2007.

Table 1: GDP Growth Driven by the Manufacturing Sector in China (1990-2007)

	GDP Growth	Contribution from the Manufacturing Sector	Proportion of GDP Growth Driven by the Manufacturing Sector
1990	3.80%	1.50%	39.47%
1991	9.20%	5.30%	57.61%
1992	14.20%	8.20%	57.75%
1993	14%	8.30%	59.29%
1994	13.10%	8.20%	62.60%
1995	10.90%	6.40%	58.72%
1996	10%	5.90%	59.00%
1997	9.30%	5.40%	58.06%
1998	7.80%	4.30%	55.13%
1999	7.60%	4.20%	55.26%
2000	8.40%	4.90%	58.33%
2001	8.30%	3.50%	42.17%
2002	9.10%	4%	43.96%
2003	10%	5.20%	52.00%
2004	10.10%	4.80%	47.52%
2005	10.40%	4.90%	47.12%
2006	11.60%	5.40%	46.55%
2007	11.90%	5.80%	48.74%
			Average: 52.74%

Source: China Statistical Yearbook (2008)

Table 2: Utilized FDI in the Manufacturing Sector from 1997 to 2007 (USD \$10,000)

	Total FDI	FDI in the manufacturing Sector	Proportion of FDI in the manufacturing Sector
1997	4525704	2811983	62.13%
1998	4546275	2558238	56.27%
1999	4031871	2260334	56.06%
2000	4071481	2584417	63.48%
2001	4687759	3090747	65.93%
2002	5274286	3679998	69.77%
2003	5350467	3693570	69.03%
2004	6062998	4301724	70.95%
2005	6032469	4245291	70.37%
2006	6302061	4007671	63.59%
2007	7476789	4086482	54.66%
			Average:63.84%

Source: China Statistical Yearbook, 1998-2008

Table 3: Gross Output Value Distribution by Different Ownerships. (1978-1999)

Year	SOE	COE	POE	FIE	OE
1978	77.63%	22.37%	0.00%	N/A	N/A
1979	78.47%	21.53%	0.00%	N/A	N/A
1980	75.98%	23.54%	0.02%	N/A	N/A
1981	74.76%	24.62%	0.04%	N/A	N/A
1982	74.40%	24.82%	0.06%	N/A	N/A
1983	73.35%	25.74%	0.12%	N/A	N/A
1984	69.09%	29.71%	0.19%	N/A	N/A
1985	64.86%	32.08%	1.85%	N/A	N/A
1986	62.27%	33.52%	2.76%	N/A	N/A
1987	59.73%	34.62%	3.63%	N/A	N/A
1988	56.80%	36.14%	4.34%	N/A	N/A
1989	56.06%	35.69%	4.81%	N/A	N/A
1990	54.61%	35.63%	5.39%	N/A	N/A
1991	56.17%	32.99%	4.83%	N/A	N/A
1992	51.52%	35.07%	5.80%	N/A	N/A
1993	46.95%	34.02%	7.98%	7.47%	3.59%
1994	37.34%	37.72%	10.09%	9.29%	5.56%
1995	33.97%	36.59%	12.86%	11.66%	4.91%
1996	28.48%	39.39%	15.48%	12.02%	4.63%
1997	25.52%	38.11%	17.92%	12.52%	5.93%
1998	28.24%	38.41%	17.11%	14.91%	1.32%
1999	28.21%	35.37%	18.18%	15.03%	3.21%

Source: China Statistical Yearbook (1979-2000)

Table 4: Gross Output Value Distribution by Different Ownerships for all SOEs and other Enterprises above Designated Size² Only (2000-2007)

Year	SOE	COE	POE	FIE	OE
2000	47.34%	14.49%	6.09%	27.39%	4.69%
2001	44.43%	10.53%	9.18%	28.52%	7.34%
2002	40.78%	8.68%	11.69%	29.30%	9.54%
2003	37.54%	6.46%	14.75%	31.18%	10.07%
2004	35.24%	5.65%	16.50%	31.43%	11.17%
2005	33.28%	3.42%	18.99%	31.74%	12.57%
2006	31.24%	2.90%	21.24%	31.61%	13.01%
2007	29.54%	2.51%	23.21%	31.50%	13.25%

Source: China Statistical Yearbook (2001-2008)

If China's economic miracle since 1978 is a story of industrialization, then the core of that industrialization is domestic ownership reform and FDI. The first "small" part of this paper reviews the whole process of domestic ownership reform since 1978 and seeks to discover the reason why public ownerships dominated the initial stage of reform. The second "large" part of the paper uses the most updated industry-level data to search for any potential FDI spillover. The rest of the paper is organized as follows. Section 2 reviews the whole process of domestic ownership reforms. It also tries to explain why Chinese-style economic reform was initially dominated by public ownerships. Section 3 is a literature review on FDI spillover which consists of both theoretical and empirical review. Sections 4&5 describe both econometrics models and data. The empirical results are presented in Section 6. Section 7 discusses any potential drawbacks in our analysis. Section 8 provides concluding remarks and a discussion of policy implications.

² Other enterprises above Designated Size: Non-SOE enterprises with annual revenue of more than 5 million Yuan.

2. Domestic Ownership Reform

SOEs are widely believed to be less productive than other forms of ownerships for several reasons. Firstly, SOEs usually face soft-budget constraints and have privileged access to bank loans and other forms of financial capital regardless of their economic performance (Coady and Wang, 2000). Thus, profitability is not the major concern for SOEs. Secondly, SOEs represent “the traditional power and influence of the Communist Party” which offers political support and control for the government (Hovey and Naughton, 2006). It is more like a political tool in some sense than a manufacturing enterprise. It helps government solve many social issues such as unemployment and pension schemes to maintain social and political stability. SOEs are always criticized for their excess employment of labour and misallocation of capital and financial resources (Chen et al., 2006; Boycko et al., 1996). As a centrally planned economy, SOEs offer life-long employment to all employees and every year new staffs are centrally deployed by the government to various SOEs. The government also sets production quotas, controls the supply of resources, and distribution of output. In addition, the corporate governance structures inside SOEs are generally not regarded as effective. The managers inside SOEs are usually appointed due to their political or personal connections with the party rather than their business expertise (Rui et al., 2006; Qian, 1998). The principal-agent problem is also a major concern since those managers are not stakeholders in SOEs. There are few incentive structures which induce those managers to act in the interests of SOEs. The measure of managers’ performances is linked more to their political loyalty and competence rather than the economic performance of the SOEs where they are appointed to (Wang and Meng, 2001).

SOE reform started in the early 1980s. In the first stage of SOE reform, as long as they met production quotas, SOEs were allowed to retain and sell the “extra” output to the market. The related profit from “extra” sales could be kept by the firm. Those profits were allowed to be re-invested in any production-related activities. Under a so-called “contract responsibility system”, the managers of SOEs signed a contract with the government which gave them more discretion in running SOEs’ daily operations subject to some written restrictions. For example, managers could adjust input levels based on the demand of the

market, but they still needed to meet the production quotas set by the government and they could not sack any employees based on their performance. However, the information asymmetry problem occurred because only managers know the “inside” situation of their enterprises. Massive corruption was found among those managers who asked for production funds from the government or loans from state-run banks for their own benefit. In the mean time, even though the productivity and efficiency of SOEs improved, large operational losses were seen due to lack of business expertise, corruption, misallocation of resources and excess employment. Due to the heavy losses of SOEs, the government made a second round of ownership reforms late in the 1990s. The government retained total control of the largest 1,500 to 2,000 SOEs which were considered strategically important while allowing the rest to be devolved. For the non-strategic SOEs, the reform was conducted in the form of reconstruction of corporate governance systems, ownership conversion, merger and acquisition, outright sale to private or foreign investors or liquidation/closing down. As a result, together with its declining output share, the number of SOEs sharply decreased from 64,737 in 1998 to 20,680 in 2007(China Statistical Yearbook, 1996-2007).

COEs are defined as public economic entities whose properties are largely funded and owned collectively by a local community. In practice, it is jointly controlled by managers and local government officials. In return, a large portion of the profits of COEs also serve as part of the local government revenues. Most COEs are small-scale town-village enterprises (TOE). They are free of government production quotas and are allowed to sell all their output in the market. They are publicly owned but market-oriented (Fu and Balasubramanyan, 2003). They are also subject to hard budget constraints. The failure of the business would lead them to bankruptcy. Similar to the SOE reform, the managers of COEs signed a contract with the local government, paying a fixed amount of total profits as a “rent” to the local government while retaining the residual most of which was used to re-invest in production-related activities. Whereas most SOEs serve domestic markets only, COEs’ products are found to be more export-oriented (Fu and Balasubramanyan, 2003). The exposure to overseas markets through trade or FDI also forces them to operate more efficiently and adopt new technologies more quickly. The success of COEs in the late 20th century arguably

contradicts the western neo-classical economic theory of property rights which states that “a clearly defined owner(s) should be assigned to every property with exclusive right of ownership” (Weitzman and Xu, 1993). Well-defined property rights are often regarded as a pre-requisite for a well-functioning market economy. The property ownership means both control rights and residual claim rights (profits or losses). A rational owner would try to maximize residuals (profits) from its production process which results in economic efficiency. However, property rights of COEs are not clearly defined. They are neither owned by the state government nor any individuals in the enterprises. By law, they belong to every member of the local community (Williams, 2001).

In 1998, Chinese officials re-defined COEs as part of the public sector; together with SOEs. Indeed, COEs should be defined as a “marketized and decentralized SOE.” It is decentralized due to the much higher decision-making autonomy of local government compared with SOEs (which are tightly controlled by the central government). It is marketized due to its market-oriented production activities. Even though they suffer hard budget constraints, compared with POEs, the close relationship with local government officials makes it easier for them to get loans from state-owned financial institutions which are in many cases on soft terms (Kung and Lin, 2007). The inherent agent-principal issue is also a serious problem within COEs. According to Xia et al (2009), COEs suffer from dual agency problems. The first one occurs between local government officials and COE managers. The local officials are the ones who selected the COE managers. Even though COE managers have more decision-making autonomy within the firm compared with those in SOEs, they still need to maintain a close relationship with government officials whose support is critical for their career advancement. As a result, the profit-maximization objective may be compromised as managers need to meet political or social objectives of local government officials such as fiscal revenue, employment, or output/sales growth. In a more serious scenario, managers may need to meet some personal objective of those officials which leads to corruption. Thus, COEs may not be profit-maximizing due to their political links to local officials (Peng et al., 2004; Li et al., 2009).

The second agency problem occurs between COE managers and COE workers. By law, COEs are collectively controlled by both managers and workers. However, in practice, most decisions are only made by managers. Due to unclearly defined property rights, COE managers are not allowed to claim the residuals of the firm. On the other hand, due to the high degree of autonomy in their decision-making, the performance of COEs is highly linked to managers' expertise and efforts. COE managers tend to be under higher pressure than comparable managers in SOEs, while their pay is similar or in most case even lower (Kung and Lin, 2007). In response to low rewards, there is some "incentive" for opportunistic actions aimed to meet their own self-interests. Due to information asymmetry and high autonomy, these opportunistic behaviors may not be effectively monitored and therefore the profit-maximization objective may be compromised. On the other hand, external factors such as "changing in the lending preferences of banks; relaxed government restrictions of ownership transformation and accelerated legitimacy building of POEs" also contributed to the fall of COEs (Li et al., 2009; Kung and Lin, 2007). Since the mid-1990s, many COEs have become privatized or corporatized into shareholding enterprises. The agent-principal problem was mitigated due to the separation of the profit-maximization objective and political objectives and "better monitoring mechanisms due to the stronger incentives of the owner" (Li et al., 2009). Several empirical literatures have shown that the performance of those transformed COEs has improved (Li et al., 2009; Kung and Lin, 2007).

The rise and decline of COEs leads to one question: Is COE-led economic growth sustainable? Or, put another way, according to some literatures (William, 2001; Fu and Balasubramanyam, 2003), the extra-ordinary performance and expansion of COEs demonstrate that a "disaggregated" property rights defined in "quasi-public entities" can also lead to sustainable economic growth. Is that true? The answer seems to be negative. COE-led economic growth is only temporary and a well-defined property right must be satisfied to secure long-term economic growth. The early "COE phenomenon" was a result of their institutional and political advantages over private enterprises and transaction cost advantages over non-marketized SOEs. While almost all empirical literatures have shown that COEs are more efficient than SOEs (Jefferson et al., 2003; Buckley et al., 2002; Fu and

Balasubramanyam, 2003), the profit-maximizing POEs eventually outperform COEs in terms of output share and economic efficiency.

The rise of POEs since reform is a story of “legitimacy building”. Legitimacy was defined as “the right to exist and perform an activity in a certain way” (Ahlstrom et al., 2008; Suchman, 1995). According to Ahlstrom (2008), the legitimacy of a firm is to seek and also be influenced by “sociopolitical and also cognitive approval from the society and its institutions”. In short, for POEs in China, legitimacy building refers to the approval and recognition of their existence from both government and the broad population.

At the early stage of reform, due to ideological conflicts, the building process was very slow. Most government officials and population still regarded capitalism as “the biggest enemy of the Party”. Mao’s “anti-capitalism” ideology still showed huge resilience after his death in 1976. Private ownership was still regarded as a typical form of capitalism in the early 1980s. Such resilience also determined the early rise of COEs rather than POEs. COEs are still publicly owned which means the “legitimacy building” of COEs was much easier and faster than that of POEs during the early stages of reform. The acceleration of “legitimacy building” started after 1992 due to the famous speech of Deng Xiao-Ping during his tour in Southern China. Regarding future directions of economic reform, “It does not matter whether the cat is black or white; as long as it catches the mouse, it is a good cat” was used by Deng to comment on the ideological conflicts between a capitalism market economy and a central planned economy. He also used the phrase “getting rich is glorious” to encourage people to start their own businesses. A dramatic increase in POEs’ output share was seen after 1992 due to accelerating legitimacy building and diminishing hostility against capitalism. This took the form of new firms created with an increase in entrepreneurship activities, and also via the privatization of a large number of both SOEs and COEs after 1997 when the Chinese government relaxed policy restrictions on ownership conversions.

Among other enterprises (OE), shareholding enterprises enjoy the largest share. The Chinese government initiated a “shareholding program” as a means of ownership restructuring in 1993 (Su and Jefferson, 2005) and since then many publicly owned enterprises, including both SOEs and COEs, have been incorporated into shareholding enterprises with limited liabilities. These publicly owned enterprises sell part of their asset holdings as shares to either private or institutional investors in the share market in exchange for extra capital (partial privatization). Partial-privatization aims to “protect transformed public enterprises from government interference, clarify their property rights, help them raise new capital, and make the management more accountable for the consequences of its decisions” (Zhang et al., 2000). Even though most empirical literatures did find that transformed public enterprises with an increased level of non-state ownership did show improved performance (Jefferson and Su, 2006; Hovey and Naughton, 2007; Qi et al., 2001), the partial-privatization approach was far from perfect since the state is still the largest shareholder in a large proportion of shareholding enterprises. Almost all empirical literatures showed the negative relationship between the portion of the shares owned by the state and the economic performance of these enterprises (Qi et al., 2000; Rui et al., 2005; Hovey and Naughton, 2007; Xu and Wang, 1999).

In summary, domestic ownership reform within the manufacturing sector could be divided into two inter-related stages. During the first stage, from 1978 to the mid-1990s, a massive decline of SOEs was seen while COEs became the major driving force of economic growth. POEs and OEs still played a very minor role during that period due to unfavourable institutional and political environments. In other words, the economic growth during that period was driven by enterprises under predominantly public ownership. In the second stage, from the mid-1990s to today, the share of SOEs continued to decline, together with the share of COEs. A dramatic rise in both POEs and OEs (mainly shareholding enterprises) was seen, which was encouraged by more favourable institutional and political policies. The decline of the public sector, together with its imperfect partial privatization and the better performance from POEs suggests that well-defined property rights are essential for long-term economic growth. After thirty years of struggle, China is now on its way towards the final stage of this reform in the manufacturing sector: a free market-oriented economy

which is dominated by a private sector with state control limited to strategically important industries.

3. FDI and Spillover

3.1 Review of FDI in the Manufacturing Sector in China

FDI in China has been mainly attracted to the manufacturing sector. Since 1992, Foreign Invested Enterprises (FIEs) have played an increasingly important role in manufacturing, surpassing SOEs in 2006 in terms of output share. Its increasing importance also reflected in its labour force share, value-added share, and asset share (Table 5). In the 1990s, most FDI was attracted by China's low labour costs. As a result, a large portion of FDI was concentrated in labour-intensive industries. For instance, in 1995, 47% of the total FDI was concentrated on labour-intensive industries while capital and technology intensive industries only accounted for 25% and 27% respectively (Chen, 2007). However, a gradual change in FDI structure was later seen. Both capital and technology intensive industries became more attractive for FIEs and these industries accounted for a combination of 69% of total FDI in manufacturing in 2005 (Figure 1). There are many factors which attract foreign firms to operate in China, namely, low labour costs, huge potential domestic market, well-developed infrastructure and tax incentives.

- **Low Wage Costs:** "Made in China" is one of the most widely recognized labels in the world. Input costs are relatively low in China, especially labour costs. The low labour costs are a major reason why labour-intensive export-oriented FDI played a dominant role in the late 1990s. Most technologies used in labour-intensive industries are quite standardized and do not require high human capital. As a result, a large amount of low-skilled labour is hired at a low wage rate by FIEs (Zhang, 2005). By taking advantage of low labour costs, FIEs import intermediate inputs to China for assembly or processing which is low value added for the host country (Sung, 2000; Branstetter and Feenstra, 2002).

- **A Large Domestic Market:** The strong economic growth and its 1.3 billion population make China a perfect place for market-oriented or import-substituting FDI. Until the mid-1990s, import-substituting FDI was not encouraged by policy or even forbidden in some industries to protect local enterprises. As this policy later relaxed, soaring domestic demand due to high economic growth attracted a large amount of import-substituting FDI in recent years. Many literatures have shown that FDI from developed countries such as the United States and European Union countries is more domestic-market-oriented in China (Zhang, 2001; Zhang, 2005). For instance, China is now the largest market for Nokia phones in the world. Almost all Nokia cell phones sold in China are domestically produced through joint ventures. China is also the second largest automobile market in the world. More than 60% of total sales in 2007 belonged to foreign brands operated in China (China Automobile Yearbook 2008). Empirically, many studies also showed a positive relationship between market size and inward FDI (Kwan and Cheng, 1999; Li et al., 2007, Zhang, 2001; Poncet and Havrylchuk, 2007).
- **Well-developed Infrastructure:** The availability of a well-developed physical infrastructure system in China, including access to deep-water ports and airports makes a difference in attracting FDI, especially for export-oriented FDI (Graham, 2004). Theoretically, a well-developed infrastructure increases FIE's operational efficiency by reducing its set-up costs for new local establishments (Lee and Kang, 2007). Empirical studies also found a positive relationship between FDI and local infrastructure development (Zhang, 2001; Havrylchuk and Poncet, 2007; Kang and Lee, 2007; Chen, 1996).

Table 5: Labour Force, Value-added and Asset Share of FIE in the Manufacturing Sector, Various Years.

	Labour Force Share	Value Added Share	Asset Share
1995	7.80%	16.72%	15.22%
1997	9.07%	17.86%	17.53%
2001	17.26%	25.16%	20.94%
2003	21.90%	27.62%	23.26%
2005	28.78%	28.05%	26.27%
2007	29.88%	27.45%	27.30%

Source: Industrial Yearbook, various issues.

Figure 1: Structural Change of FDI in the Manufacturing Sector, 1995, 2001 and 2005.



Source: Chen (2007)

- **Tax Incentives:** During the early stage of reform, China set up four “Special Economic Zones” (SEZ) at coastal areas to attract FDI. FIEs operating in SEZs could enjoy preferential tax and administrative treatments. For instance, the income tax for FIEs in SEZs was only 15%, compared with the standard national rate of 30%. FIEs in those zones could also enjoy two year tax holidays plus three years at a half rate. Such “location-specific” tax incentives were later extended to FIEs in almost all coastal cities in the late 1980s. A consolidated tax incentive regime for FIEs was introduced in the early 1990s after the enactment of the Income Tax Law for Enterprises with Foreign Investment and Foreign Enterprises (Andrew and Ren, 2008). Under this new incentive regime, FIEs, according to their different types and locations, were entitled to different types of tax incentives. Several amendments were made afterwards which reduced or eliminated tax incentives for environment-damaging FDI and low value-added labour-intensive FDI in coastal regions. Nevertheless, in general, FIEs enjoyed a lower corporate tax rate compared to domestic firms.
- **Other Factors:** Xing (2006) argued that an undervalued Chinese currency (RMB) also attracted FIEs to operate in China. He found a positive relationship between the real exchange rate between RMB and Japanese Yen and FDI from Japan. China devalued its currency against the US dollar and Japanese Yen by more than 50% in the 1990s. A devalued RMB would attract export-oriented FDI in particular due to reduced local input prices. As a result, a higher profit margin can be enjoyed by those FIEs due to the separation of production location (China) and product market (overseas). They can charge the same prices with lower input costs (Xing, 2006). On the other hand, Huang (2003) argued that many FDI inflows in the 1990s were due to certain distortions in the Chinese state-dominated financial system. As mentioned earlier, POEs suffered both institutional and political constraints in the early 1990s. State owned financial institutions were not allowed to issue loans to POEs until the late 1990s. Such constraints did not exist for publicly owned enterprises or FIEs. As a result, many POEs were forced to seek foreign partners by forming joint ventures in order to gain access to the credit market. This hypothesis was tested and confirmed empirically by Havrylchyk and Poncet (2007).

3.2 Literature Review on FDI Spillover (Theoretical Review)

Public subsidies to attract FDI are very common nowadays in both developed and developing countries. For instance, it was estimated that the British government subsidized an equivalent of \$30,000 to \$50,000 (US dollars) per employee to attract Siemens and Samsung respectively to Northern England (Görg and Greenaway, 2001; Girma et al., 2001). The government of Ireland also offered a corporate tax reduction for all manufacturing FIEs (Görg and Greenaway, 2004). Counter-part stories could also be found in developing countries such as Costa Rica. In order to attract a 300 million FDI from Intel, the Costa Rican government invested millions of dollars on related infrastructures including a new air cargo terminal exclusively for Intel's use. It also offered a 12-year tax holiday for Intel's operations within the country (Moran, 2007).

While FDI can help to create local jobs and bring in capital, the widespread use of policy incentives to attract FDI are supported by the belief that multi-national corporations are possessed with some advanced firm-specific technologies which will spillover to domestic sectors. Such spillover would lead to productivity or efficiency benefits. The advanced firm-specific technologies could lie in its cutting edge production or process technology, marketing skills, or managerial practices (Kokko and Blomström, 1998). Since FIEs would not simply hand over their firm-specific technologies to domestic competitors, the technology spillover is indirect. Broadly speaking, there are two different spillover or externalities between FIEs and domestic firms, namely, horizontal and vertical externalities (Moran, 2007).

- Horizontal externalities: horizontal externalities refer to technology spillover between FIEs and potential intra-industry domestic rivals. Evidence has shown that FIEs exert huge efforts to prevent leaks of technologies or know-how to domestic competitors or domestic joint venture partners. For instance, FIEs usually prefer to maintain whole ownership which gives them more abilities to control potential leaks than would be the case with 50:50 joint ventures. FIEs can also prevent such leaks

by not using their latest technology in joint ventures. Some surveys conducted in developing countries showed that the technology employed in joint ventures was on average 3 to 10 years behind the cutting edge technology of the industry (Moran, 2002; Lee and Mansfield; 1996). Employees in joint ventures also received less training compared with wholly-owned FIEs (Blomström, 1992). FIEs seek local business partners in order to spread risk and penetrate local markets rather than sharing their advanced firm-specific technologies. Those import-substituting FIEs usually prefer to use lagged or mature technologies for local markets. Most of their R&D activities are also conducted in their home countries (Kokko and Blomström, 1998). However, despite those self-protective actions, indirect spillover could still occur through several channels.

1. Staff Turnover: In the scenario where FIEs are wholly-owned, they still cannot prevent labour turnover from occurring. FIEs usually prefer to hire relatively skilled labour and invest more in job training than domestic firms, especially in developing countries. The movement of skilled labourers who have received relevant job training in FIEs to domestic firms; or to start their own businesses could generate productivity improvements since those workers possess advanced production technology knowledge or modern managerial practices (Görg and Greenaway, 2001).
2. Imitation (demonstration effects): Arguably, imitation or demonstration effects are another commonly used transmission mechanism by domestic firms. As domestic firms are exposed to new products or production processes of FIEs in the domestic market, reverse engineering may be a very cost effective option. Its scope, however, may depend on the complexity of the product or process (Görg and Greenaway, 2004). It may also depend on the technology gap between domestic and foreign firms. On the other hand, non-production skills such as marketing or managerial skills are easier to imitate since they do not require a high level of technical capacities.

3. Competition: Competition could generate either positive or negative spillover. On one hand, the entry of FIEs would induce domestic firms to use existing production technologies more efficiently. The reduction of “X-inefficiency” may be due to the fierce competitive pressure from FIEs (Caves, 1974). The competition may also induce domestic firms to adopt new technologies sooner. Kokko (1996) also demonstrated that FIEs preferred to enter industries with high entry barriers which helped to break down the domestic monopolies and improve resources allocations within the industry. On the other hand, Aitken and Harrison (1999) have argued that in the short run the entry of FIEs may reduce productivity of local firms. Since FIE are usually large in scale, they may face lower marginal costs compared with small-scale domestic firms. The low marginal costs would allow FIEs to capture market share from domestic firms. The fall in demand would cause domestic firms to cut production, which, if they face fixed cost of production, will raise their average cost and, therefore, reduce their productivity and profitability.
4. Exports: Domestic enterprises may simply learn how to export from FIEs. To set up an export channel requires high fixed costs such as “creating distribution networks, creating transport infrastructure, learning about customers’ tastes and so on” in foreign markets (Görg and Greenaway, 2004). Since FIEs are already equipped with this information in their home countries, domestic firms could learn how to access foreign market by imitation or cooperation (joint venture). Several studies have empirically confirmed that the entry of FIEs would induce domestic firms to penetrate foreign markets (Aitken et al., 1997; Ma, 2006). On the other hand, export spillovers may be positively linked to productivity spillovers. In order to compete in foreign markets local firms may be forced to enhance their productivity and improve the quality of their products.

- Vertical externalities: These occur through economic contacts between FIEs and their local suppliers or customers. FIEs have an incentive to prevent intra-industry spill-over from taking place since they want to maintain their advantages over domestic firms in the same industry. However, FIEs do not have an incentive to prevent inter-industry spill-over from occurring since such spill-over through either backward or forward linkage may benefit FIEs themselves. The intensity of vertical linkages depends largely on the type of FIE and also the length of time FIEs have spent in the host nation. Most of the literature on this topic found that market-seeking FIEs have higher levels of vertical linkages (Jindra et al., 2009). The intensity of vertical linkages also positively related to the length of time FIEs have spent in their host nations (Moran, 2007).

1. Backward linkages: The entry of FIEs may have significant impacts on indigenous suppliers of their intermediate inputs. Although many FIEs still import intermediate inputs from their home countries or purchase them from other FIEs in host countries, many micro-level studies have shown that there has been a growing number of purchases from local suppliers since the 1980s (Moran, 2007; Austin, 1990; Shujiro and Hiroki, 2000; Rhee et al., 1984). The backward linkages between FIEs and local suppliers can usually take four different forms. First, if the local suppliers in that industry have already met the quality standard of FIEs, the entry of FIEs simply increase the demand of those intermediate inputs which allow local suppliers to reap the benefits of economies of scale (Javarcik, 2004). Second, if the local suppliers have not yet met the standards of FIEs, FIEs may provide various forms of assistance to potential suppliers to help them improve the quality of their products. For instance, in a survey conducted by the World Bank in Latvia in 1993, one-third of total Latvian firms who supplied intermediate inputs to FIEs reported that they received assistance from their customers (World Bank, 2003). A similar story also occurred in the electronics industry in Singapore where FIEs were found to provide technical assistance to local suppliers in terms of marketing information, design and purchasing both before and after

contracts were signed (Lim and Pang, 1982). In the automobile industry in developing countries, U.S. and European firms usually invite local suppliers to their training programs to ensure high quality, efficient production, in-time delivery, and team spirit (Klein, 1995; Lipsey, 2002). Thirdly, FIEs may announce a certain selection criteria local suppliers must meet in order to be considered. The set of criteria could act as a stimulus to induce many local suppliers to improve the quality of products or the timing of delivery. For instance, FIEs may require that any potential local suppliers must have already obtained ISO 9000 quality-management certification. Last but not least, the knowledge and spill-over gained as a supplier to FIEs could help a company increase its own direct exports to foreign markets. FIEs may provide export-coaching to other users in their home countries within their own corporate network (Moran, 2007). Equipped with foreign market knowledge learnt from FIEs, those local suppliers may expand their export channels to other independent foreign customers later to maximize their economies of scale. A large number of case studies confirm that FIEs helped local suppliers penetrate international markets by providing quality control procedures, design plans, and production processes to ensure that local suppliers could meet the quality standard in overseas markets. For instance, those local IT superpowers in Taiwan, including Acer and MiTAC, entered the export market as suppliers to FIEs, gradually learning advanced design techniques and marketing skills as they went (Moran, 2007). They started out producing simple electronics components such as motherboards and mice for established computer companies and moved on to manufacturing and exporting locally designed personal computers of their own. Another example is furniture retailers IKEA in Sweden. Its exports have successfully opened a huge foreign market for both its local and overseas suppliers and sub-contractors (Kokko and Blomström, 1998).

2. Forward linkages: These occur between FIEs and their downstream customers in the host countries. Domestic firms may improve their productivity from the use of advanced intermediate inputs supplied by FIEs. FIEs, in some cases, may even provide direct assistance to their local customers after the purchase (Dunning, 1993). In addition to the productivity gains, forward linkages could also contribute to the development of local sales and distribution channels, accelerate the adoption of new technologies and help solve contract enforcement issues (Liu et al., 2009; Key and Runsten, 1999).

3.3 Literature Review on FDI Spillover (Empirical Review)

The spillover hypothesis has been tested empirically in many countries. While almost all the literature focusing on inter-industry spillover found positive results, the results for intra-industry is more mixed and inconclusive for both developed and developing countries (Table 6 and 7). Caves (1974) wrote the first empirical paper testing intra-sector spillovers in the manufacturing sectors. He found that higher foreign shares do coincide with higher values added per worker in competing domestic firms in Australia. The entry of FIEs would narrow the productivity gap between foreign and local firms. Globerman (1979) also found that the a foreign presence would enhance the labour productivity of local firms in Canada even though the productivity effects of FDI is somewhat weaker than those of capital deepening and increasing average firm size. However, it is mentioned in his paper that the empirical results for so-called intra-industry spillover may underestimate the true magnitude of benefits related to the presence of FIEs. Many indirect benefits such as enhanced output quality and higher wages may not be captured and inter-industry spillovers may be much larger than intra-industry spillover.

Among developed countries, a lot of empirical papers have analysed spillover effects in the United Kingdom. Liu et al (2000) used panel data for 48 industries from 1991-95 in the United Kingdom to test for any intra-industry spillover. After controlling for labour quality,

capital intensity, and stock of knowledge, they found that there was a positive intra-industry spillover among local firms. However, the magnitude of spillover depends on the technological capacities of local firms. Industries with high technological capacities are found to benefit more from the presence of FIEs. Their result is robust for both capital and employment measure of foreign presence. Driffield and Munday (2001) examined industry level panel data from 1984 to 1992 in the United Kingdom and found that the technical efficiency spillover generated by foreign investment varies according to industry characteristics. Spillovers are more pronounced in industry sectors that are relatively productive and regionally concentrated. By examining firm level data from 1991-96, Girma et al (2001) found that there is no intra-industry productivity spillover even though FIEs enjoyed 10% higher labour productivity on average. They also argued that the cost of financial support from the U.K. government towards FIEs simply outweighed any potential gains through spillover. Harris and Robinson (2004) analysed firm-level panel data from 1974 to 1995 in the United Kingdom and found statistically significant but negative intra-industry spillover and positive but statistically insignificant inter-industry spillover. They argued that the negative effects of competition and 'absorption capacity' effect at times outweighed potential gains, leading to negative intra-industry spillover. They also argued that traditional methodology for measuring spillover may be inadequate for explaining the indirect benefits generated from FIEs. In Greece, Dimelis and Louri (2004) investigated any possible intra-industry spillover in Greek Manufacturing firms in 1997. Based on the relative size of firms' assets, they separated domestic firms into big and small firm groups. A statistically positive spillover was only found in the group of small domestic firms. Both Keller and Yeaple (2003) and Branstetter (2006) provided convincing evidence of positive intra-industry FDI spillovers in the United States, while Hamida and Gugler (2009) also found positive FDI spillover in Switzerland.

Among developing countries, Aitken and Harrison (1999) investigated any possible FDI spillovers in Venezuela from 1976 to 1989. They found that increasing foreign equity participation would lead to increases in plant productivities. However, such positive correlation was only robust for small firms with less than 50 employees. In terms of intra-industry spillovers, they found that increases in foreign presence would negatively affect the

productivity of wholly domestically owned enterprises. The negative impacts are large, significant, and robust to alternative model specifications. Kokko (1996) used a simultaneous model to examine whether productivity spillover could occur due to competition between local firms and FIEs. He argued that spillover from competition is not solely determined by the presence of FDI alone, but also by the simultaneous interaction between both groups. The result showed that competition spillover is statistically significant only when those “enclave” industries were dropped. The “enclave” industries refer to industries where there is a huge technology gap measured by labour productivity differentials between local firms and FIEs. Local firms are unable to compete with FIEs in “enclave” industries. In Morocco, Haddad and Harrison (1993) found that foreign presence is associated with increased productivity in wholly domestically owned firms by pushing domestic firms closer to the efficiency frontier. Kokko et al (2001) separated FDI into import-substituting and export-oriented ones. He found that productivity spillovers only occurred in the former. However, the export spillover in terms of the increasing export propensity of local firms was seen in industries where export-oriented FDI dominated. By investigating micro level Indonesian data, Blomström and Sjöholm (1999) found that labour productivity in firms with foreign equity are higher than wholly domestically owned firms. There was also a positive FDI spillover to the latter. However, the degree of local ownership in FIEs did not affect both the level of productivity of FIEs and the level of FDI spillovers to local firms. Using cross-sectional data in Taiwan, Chuang and Lin (1999) found that both FDI and R&D have a spillover effect on productivity of local firms. A 1% increase in foreign presence in one industry leads to a 1.4-1.88 percent increase in domestic firm productivity. By applying input-output matrices to measure interactions between different industries in Lithuania, Javorcik (2004) separated horizontal and vertical externalities and found that the statistically significant spillovers only occurred between FIEs and their local suppliers in upstream sectors. He did not find any horizontal externalities between FIEs and local firms in the same industry. A positive spillover did not exist between FIEs and their local customers either. Nevertheless, he further separated FIEs into partial and full foreign ownerships and found that “backward linkage” spillover only occurred between FIEs with partial foreign ownership (joint ventures) and local suppliers. The result was found to be consistent with the observation that domestic capital participation in FDI projects helped to

lower foreign investors' costs of using local suppliers which resulted in more local sourcing and greater productivity spillovers to upstream local suppliers (Javorcik, 2004).

FDI spillover in China has also been investigated by many literatures (Table 8). For instance, by using the industry level panel data from 2001 to 2003, Li et al (2007) found that even though the net effect of FDI was still positive in the whole China, there was growing regional disparity. Coastal regions benefit much more than central and western regions. The technology gap between local and foreign firms was higher in non-coastal regions which prevented a high level spillover from happening. Liu (2002) analysed industry-level FDI spillover in the Shenzhen Special Zone of China from 1993 to 1998. He found that overall domestic sectors benefited significantly from intra-industry spillover in terms of labour productivity even though joint ventures were found to benefit more than other forms of domestic ownership. FDI also raised the productivity growth rate of manufacturing industries. A 1% increase in foreign presence would raise the rate of productivity growth by as much as 0.5%. His results were similar with different measures of foreign presence.

Cheung and Lin (2003) used provincial data from 1995 to 2000 and found that FDI could also have a positive spillover effect on domestic innovation activities. Lin et al (2009) used firm-level panel data to examine both vertical and horizontal spillover. They separated FIEs into those from HMT (FIEs from Hong Kong, Macau and Taiwan) and non-HMT (mainly OECD countries). They also separated domestic firms into SOEs and non-SOEs. They found that even though both HMT firms and non-HMT firms generated positive vertical spillover, only non-HMT firms generated positive horizontal spillover. In fact, FIEs from HMT generated negative horizontal spillover on domestic firms. They believed that this was due to the fact that firms from HMT are more labour-intensive, technologically less advanced, and more export-oriented. They also found that horizontal spillover upon both SOEs and non-SOEs is not statistically significant due to the cancelling out effect between positive spillover from non-HMT firms and negative spillover from HMT firms. On the other hand, vertical FDI spillover on both SOEs and non-SOEs is positive. Li et al (2001) used a 1995 official industry

survey and found that import-substituting FDI generated higher spillover than export-oriented FDI due to their direct competition with local firms in domestic markets.

Table 6: Papers on intra-industry spillovers in developed countries

	Author	Country	Period	Data	Aggregation	Foreign Presence	Result
1	Caves(1974)	Australia	1966	Cross-Sectional	Industry	Employment	Positive
2	Globerman(1979)	Canada	1972	Cross-Sectional	Industry	Output	Positive
3	Liu et al(2000)	UK	1991-95	Panel	Industry	Employment /Capital	Positive
4	Girma et al(2001)	UK	1991-96	Panel	Firm	Employment	Not Significant
5	Driffield and Munday(2001)	UK	1984-92	Panel	Industry	Value-added	Mixed
6	Girma and Wakelin(2001)	UK	1980-92	Panel	Firm	Employment	Positive
7	Harris and Robinson(2004)	UK	1974-95	Panel	Firm	Employment /Capital	Negative
8	Haskel et al(2007)	UK	1973-92	Panel	Firm	Employment	Positive
9	Ruane and Ugar(2002)	Ireland	1991-98	Panel	Firm	Employment	Positive
10	Gorg and Strobl(2003)	Ireland	1973-96	Panel	Firm	Employment	Mixed
11	Dimelis and Louri(2004)	Greece	1997	Cross-Sectional	Firm	Capital	Positive
12	Dimelis et al(2002)	Greece, Ireland and Spain	1992-97	Panel	Firm	Employment	Mixed
13	Keller and Yeapl (2003)	USA	1987-96	Panel	Firm	Employment	Positive

14	Branstetter(2006)	USA	1980-97	Panel	Firm	R&D	Positive
15	Hamida and Gugler(2009)	Switzerland	1998 and 2001	Cross-Sectional	Firm	Sales	Positive

Table 7: Papers on intra-industry spillovers in developing countries (excluding China)

	Author	Country	Period	Data	Aggregation	Foreign Presence	Result
1	Aitken and Harrison (1999)	Venezuela	1976-89	Panel	Firm	Capital/Employment	Negative
2	Kokko (1996)	Mexico	1970	Cross-Sectional	Industry	Employment	Positive
3	Blomström (1986)	Mexico	1970 and 1975	Cross-Sectional	Industry	Employment	Positive
4	Haddad and Harrison (1993)	Morocco	1985-89	Panel	Firm/Industry	Assets	Mixed
5	Chuang and Lin (1999)	Taiwan	1991	Cross-Sectional	Firm	Assets	Positive
6	Djankov and Hoekman (2000)	Czech Republic	1993-96	Panel	Firm	Assets	Negative
7	Javorcik (2004)	Lithuania	1996-2000	Panel	Firm	Equity/Output	Mixed
8	Blomström and Sjöholm (1999)	Indonesia	1991	Cross-Sectional	Firm	Output	Positive
9	Sjöholm(1999)	Indonesia	1980-91	Cross-Sectional	Firm	Output	Positive
10	Kokko et al(2001)	Uruguay	1990	Cross-Sectional	Firm	Output	Mixed

Table 8: Papers on FDI Spillover Effects in China.

	Author	Period	Data	Aggregation	Foreign Presence	Result
1	Li et al (2007)	2001-03	Panel	Industry	Capital/Employment	Positive
2	Wang et al (2007)	1995	Cross-Sectional	Industry	Capital	Positive
3	Hu and Tong (2003)	1995	Cross-Sectional	Firm	Employment	Mixed
4	Huang (2004)	1993,1994 and 1997	Cross-Sectional	Region	Employment	Mixed
5	Liu (2002)	1993-98	Panel	Industry	Output/Equity/Capital	Positive
6	Lin et al (2009)	1998-2005	Panel	Firm	Equity	Mixed
7	Tian (2007)	1996-99	Panel	Firm	Capital/Employment/Sales	Mixed
8	Wang (2002)	1995	Cross-Sectional	Industry	Employment	Mixed
9	Liu and Wei (2006)	1998-2001	Panel	Firm	Capital/Employment/Sales/Equity/R&D	Positive
10	Li et al (2001)	1995	Cross-Sectional	Industry	Employment/Asset	Positive
11	Lin and cheung (2004)	1995-2000	Panel	Region	Investment	Positive

By using the latest industry-level panel data, we seek to differentiate our spillover analysis in the following way. Firstly, we decompose the measures of foreign presence into input and output measures. We argued that mixed results in productivity spillover from previous studies could be explained by different measures of foreign presence. Secondly, we separated industries into different categories based on their diverse characteristics. Our results showed that the magnitude of spillover was different across different types of industries. Last but not least, we tried to explore whether the presence of local firms could enhance the productivity of FIEs (reverse spillover).

4. Econometrics Model

Following a standard approach frequently used by previous studies on FDI spillover, both intra-industry and inter-industry foreign presences were incorporated into the production function to capture horizontal and vertical spillover respectively. Thus, our first function (function (1)) was specified as:

$$\ln Y_{it} = \alpha + \beta_1 \ln K_{it} + \beta_2 \ln L_{it} + \beta_3 \ln \text{FPINTRA}_{it} + \beta_4 \ln \text{FPINTER}_{it} + u_{it} \quad (1)$$

where subscripts i and t refer to industry i in year t . Y , K , and L are real value-added, capital and labour inputs respectively. FPINTRA and FPINTER are variables measuring intra-industry and inter-industry spillover effects. All variables are in logarithmic forms. Year dummies are used to capture any unobserved, year-specific effects. Industry dummies are used to account for any industry-specific effects. We choose the first year of our dataset (year 1999) as our base year. Real value added is obtained by deflating the value-added in current prices using the Producer Price Index (PPI). We use net fixed asset to measure capital inputs. Labour inputs are measured by the total number of employees rather than total hours worked due to the lack of data on the latter.

Tian (2007) and Wang et al (2008) argued that different measures of intra-industry foreign presence represent different channels through which FDI could impact the productivity of domestic firms. Thus, for instance, the spillover effect from staff turnover may be expected to be more directly related to FIEs' employment and thus could be better captured by the employment measure of foreign presence. Intra-industry spillover through competition may be better captured by the sales measure of foreign presence as well. Intra-industry spillover through demonstration effects may be better captured by the capital measure of foreign presence (Wang et al., 2008).

In a similar vein, I would argue that vertical or inter-industry spillovers measured by employment, capital, or sales may also capture different channels through which inter-industry spillovers could occur. For instance, the spillover effect through staff interaction or co-operation between domestic firms and their FIE customers or suppliers in other industries may be better captured by the employment measure of inter-industry foreign presence. The capital measure may better capture the spillover through technical assistance from FIEs to their downstream domestic customers or upstream domestic suppliers. FIEs may provide technical assistance to potential domestic suppliers in order to raise the quality of suppliers' products and to facilitate innovation (Lin et al, 2009). FIEs as suppliers to domestic firms may also offer technical assistance to those local customers who are initially not familiar with the technology in those intermediate goods. Such technical assistance relies upon the advanced technology of FIEs which is arguably embodied within their capital. In contrast with the input measure (employment and capital), the output or sales measure of foreign presence may capture all channels through which inter-industry spillover could occur. In addition to 'staff interaction' and 'technical assistance' channels, the sales measure might be expected to also capture the boost to economies of scale to domestic suppliers which enhance their productivity. Similarly, increases in purchases of intermediate goods from FIEs may expose more local firms to advanced technology embodied within intermediate goods. These potential spillover channels are likely to be related to the volume of sales.

To provide some insight on this argument, both intra-industry and inter-industry foreign presences were each measured respectively by the employment, capital and sales shares of FIEs. Intra-industry foreign presence ($FPINTRA_i$) was measured by employment (capital or sales) share of FIE in industry i . Inter-industry foreign presence ($FPINTER_i$) was measured by total employment (capital or sales) share of FIE in all other industries (except for industry i).

5. Data

We use industry level panel data from 1999 to 2007 which are sourced from the Industry Yearbook of China. There are 40 two-digit industries in the Industry Yearbook. However, five industries are excluded from our analysis since there was no participation of FIEs in those industries in 1999. China did not publish industry yearbook in 2005. As a result, 2004 data is estimated by averaging of 2003 and 2005 data. Table 9 shows the summary statistics for the key variables used in our analysis. Table 10 presents the correlation coefficients among all the variables. It can be seen that different measures of intra-industry foreign presence are highly correlated, as are the different measure of inter-industry foreign presence. The correlation coefficients among three measures of intra-industry foreign presence ranged from 0.92 to 0.97. The correlation coefficients among three measures of inter-industry foreign presence ranged from 0.88 to 0.94. Labour and capital are also highly correlated which is expected. Importantly, the correlation coefficients between intra-industry and inter-industry variables, however measured, are low. Since we run separate regression on different measure of foreign presence, multi-collinearity does not seem to be a serious problem in our analysis.

Table 9: Summary Statistics of Key Variables Used (35 Manufacturing Industries, 1999-2007).

Variable	Sample				
	Size	Mean	S.D.	Min	Max
lnY	315	24.69	1.13	21.70	27.22
lnL	315	13.71	0.92	11.64	15.36
lnK	315	25.06	1.16	22.42	28.69
lnFPINTRA(employment)	315	-2.19	1.47	-7.89	-0.28
lnFPINTER(employment)	315	-1.55	0.27	-2.07	-1.15
lnFPINTRA(Capital)	315	-1.78	1.40	-7.27	-0.20
lnFPINTER(Capital)	315	-1.50	0.11	-1.73	-1.16
lnFPINTRA(Sales)	315	-1.72	1.26	-5.87	-0.18
lnFPINTER(Sales)	315	-1.21	0.08	-1.49	-1.07

Notes: S.D. =Standard deviation. Intra-industry and inter-industry foreign presences were measured by employment, capital and sales share respectively.

Table 10: Correlation Coefficient Matrix among all the variables

	lnL	lnK	lnFPINTRA (employment)	lnFPINTER (employment)	lnFPINTRA (Capital)	lnFPINTER (Capital)	lnFPINTRA (Sales)	lnFPINTER (Sales)
lnL	1							
lnK	0.75	1						
lnFPINTRA (employment)	-0.01	-0.24	1					
lnFPINTER (employment)	0.10	0.28	0.14	1				
lnFPINTRA (Capital)	0.09	-0.12	0.97	0.09	1			
lnFPINTER (Capital)	0.12	0.36	0.05	0.94	0.01	1		
lnFPINTRA (Sales)	0.09	-0.16	0.92	0.02	0.96	-0.06	1	
lnFPINTER (Sales)	0.10	0.32	0.00	0.90	-0.04	0.88	-0.11	1

6. Results

6.1 Domestic firms in all industries

The results for our function (1) which covers all domestic firms are reported in Table 11. Fixed-effects and random-effects models are used separately in model 1 and 2. We conduct the Hausman test with corresponding P-values listed. One of the main issues of our regression is the possibility of endogeneity. FIEs may be attracted to high productivity industries without creating any spillovers. Lagged foreign presences are used in model 3 (fixed-effects) and 4 (random-effects) to account for potential endogeneity problems. As expected, the elasticity estimates for both labour and capital are statistically significant in all models.

As shown in table 11, when foreign presence is estimated by employment share of FIEs, intra-industry spillover is significant in both fixed-effects and random-effects models. For fixed-effects specification model 1, a 1% increase in foreign presence would lead to a 0.228%

increase in total value-added in domestic firms in the same industry. Since we have controlled for both labour and capital inputs in our model, the increase in total value-added could arguably be attributed largely to productivity improvements through FDI spillovers. The fixed-effects model seems to be the correct specification since random-effects specification was rejected at the 5% level. Nevertheless, random effects specification in model 2 gives us similar results. We also see a positive and statistically significant result for intra-industry spillover. A lagged measure of foreign presence is used in model 3 and 4. In both cases, the parameters and statistical significance of intra-industry foreign presence remain essentially unchanged. On the other hand, across all our four models, the inter-industry spillover remains insignificant. Thus, if the employment measure of inter-industry spillover captures spillover through staff interaction or co-operation between domestic firms and their FIE customers or suppliers in other industries, the results show that such spillover may not exist.

Similar to the employment measure, when we use capital share to measure foreign presence, we only find intra-industry spillover to be statistically significant in all models. For a non-lagged measure of foreign presence, the intra-industry spillover is positive and statistically significant in both model 1 and 2. When a lagged foreign presence is used in model 3 and 4, the sign of intra-industry spillover remains positive and statistically significant. The magnitude of intra-industry spillovers measured by capital share is smaller than those measured by employment share across all our four models. If intra-industry capital spillover captures the spillover through the demonstration effects (Wang et al., 2008; Liu and Wei, 2006), then the magnitude of such spillover is smaller than the staff turnover spillover. On the other hand, the inter-industry spillover is negative in all models but remains insignificant. As a result, if the capital measure captures the inter-industry spillover through technical assistance from FIEs to their downstream domestic customers or upstream domestic suppliers, the results show that such spillover may not exist.

Interestingly, inter-industry spillovers do become statistically significant across all our models when sales share is used as the proxy for foreign presence. On the other hand, the magnitude of intra-industry spillover measured by sales share becomes smaller in all our models if we compare the results with those measured by employment and capital shares.

In conclusion, the measures of foreign presence do indeed influence the outcomes of our analysis because they may measure different aspects of spillovers. The intra-industry spillover through staff turnover (employment measure) or demonstration effect (capital measure) is larger than that generated by competition (sales measure). The intra-industry inputs (employment or capital measure) spillover contributes (more) directly to the technology base of local firms. Domestic firms in the same industry could simply acquire FIE's technology by hiring their former staffs or purchasing their technology directly which embodied within their capital. On the other hand, domestic firms could also become more efficient in utilizing their own production technology due to the competition pressure from FIEs. However, intra-industry spillover through competition (captured by sales share) does not expose domestic firms to the advanced technology of FIEs and thus the magnitude of such spillover is smaller. In terms of inter-industry spillover, our results show that inter-industry spillover through staff cooperation or technical assistance may not exist.

Table 11: Production Function Regression for All domestic firms (35 manufacturing industries, 1999-2007)

Variables	Model 1	Model 2 [®]	Model 3 ^{®®}	Model 4 ^{®®®}
Labour	0.535*** (0.0881)	0.426*** (0.0696)	0.420*** (0.0932)	0.335*** (0.0730)
Capital	0.362*** (0.0707)	0.479*** (0.0568)	0.486*** (0.0801)	0.58*** (0.0630)
FPINTRA(employment)	0.228*** (0.0274)	0.187*** (0.0247)	0.249*** (0.0308)	0.2*** (0.0271)
FPINTER(employment)	-0.0802 (1.33)	0.384 (1.22)	0.208 (1.42)	0.155 (1.33)
Constant	8.20*** (2.94)	7.62*** (2.77)	7.42** (3.32)	6.01*
Industry Dummy	Yes	No	Yes	No
Year Dummy	Yes	Yes	Yes	Yes
Sample Size	315	315	280	280
Adjusted R ²	0.76	0.79	0.76	0.78
Hausman Test (Prob(>0))		0.0257		0.0580
Labour	0.347*** (0.0782)	0.334*** (0.0670)	0.24*** (0.0939)	0.254*** (0.0761)
Capital	0.464*** (0.0702)	0.523*** (0.0594)	0.558*** (0.0880)	0.598*** (0.0692)
FPINTRA(capital)	0.158*** (0.0210)	0.141*** (0.0197)	0.156*** (0.0241)	0.136*** (0.0219)
FPINTER(capital)	-0.758 (0.894)	-0.919 (0.864)	-0.418 (1.033)	-0.689 (0.985)
Constant	6.87*** (2.17)	5.31*** (1.99)	6.67*** (2.60)	5.00 (**2.30)
Industry Dummy	Yes	No	Yes	No
Year Dummy	Yes	Yes	Yes	Yes
Sample Size	315	315	280	280
Adjusted R ²	0.76	0.79	0.77	0.78
Hausman Test (Prob(>0))		0.364		0.404
Labour	0.157*** (0.0861)	0.266*** (0.070)	0.142 (0.0959)	0.235*** (0.0765)
Capital	0.52*** (0.0751)	0.514*** (0.060)	0.564*** (0.0896)	0.573*** (0.0682)
FPINTRA(Sales)	0.1154*** (0.0346)	0.0892*** (0.0306)	0.101** (0.0391)	0.0721** (0.0332)
FPINTER(Sales)	7.01*** (1.65)	3.8*** (1.30)	5.2*** (1.67)	2.66** (1.35)
Constant	18.6*** (2.58)	12.9*** (2.16)	15.3*** (3.03)	10.4*** (2.42)
Industry Dummy	Yes	No	Yes	No
Year Dummy	Yes	Yes	Yes	Yes
Sample Size	315	315	280	280
Adjusted R ²	0.70	0.77	0.73	0.78
Hausman Test (Prob(>0))		0.0065		0.0634

Note: Foreign Presence was measured by employment, capital and sales shares of FIEs respectively

[®] Random Effects Specification

^{®®} Foreign Presence was lagged for one year.

^{®®®} Foreign presence was lagged for one year (random effects specification).

*, **, *** denote significance at the 10%, 5% and 1% levels respectively.

6.2 Does the level of the technology gap matter?

From previous literatures, there are two competing theories regarding the impacts of a technology gap on the level of spillovers. One theory indicates that the level of spillover would be larger if the technology gap is smaller. If the gap between domestic firms and FIEs is too big, then domestic firms may not benefit from the introduction of advanced technology due to smaller absorption capacity. It is easier to teach a high school student how to do differentiation and algebra compared to a primary school student. In this case, FIEs were “enclaved” which led to little or no spillover. On the other hand, another theory indicates that a larger technology gap generated higher spillover since domestic firms have more “space” to catch up.

To provide some insight on this issue, the 35 industries can be divided into those with a relatively large technology gap between domestic firms and FIEs and those with a relatively small technology gap. We can then observe whether the pattern of FDI spillover was different across those two groups. The technology gap in each industry is measured by the ratio between average labour productivity in domestic firms and average labour productivity in FIEs. Table 12 summarises the average technology gap between local firms and FIEs in descending order from 1999 to 2007 in all industries. Industries at the top of the table had the largest technology gap, or, in other words, FIEs were far more productive than domestic firms in these industries. Industries at the bottom of the table had the smallest technology gap. Although local firms were less productive in most industries, it was surprising to find that FIEs were less productive in some industries such as Transport Equipment or Manufacture of Tobacco. We gather together the 18 industries with relatively large technology gaps in Table 12 and pool the rest as the group with relatively small technology gaps. Unfortunately, measuring the technology gap by labour productivity differentials may not capture the quality differentials. Thus, the results need to be interpreted with caution. Table 13 and 14 report the results for both groups respectively.

Table 12: Average technology gap in all industries from 1999-2007 (in log forms)

Industry	Average Technology gap(in log forms)
Production and Supply of Gas	-1.291764568
Mining and Washing of Coal	-1.26130636
Production and Supply of Tap Water	-1.247498807
Transport Equipment	-1.216141731
Production and Supply of Electric Power, Steam and Hot Water	-1.194685987
Raw Chemical Materials and Chemical Products	-1.087428033
Ordinary Machinery	-0.804263284
Mining and Processing of Non-Ferrous Metal Ores	-0.786061316
Petroleum Processing and Coking	-0.774597274
Chemical Fibre	-0.713263533
Papermaking and Paper Products	-0.692733494
Special Purpose Equipment	-0.679633923
Manufacture of Beverages	-0.653687713
Medical and Pharmaceutical Products	-0.638451416
Manufacture of Foods	-0.634769409
Instruments, Meters, Cultural and Office Machinery	-0.627073648
Mining and Processing of Non-metal Ores	-0.565199586
Non-metal Mineral Products	-0.543829431
Smelting and Pressing of Ferrous Metals	-0.541747248
Printing and Record Medium Reproduction	-0.475461076
Smelting and Pressing of Nonferrous Metals	-0.426768119
Electronic and Telecommunications Equipment	-0.422859332
Processing of Food From Agricultural Products	-0.39035759
Metal Products	-0.337077339
Rubber Products	-0.296675501
Manufacture of Textile	-0.261752577
Mining and Processing of Ferrous Metal Ores	-0.245591122
Processing of Timber, Manufacture of Wood, Bamboo, Rattan, Palm, and Straw Products	-0.183772
Plastic Products	-0.120816851
Furniture Manufacturing	-0.021442091
Manufacture of Textile Wearing Apparel, footwear, and Caps	0.087836672
Electric Equipment and Machinery	0.091854411
Cultural, Educational and Sports Goods	0.200385232
Transport Equipment	0.359547481
Manufacture of Tobacco	1.528550805

Note: Industries at the top of the table have the largest technology gap between domestic firms and FIEs while those at the bottom have the smallest technology gap. A negative number indicates that FIEs were more productive than local firms. A positive number indicates that local firms were more productive than FIEs.

In line with our first regression, we still use both input (employment and capital share) and output (sales share) measures of foreign presence. Focusing on industries with relatively large technology gaps first (Table 13), we can see that those industries are more labour-intensive than in the case when we pool all industries together (Table 11). The labour coefficients are larger in all the corresponding models. Capital may even become insignificant in some models. When we use employment share as a proxy for foreign presence, the magnitude of intra-industry spillover measured by employment share is smaller in both model 1 (fixed-effects) and model 2 (random-effects) than in the case when we pool all industries (Table 11). A similar situation applies to a lagged measure of foreign presence where we see a smaller magnitude of intra-industry spillover in industries with large technology gaps in both model 3 and 4 when the results are compared with those in Table 11. Inter-industry spillovers remain insignificant in all our models which are similar to the case with all industries in Table 11.

In terms of spillover measured by capital share, we also find smaller intra-industry spillover for both non-lagged and lagged measures of foreign presence across all our models when we compare the results to the case where we pool all industries together in Table 11. On the other hand, no significant inter-industry spillovers are found when we use capital share as a proxy for foreign presence.

When we look at sales spillover, we see some very interesting results. The intra-industry spillover becomes insignificant in all our models (except for model 4 which is statistically significant at the 5% level). However, if we compare the magnitude of inter-industry spillover in table 13 with those when we pool all industries together (Table 11), we find that the magnitude becomes larger in all our models.

In conclusion, when we compare the results in Table 13 with those in Table 11, we find that all intra-industry spillover becomes either smaller or insignificant for both input and output measures of foreign presences. The intuition here might be that FIEs in those industries are

indeed “enclaved” which leads to smaller or no intra-industry spillover to domestic firms. However, while the vertical (inter-industry) spillover measured by labour and capital still remains insignificant, the vertical spillover measured by sales share becomes larger for those industries. Domestic firms in industries with relatively large technology gaps (in favour of the FIEs) might benefit more from being either the suppliers to or customers of FIEs in other industries. Or, in other words, the marginal benefits of being the suppliers to or customers of FIEs in other industries increase with the magnitude of the intra-industry technology gap between domestic firms and FIEs. Thus, our result supports the second theory of the technology gap for inter-industry spillover: The larger the gap, the faster to catch up.

The story is very much a contrast when we look at results for industries with relatively small technology gaps (Table 14). The industries with relatively small technology gaps seem to be much more capital-intensive than those industries with relatively large gaps (Table 13). Reflecting this, the capital coefficients are larger and the labour coefficients are smaller or even insignificant in some models in Table 14. Looking at intra-industry spillover firstly with employment share, it remains statistically significant and the magnitude of parameters is larger in all our models when we compare with the results for industries with relatively large technology gap (Table 13). In terms of inter-industry spillover, it remains statistically insignificant in all models.

Secondly, when capital share is adopted as a proxy for foreign presence, the magnitude of intra-industry spillover (measured by capital share) in all our models is larger when we compare the results with industries with relatively large technology gaps (Table 13). For inter-industry spillover, it shows a consistently positive effect in contrast to the most negative effect for relatively large technology gaps in Table 13. Nevertheless, the result is not statistically significant for the lagged measure of foreign presence, but is significant at the 5% level for non-lagged measure of foreign presence in model 1 and 2.

Thirdly, when sales share is used to measure foreign presence, the results are less convincing for intra-industry spillover as was the case with industries with relatively large technology gaps. A larger and more significant intra-industry spillover result can be seen for non-lagged measures of foreign presence in model 1 and 2 in Table 14 when we compare the results with industries with relatively large technology gaps (Table 13). However, the results need to be interpreted with caution since such spillover remains insignificant when we use the lagged measure in model 3 and 4. On the other hand, the magnitude of inter-industry spillover effect is smaller for non-lagged measure of foreign presence in model 1 and 2 when we compare the results with industries with relatively large technology gaps (Table 13). It becomes statistically insignificant for lagged measure in model 3 and 4.

Thus, we see a clear distinction between industries with relatively large technology gaps and those with relatively small gaps. The industries with relatively small technology gaps seem to benefit more from intra-industry spillover measured by both input (employment and capital) and output (sales) shares of FIEs. FIEs seem to be “enclaved” in industries in which they are relatively more technologically advanced than domestic firms. On the other hand, industries with relatively large technology gaps seem to have a larger inter-industry or vertical spillover effect (measured by the sales share of FIEs). Inter-industry spillover measured by both employment and capital shares remains insignificant for both groups. As mentioned earlier, for inter-industry spillover, our results show that the marginal benefits of being customers of or suppliers to FIEs in other industries increase with the magnitude of an intra-industry technology gap between domestic firms and FIEs. In other words, the larger the intra-industry technology gap, the higher the inter-industry spillover. For instance, we assume that there are two firms in industry i . One of them is FIE and another firm is domestic firm. If the technology gap between them is larger, then domestic firm in industry i benefits more from being the supplier to or customer of FIEs in other industries. The intuition here may be that the technology advantage of FIE in industry i may rely on the advanced intermediate goods supplied by FIEs in other industries. If FIEs in other industries now decide to supply same intermediate goods to that domestic firm in industry i . Then the technology gap between FIE and domestic firm in industry i would be narrowed or even disappear.

Table 13: Production Function Regression for Industries with relatively large technology gaps (18 industries, 1999-2007)

Variables	Model 1	Model 2 [®]	Model 3 ^{®®}	Model 4 ^{®®®}
Labour	0.735*** (0.196)	0.726*** (0.104)	0.629*** (0.197)	0.702*** (0.105)
Capital	0.0594 (0.117)	0.283*** (0.0789)	0.131 (0.121)	0.310*** (0.0821)
FPINTRA(employment)	0.164*** (0.0349)	0.156*** (0.0308)	0.186*** (0.0390)	0.171*** (0.0334)
FPINTER(employment)	-6.62* (3.88)	-2.21 (3.49)	-7.38* (4.29)	-1.82 (1.33)
Constant	0.0337 (7.95)	3.13 (7.58)	-1.60** (8.64)	3.71 (8.07)
Industry Dummy	Yes	No	Yes	No
Year Dummy	Yes	Yes	Yes	Yes
Sample Size	162	162	144	144
Adjusted R ²	0.77	0.80	0.75	0.81
Hausman Test (Prob(>0))		0.996		0.994
Labour	0.461** (0.197)	0.634*** (0.106)	0.495** (0.213)	0.668*** (0.110)
Capital	0.250* (0.130)	0.334*** (0.0931)	0.189 (0.140)	0.288*** (0.0966)
FPINTRA(capital)	0.115*** (0.0271)	0.125*** (0.0247)	0.126*** (0.030)	0.130*** (0.0270)
FPINTER(capital)	-1.14 (1.14)	-0.848 (1.10)	-0.254 (1.29)	0.191 (1.22)
Constant	9.90*** (3.55)	5.88*** (2.92)	12.5*** (2.60)	8.37*** (3.12)
Industry Dummy	Yes	No	Yes	No
Year Dummy	Yes	Yes	Yes	Yes
Sample Size	162	162	144	144
Adjusted R ²	0.75	0.83	0.83	0.82
Hausman Test (Prob(>0))		0.818		0.799
Labour	0.313 (0.202)	0.685*** (0.101)	0.365* (0.216)	0.707*** (0.101)
Capital	0.14 (0.126)	0.172*** (0.0882)	0.157 (0.135)	0.177* (0.0911)
FPINTRA(Sales)	0.0156 (0.0488)	0.0721* (0.0409)	0.030 (0.0535)	0.0845** (0.0427)
FPINTER(Sales)	9.85*** (3.42)	11.40*** (3.09)	9.45** (3.83)	11.77*** (3.03)
Constant	29.28*** (5.41)	25.60*** (4.96)	27.81*** (5.94)	25.78*** (5.39)
Industry Dummy	Yes	No	Yes	No
Year Dummy	Yes	Yes	Yes	Yes
Sample Size	162	162	144	144
Adjusted R ²	0.80	0.82	0.84	0.81
Hausman Test (Prob(>0))		0.574		0.794

Note: Foreign Presence was measured by employment, capital and sales shares of FIEs respectively

[®] Random Effects Specification

^{®®} Foreign Presence was lagged for one year.

^{®®®} Foreign presence was lagged for one year (random effects specification).

*, **, *** denote significance at the 10%, 5% and 1% levels respectively.

Table 14: Production Function Regression for Industries with relatively small technology gaps (18 industries, 1999-2007)

Variables	Model 1	Model 2 [®]	Model 3 ^{®®}	Model 4 ^{®®®}
Labour	0.474*** (0.105)	0.153* (0.0870)	0.179 (0.125)	-0.0547 (0.0905)
Capital	0.462*** (0.0918)	0.739*** (0.0736)	0.826*** (0.121)	0.998*** (0.0812)
FPINTRA(employment)	0.401*** (0.0567)	0.190*** (0.046)	0.282*** (0.0664)	0.137 (0.0456)
FPINTER(employment)	2.09 (1.28)	1.68 (1.29)	1.34 (1.38)	-0.205 (1.32)
Constant	11.3*** (3.01)	7.63** (3.01)	4.72 (3.77)	0.324 (3.27)
Industry Dummy	Yes	No	Yes	No
Year Dummy	Yes	Yes	Yes	Yes
Sample Size	153	153	136	136
Adjusted R ²	0.76	0.79	0.76	0.75
Hausman Test (Prob(>0))		1.00		0.0784
Labour	0.202** (0.0862)	0.0845 (0.0819)	0.0244 (0.11)	-0.103 (0.089)
Capital	0.492*** (0.0860)	0.70*** (0.073)	0.779*** (0.139)	0.970*** (0.0881)
FPINTRA(capital)	0.327*** (0.0445)	0.205*** (0.0390)	0.245*** (0.0638)	0.133*** (0.0426)
FPINTER(capital)	4.53** (1.77)	3.86** (1.69)	2.60 (2.00)	0.826 (1.75)
Constant	17.2*** (3.45)	12.5*** (3.28)	9.43* (5.00)	3.37 (3.76)
Industry Dummy	Yes	No	Yes	No
Year Dummy	Yes	Yes	Yes	Yes
Sample Size	153	153	136	136
Adjusted R ²	0.82	0.76	0.80	0.83
Hausman Test (Prob(>0))		0.00		0.187
Labour	0.024 (0.098)	0.0178 (0.0862)	-0.126 (0.110)	-0.128 (0.0914)
Capital	0.716*** (0.105)	0.798*** (0.0749)	1.06*** (0.133)	1.03*** (0.0836)
FPINTRA(Sales)	0.199*** (0.0630)	0.102** (0.0451)	0.0634 (0.0738)	0.0447* (0.0463)
FPINTER(Sales)	7.20*** (1.76)	4.03*** (1.30)	2.54 (1.58)	1.08 (1.22)
Constant	16.2*** (2.70)	9.84*** (2.27)	3.51 (3.72)	2.28 (2.49)
Industry Dummy	Yes	No	Yes	No
Year Dummy	Yes	Yes	Yes	Yes
Sample Size	153	153	136	136
Adjusted R ²	0.79	0.78	0.83	0.85
Hausman Test (Prob(>0))		0.003		0.398

Note: Foreign Presence was measured by employment, capital and sales shares of FIEs respectively

[®] Random Effects Specification

^{®®} Foreign Presence was lagged for one year.

^{®®®} Foreign presence was lagged for one year (random effects specification).

*, **, *** denote significance at the 10%, 5% and 1% levels respectively.

6.3 Import-substituting FIE vs. Export-oriented FIE

As mentioned earlier, the past literature on other developing countries has shown that import-substituting FIEs tend to generate a higher level of intra-industry productivity spillover due to the direct competition they provide for domestic firms. Import-substituting FIEs enter the domestic market with technologies that are either missing or weakly developed among domestic firms, which generate a large potential for intra-industry spillover. On the other hand, export-oriented FIEs are more likely to be “enclaved” in the sense that they do not compete directly with local firms. Export-oriented FIEs enter the domestic market to exploit the competitive assets of the host nation (Kokko et al., 2001). They may also enter the domestic market to take advantage of the lower inputs costs offered by the host nation (e.g. China’s cheaper labour costs). Their comparative advantages or strengths lie in their international distribution and marketing networks (Kokko et al., 2001). Since export-oriented FIEs do not compete directly with domestic firms in domestic markets, the magnitude of intra-industry productivity spillover could be lower. However, intra-industry spillover could happen differently between export-oriented FIEs and domestic firms in the same industry. As mentioned earlier, domestic firms could learn how to access foreign markets by imitating FIEs or collaboration (joint venture) with export-oriented FIEs which could improve domestic firms’ international sales/export performance. However, such export spillover cannot be captured by our production function regression.

In order to separate FIEs in different industries into two groups, the 35 industries have been divided into import-substituting and export-oriented industries (on a relative basis). Export-oriented industries are those where a relatively high proportion of FIEs’ output is exported while a relatively high proportion of FIEs’ output is sold domestically in import-substituting industries. Our dataset is narrowed due to data availability. The Industry Yearbook of China did not publish information regarding the proportion of output exported by FIEs in different industries until 2001.

Table 15: The average proportion of output exported among FIEs in all industries from 2001-2007.

Industry	The proportion of Output exported By FIEs(2001-07)
Production and Supply of Gas	0.79%
Mining and Washing of Coal	1.28%
Mining and Processing of Ferrous Metal Ores	2.65%
Manufacture of Tobacco	3.06%
Production and Supply of Electric Power, Steam and Hot Water	3.56%
Manufacture of Beverages	4.41%
Production and Supply of Tap Water	6.62%
Mining and Processing of Non-Ferrous Metal Ores	7.95%
Smelting and Pressing of Ferrous Metals	8.16%
Medical and Pharmaceutical Products	12.10%
Chemical Fiber	12.18%
Transport Equipment	12.46%
Manufacture of Foods	12.88%
Petroleum Processing and Coking	15.32%
Papermaking and Paper Products	17.96%
Raw Chemical Materials and Chemical Products	18.13%
Smelting and Pressing of Nonferrous Metals	18.65%
Processing of Food From Agricultural Products	20.71%
Mining and Processing of Nonmetal Ores	25.58%
Printing and Record Medium Reproduction	26.10%
Nonmetal Mineral Products	27.50%
Ordinary Machinery	31.84%
Rubber Products	38.10%
Processing of Timber, Manufacture of Wood, Bamboo, Rattan, Palm, and Straw Products	40.13%
Special Purpose Equipment	40.42%
Metal Products	44.45%
Plastic Products	45.89%
Electric Equipment and Machinery	46.61%
Manufacture of Textile	49.44%
Manufacture of Textile Wearing Apparel, footwear, and Caps	64.44%
Electronic and Telecommunications Equipment	65.70%
Furniture Manufacturing	69.36%
Instruments, Meters, Cultural and Office Machinery	69.91%
Manufacture of Leather, Fur, Feather and Related Products	69.98%
Cultural, Educational and Sports Goods	77.85%

Table 15 summarises the average proportion of output exported by FIEs in all industries from 2001 to 2007. The top 17 industries in which a relatively small proportion of FIE products are exported are pooled together (import-substituting industries). The rest 18 industries in which a relatively large proportion of FIE products are exported are pooled together as export-oriented industries.

Table 16 and 17 display the regression results for these two groups. It seems that export-oriented industries (Table 17) are more labour-intensive. The magnitude of the coefficient on labour in export-oriented industries is higher than that in import-substituting industries across all our models. This finding supports our hypothesis that export-oriented FIEs enter China to take advantage of lower input cost (low labour costs) in order to minimize their production costs. Looking at intra-industry FDI spillover measured by the employment share, we find that such spillover is larger for import-substituting industries (Table 16) than export-oriented industries (Table 17) across all our models. For instance, when we compare the results of two groups in model 1, we found that a 1% increase in intra-industry foreign presence would lead to a 0.409% increase in total value added among domestic firms for import-substituting industries. The corresponding productivity gain in export-oriented industries is only 0.194%. Similar results could be found in the other three models. In terms of inter-industry spillover, the effect is consistently positive for import-substituting industries but only significant at 5% level for model 3 (Table 16). For export-oriented industries, the results for all models are mixed in directions and all of them are statistically insignificant (Table 17).

When we use capital share to measure foreign presence in both groups, we find again that the magnitude of intra-industry capital spillover is larger in import-substituting industries across all our models. For instance, when we compare the results of both groups in model 1, we find that a 1% increase in intra-industry foreign presence would lead to a 0.362% increase in total value added among domestic firms for import-substituting industries. The magnitude of such spillover is reduced to 0.136% for export-oriented industries. Similar results could be seen for another three models. On the other hand, when we look at inter-

industry capital spillover between these two groups, we find that the positive effect for import-substituting industries has become more significant in fixed-effects models (model 1 and 3). For export-oriented industries, the effect remains negative but statistically insignificant among all our models.

When we turn to the sales measure of foreign presence, we find that intra-industry sales spillover becomes insignificant for export-oriented industries (Table 17) among all our models, while it remains statistically significant for import-substituting industries (Table 16) across our four models. However, the opposite is true when we look at results for inter-industry sales spillover. It becomes statistically insignificant for import-substituting industries (Table 16) except for model 3 while it turns out to be statistically significant and large in scale for export-oriented industries (Table 17). For instance, even when we compare the magnitude of inter-industry sales spillover in model 3 between those two industry groups, we can see a clear distinction: a 1% increase in inter-industry foreign presence measured by sales share would lead to a 14% increase in total value-added among all domestic firms in the industry among export-oriented industries. The magnitude of such spillover was reduced to 6.93% for domestic firms in import-substituting industries.

Thus, in line with previous studies, we find that the magnitude of intra-industry spillover is larger in import-substituting industries than in export-oriented industries for all three measures of foreign presence. The magnitude of intra-industry inputs spillover (employment and capital measure) becomes smaller for export-oriented industries even though they still remain significant in all our models. If employment share measures the labour turnover spillover, the magnitude of such intra-industry spillover is smaller for two reasons. Firstly, former staff in export-oriented FIEs may not be familiar with domestic market conditions. Secondly, former staffs in export-oriented FIEs are more likely to be unskilled or lower skilled labour. As mentioned earlier, most technologies used in labour-intensive industries are quite standardized which do not require high human capital and as a result, a large amount of low-skilled labour is hired at a low wage rate by FIEs (Zhang, 2005). Taking advantage of low labour costs, FIEs import intermediate inputs to China for assembly

or processing. The superior production technologies embodied within export-oriented FIEs' capital may not be suitable for domestic markets which lead to a smaller magnitude of intra-industry capital spillover. On the other hand, the magnitude of intra-industry output (sales) spillover becomes statistically insignificant for export-oriented industries in all our models. Since a large proportion of products in export-orientated industries are not sold in the domestic markets, productivity gains through direct competition are small.

We find some interesting results for inter-industry spillover. While inter-industry labour spillover still remains insignificant for both groups of industries, we see a positive and somewhat significant sign for inter-industry capital spillover in fixed-effects models for import-substituting industries. Domestic firms who compete directly with FIEs in import-substituting industries may benefit from the technical assistance derived from downstream FIE customers or upstream FIE suppliers. Or, put another way, the marginal benefit of receiving technical assistance from downstream FIE customers or upstream FIE suppliers is high due to the fierce competition they face in their own industry (import-substituting industry).

On the other hand, our results show that domestic firms only benefit from inter-industry sales spillover in export-oriented industries. If FIEs export most of their products overseas, then it is less likely that FIEs in export-oriented industries would engage in buyer-supplier relations with FIEs in other industries. For instance, we assume that there are two firms in industry i . One is domestic firm and another is FIE. We also assumed that industry i is export-oriented industry for FIE and FIE exports all its products overseas. Now, there is one FIE in another industry who try to find one supplier of their intermediate goods in industry i . The FIE in another industry only have two choice. He can choose either domestic firm or FIE in industry i as his supplier. However, since FIE in industry i do not sell anything in domestic market. FIE in another industry may have no choice but to choose domestic firm in industry i as his supplier in domestic market.

Similar case could be applied to FIEs in another industry who try to become the suppliers of intermediate goods to firms in industry i . As mentioned by Lin et al (2009), since export-oriented FIEs are usually part of global production network, they often depend on the suppliers from their parent company or their affiliates in other countries. As a result, exported-oriented FIEs are less likely to source locally from either potential domestic-owned firms or FIEs operated in China in other industries. Such argument is supported by some empirical findings (Lin et al., 2009; Belderbos et al., 2001). Thus, if FIE in industry i (export-oriented industry) is less likely to engage in buyer-supplier relation with FIEs in another industry in China, domestic firms in the same industry may simply have more opportunities to get involved in buyer-supplier relations with those FIEs in another industry.

The story is the opposite for import-substituting FIEs; they are more likely to engage in buyer-supplier relations with FIEs in other industries. For instance, we assume that there are two firms in industry i . One is domestic firm and another is FIE. We also assumed that industry i is import-substituting industry for FIE and FIE sells most of his products in the domestic market. Now, there is one FIE in another industry who try to find one supplier of their intermediate goods in industry i . The FIE in another industry only have two choice. He can choose either domestic firm or FIE in industry i as his supplier. However, everything else being equal, FIE in another industry may be more likely to choose FIE in industry i as his supplier because it is more likely that FIE in industry i is more technologically advanced. Similar story could be applied to FIE in another industry who is the suppliers of intermediate goods for firms in industry i . FIE in another industry may prefer to supply FIE rather than domestic firm in industry i because they may have already established buyer-supplier relationships in other countries. As a result, domestic firms in the same industry have less opportunity (crowding-out effect). They are less likely to become the potential customers or suppliers of FIEs in other industries.

Table 16: Production Function Regression for import-substituting industries (17 industries, 2001-2007)

Variables	Model 1	Model 2 [®]	Model 3 ^{®®}	Model 4 ^{®®®}
Labour	0.464*** (0.125)	0.437*** (0.0882)	0.514*** (0.143)	0.466*** (0.0968)
Capital	0.316*** (0.103)	0.546*** (0.0792)	0.268** (0.113)	0.520*** (0.0857)
FPINTRA(employment)	0.409*** (0.0874)	0.294*** (0.0547)	0.418*** (0.0915)	0.244*** (0.0573)
FPINTER(employment)	2.07 (5.50)	0.150 (1.08)	3.37** (1.49)	0.330 (1.19)
Constant	14.32*** (10.05)	5.52** (2.28)	17.24*** (3.37)	6.11** (2.53)
Industry Dummy	Yes	No	Yes	No
Year Dummy	Yes	Yes	Yes	Yes
Sample Size	119	119	102	102
Adjusted R ²	0.76	0.73	0.74	0.73
Hausman Test (Prob(>0))		0.00		0.00
Labour	0.256** (0.102)	0.326*** (0.0823)	0.427*** (0.116)	0.412*** (0.0931)
Capital	0.607*** (0.121)	0.655*** (0.0770)	0.328*** (0.112)	0.565*** (0.0831)
FPINTRA(capital)	0.362*** (0.0311)	0.337*** (0.0442)	0.320*** (0.0538)	0.288*** (0.0463)
FPINTER(capital)	4.05** (1.32)	0.808 (1.38)	9.37** (2.06)	2.11 (1.49)
Constant	12.57*** (3.71)	5.35** (2.27)	25.49*** (4.10)	8.47 *** (2.49)
Industry Dummy	Yes	No	Yes	No
Year Dummy	Yes	Yes	Yes	Yes
Sample Size	119	119	102	102
Adjusted R ²	0.76	0.72	0.70	0.71
Hausman Test (Prob(>0))		0.00		0.00
Labour	0.182 (0.115)	0.381*** (0.0960)	0.273** (0.126)	0.412*** (0.102)
Capital	0.369*** (0.124)	0.552*** (0.0903)	0.383*** (0.121)	0.545*** (0.0928)
FPINTRA(Sales)	0.220* (1.31)	0.274*** (0.774)	0.475*** (0.127)	0.286*** (0.0785)
FPINTER(Sales)	-1.72 (2.57)	-0.887 (0.980)	6.93*** (2.44)	-0.0062 (0.973)
Constant	10.67*** (3.92)	4.62***	20.5*** (3.92)	5.61*** (1.56)
Industry Dummy	Yes	No	Yes	No
Year Dummy	Yes	Yes	Yes	Yes
Sample Size	119	119	102	102
Adjusted R ²	0.75	0.73	0.72	0.70
Hausman Test (Prob(>0))		0.00		0.00

Note: Foreign Presence was measured by employment, capital and sales shares of FIEs respectively

[®] Random Effects Specification

^{®®} Foreign Presence was lagged for one year.

^{®®®} Foreign presence was lagged for one year (random effects specification).

*, **, *** denote significance at the 10%, 5% and 1% levels respectively.

Table 17: Production Function Regression for export-orientated industries (18 industries, 2001-2007)

Variables	Model 1	Model 2 [®]	Model 3 ^{®®}	Model 4 ^{®®®}
Labour	0.931*** (0.228)	0.664*** (0.174)	0.851*** (0.224)	0.621*** (0.174)
Capital	0.415*** (0.157)	0.503*** (0.128)	0.506*** (0.160)	0.556*** (0.133)
FPINTRA(employment)	0.194*** (0.0426)	0.156*** (0.0407)	0.228*** (0.0453)	0.187*** (0.0433)
FPINTER(employment)	0.525 (5.50)	-0.722 (5.13)	1.21 (5.88)	-0.536 (5.41)
Constant	2.84 (10.05)	1.97 (9.64)	4.72 (3.77)	1.78 (10.2)
Industry Dummy	Yes	No	Yes	No
Year Dummy	Yes	Yes	Yes	Yes
Sample Size	126	126	108	108
Adjusted R ²	0.67	0.69	0.66	0.67
Hausman Test (Prob(>0))		0.998		0.619
Labour	0.637*** (0.221)	0.490*** (0.169)	0.690*** (0.242)	0.516*** (0.179)
Capital	0.581*** (0.166)	0.620*** (0.140)	0.542*** (0.186)	0.585*** (0.152)
FPINTRA(capital)	0.136*** (0.0311)	0.118*** (0.0303)	0.134*** (0.0348)	0.113*** (0.0334)
FPINTER(capital)	-1.53 (1.32)	-1.82 (1.69)	-0.428 (1.41)	-0.853 (1.38)
Constant	-0.916 (3.71)	-0.403 (3.55)	1.18 (4.03)	1.76 (3.80)
Industry Dummy	Yes	No	Yes	No
Year Dummy	Yes	Yes	Yes	Yes
Sample Size	126	126	108	108
Adjusted R ²	0.67	0.68	0.66	0.67
Hausman Test (Prob(>0))		0.534		0.391
Labour	0.558*** (0.214)	0.541*** (0.159)	0.551** (0.237)	0.525*** (0.168)
Capital	0.467*** (0.156)	0.404*** (0.131)	0.561*** (0.180)	0.463*** (0.146)
FPINTRA(Sales)	0.0363 (0.0457)	0.0243 (0.0420)	0.0214 (0.0499)	0.00920 (0.0451)
FPINTER(Sales)	16.88*** (3.83)	16.11*** (3.60)	14.0*** (4.21)	13.49*** (3.96)
Constant	26.19*** (6.13)	27.03*** (5.82)	20.4*** (6.81)	22.59*** (6.48)
Industry Dummy	Yes	No	Yes	No
Year Dummy	Yes	Yes	Yes	Yes
Sample Size	126	126	108	108
Adjusted R ²	0.72	0.73	0.71	0.72
Hausman Test (Prob(>0))		0.887		0.779

Note: Foreign Presence was measured by employment, capital and sales shares of FIEs respectively

[®] Random Effects Specification

^{®®} Foreign Presence was lagged for one year.

^{®®®} Foreign presence was lagged for one year (random effects specification).

*, **, *** denote significance at the 10%, 5% and 1% levels respectively.

6.4 Could FIEs benefit from the intra-industry presence of domestically owned firms and the inter-industry presence of other FIEs?

As mentioned earlier, widespread government incentives to attract foreign investment from other countries are supported by the belief that multi-national corporations are possessed with some advanced firm-specific technologies which would spillover to domestic sectors. Due to the high fixed cost of investing overseas, if a foreign company is identical to its domestic rivals, foreign firms would find it unprofitable to enter the overseas market (Fosfuri and Motta, 1999). In theory, multinational corporations invest overseas in order to exploit their firm-specific knowledge or technologies. However, the notion of “technology exploiting FDI” has recently been challenged by the view that the motive of FDI is not to exploit firm-specific technology, but to access it. In other words, a firm decides to invest in foreign countries not to exploit their own firm-specific knowledge, but to access firm-specific knowledge in foreign countries and then transfer it back from foreign countries to the firm itself via spillover effects (Love, 2003).

Theoretically, Fosfuri and Motta (1999) developed a model to show that technologically lagged firms may invest overseas in order to access the “location-specific” superior technology of the host nation. On the other hand, technologically advanced firms may prefer exports rather than FDI in order to avoid the “dissipation of their firm-specific technology” (Fosfuri and Motta, 1999). However, the investment decision of technologically advanced firms may also depend on the marginal gains firms can achieve from locating overseas. For instance, even if there is a risk to the technologically advanced firms (firms from developed countries) that they may generate spillover of their firm-specific technology to technologically lagged firms in developing countries, they may still choose to invest in those countries if the expected marginal gains from doing so are high enough to offset the cost. Such marginal gains could originate from the host country specific advantages such as the cheaper labour supply, reduced social overheads or the availability of a large stock of (immobile) stocks (Siotis and Neven, 1996). In some cases, firms may find it more profitable to invest and operate in foreign countries instead of exporting due to high trade barriers. On the other hand, if the firms are technologically behind, they may find it profitable to invest

overseas if the expected marginal gains from accessing the superior technology of the host nation outweigh the extra high fixed costs from investing overseas. Patel and Vega (1999) also developed a conceptual model to demonstrate that technology-sourcing FDI only occurs from technologically weak countries to technologically strong countries. It could also occur from technologically strong countries to technologically strong countries if the latter is somewhat stronger than the former (Patel and Vega, 1999). In other words, technology-sourcing FDI is unlikely to occur from developed countries to developing countries.

Empirically, Driffield and Love (2003) analysed a panel of UK manufacturing industries and found that technology possessed by domestic sectors could spillover to FIEs. Such “reverse spillover” demonstrated the possible existence of “technology sourcing” FDI. Kogut and Chang (1999) reported similar findings among Japanese firms investing in the United States. They investigated the entry of Japanese firms into U.S. manufacturing sectors from 1976 to 1987 and found that Japanese firms were more likely to invest in the U.S. if the technology gap or differences in R&D intensity was high between the two countries. The intuition is that Japanese firms in one sector are more likely to invest in the United States if the counterpart U.S. firms in the same sector have technological advantages over Japanese firms. The results indicate that technological sourcing may be a motivation of Japanese firms who invest in the U.S. However, this evidence only applied to joint ventures. On the other hand, they also found that Japanese firms in one sector which are more technologically advanced are less likely to invest in the US. Instead, exports are more preferable than FDI for those Japanese firms. Håkanson and Nobel (1993) also found that 13 out of 192 Swedish research centres set up overseas had the sole intention of technology-sourcing.

Nevertheless, most theoretical and empirical studies have shown that technology-sourcing FDI does not occur from developed or technologically advanced countries to developing or technologically weak countries. In other words, it is highly unlikely for FIEs to invest in China in order to access superior technologies in the domestic market. FDI in China should be purely “technology exploiting”. However, a few literatures have recently started to challenge this view by arguing that FIEs located in developing countries may still benefit

from their counterpart domestic firms if the latter could help the former to overcome so called “location-based disadvantages”(Makino and Delios, 1996; Hymer, 1976).

Compared to domestic firms, foreign firms are not familiar with indigenous knowledge which may adversely affect their performances. Indigenous knowledge refers to the host nation’s cultural and business traditions, customer tastes, and political systems or laws. For instance, developing close personal relationships or “GuanXi” is very important when you do business with domestic Chinese firms. This is also important when you deal with government agents in China. FIEs may acquire this indigenous knowledge when they hire former domestic firms’ employees and hence improve their performances.

On the other hand, FIEs may need to adjust their products/technologies in order to meet different customer tastes in China. For instance, Wang et al (2008) conducted a case study on the motor industry in the city of Chongqing in China to identify the channels through which reverse spillover could occur. He interviewed several executives in FIEs and found that the demonstration effects of “indigenous technology” did exist. During the interview, the executives told the interviewer that they initially found that small-engine motorcycles produced by domestic rivals were more preferred by local customers due to both economic and geographic reasons. As a result, those FIEs later switched to producing small engine motorcycles which better met the tastes of local customers. Thus, due to the demonstration effects of “indigenous technology”, FIEs may acquire the knowledge of the unique customer tastes in China. The demonstration effects of “indigenous technology” could be embodied within the capital of domestic firms. Since spillover through competition could be better captured by the sales measure of foreign presence, the reverse spillover through competition could also be better captured by the sales measure of domestic presence. However, as mentioned earlier, the competition spillover could be either negative or positive. It becomes positive when the gains from competition (e.g., help firms to achieve X-efficiency) outweigh the loss (e.g. higher average cost of production due to reduced demand) and vice versa.

Nevertheless, all the channels mentioned above through which reverse spillover could happen seems to be intra-industry only. As far as I am concerned, to date there has been no theoretical or empirical support for possible inter-industry reverse spillover in developing countries. However, in terms of inter-industry spillover, it could happen between FIEs in one industry and FIEs in downstream or upstream industries. Similarly to domestic firms, FIEs in one industry may also benefit from the advanced technologies embodied with their downstream FIE customers or upstream FIE suppliers.

In line with the discussions so far, we incorporate both intra-industry domestic presence and inter-industry foreign presence into the FIE production function to capture both intra-industry reverse spillover and inter-industry FDI spillover:

$$\ln Y_{i,t}^{FIE} = a + B_1 \ln K_{i,t}^{FIE} + B_2 \ln L_{i,t}^{FIE} + B_3 \ln DPINTRA_{it} + B_4 \ln FPINTER_{it} + u_{it} \quad (2)$$

where subscripts i and t refer to industry i in year t . The subscript FIE is used to distinguish function (2) from function (1): function (1) is the production function for domestic firms and function (2) is the production function for FIEs. Y , K , and L are real value-added, capital and labour inputs for FIEs respectively. The measures of these three variables are similar to those in Function (1). Intra-industry domestic presence $DPINTRA_{it}$ is the variable measuring intra-industry reverse spillover effects. Similar to function (1), we use three different measures of domestic presence in order to capture different channels through which reverse spillover could happen. Thus, $DPINTRA_{it}$ is measured by employment (capital or sales) share of domestic firms in industry i at time t . In line with function (1), inter-industry foreign presence $FPINTER_{it}$ is measured by total employment (capital or sales) share of FIEs in all other industries (except for industry i). All variables are in logarithmic forms and both year and industry dummies are used. Table 18 summarises key variables used while Table 19 presents the correlation coefficients among all the variables. As can be seen in Table 19, different measures of intra-industry domestic presence and inter-industry foreign presences are highly correlated. The correlation coefficients among the three measures of intra-industry domestic presence ranged from 0.92 to 0.94. The correlation coefficients among the three measures of inter-industry foreign presence ranged

from 0.88 to 0.94. The correlation coefficients between other variables are low, except the one between labour and capital. Since we run regression on different measures of intra-industry domestic presence and inter-industry foreign presence separately, multicollinearity does not seem to be a serious problem for our analysis.

Table 20 reports the results for our regression covering all FIEs. When we use the employment share to measure both intra-industry domestic presence and inter-industry foreign presence, the results are not statistically significant for all our models. If intra-industry “reverse spillover” measured by domestic employment share captures the acquisition of indigenous knowledge via staff turnover from domestic firms to FIEs, Our results do not reflect this spillover. As mentioned earlier, labour productivity in domestic firms is usually lower than that in FIEs. As a result, the staff turnover from domestic firms to FIEs may create some negative productivity spillover on FIEs. Such negative spillover could offset the positive spillover generated from the acquisition of local knowledge. In terms of inter-industry spillover, if the employment share of FIEs in other industries captures the spillover through staff interaction or co-operation between FIEs in one industry and their FIE customers or suppliers in other industries, our results do not indicate that existence of such spillover.

When we use the capital share to measure both intra-industry domestic presence and inter-industry foreign presence, the results for both of them are only statistically significant at the 10% level in model 1. They are insignificant for other three models. If intra-industry domestic presence measured by the capital share captures the demonstration effects of “indigenous technology” embodied within domestic firms’ capital, the results show that such spillover may not exist. FIEs may find that indigenous technology is less productive even though the products produced by such technology better meet the tastes of local customers. In terms of inter-industry spillover, if the capital share of FIEs in other industries capture the technology spillover through technical assistance embodied within their advanced technology from FIEs in other industries to their downstream FIE customers or upstream FIE suppliers, the results show that such spillover may not exist. Since most FIEs

are technologically more advanced than domestic firms, they may not need any technical assistance from their downstream or upstream FIE customers/suppliers. The supplier-buyer relationships between them may have already existed in other countries.

Table 18: Summary Statistics of Key Variables Used in Function (2) (35 Manufacturing Industries, 1999-2007).

Variable	Sample Size	Mean	S.D.	Min	Max
lnY	315	23.27	1.85	17.22	26.95
lnL	315	11.80	1.90	6.40	15.30
lnK	315	23.66	1.83	17.03	26.95
lnDPINTRA(employment)	315	-0.28	0.30	-1.40	0.00
lnDPINTRA(capital)	315	-0.37	0.31	-1.71	0.00
lnDPINTRA(sales)	315	-0.37	0.32	-1.81	0.00
lnFPINTER(employment)	315	-1.55	0.27	-2.07	-1.15
lnFPINTER(capital)	315	-1.50	0.11	-1.73	-1.16
lnFPINTER(sales)	315	-1.21	0.08	-1.49	-1.07

Notes: S.D. = Standard deviation. Intra-industry and inter-industry foreign presences were measured by employment, capital and sales shares respectively.

Table 19: Correlation Coefficient Matrix among all the variables in Function (2)

	lnL	lnK	lnDPINTRA (employment)	lnDPINTRA (capital)	lnDPINTRA (sales)	lnFPINTER (employment)	lnFPINTER (capital)	lnFPINTER (sales)
lnL	1							
lnK	0.86	1						
lnDPINTRA (employment)	-0.64	-0.34	1					
lnDPINTRA (capital)	-0.72	-0.49	0.92	1				
lnDPINTRA (sales)	-0.66	-0.43	0.90	0.94	1			
lnFPINTER (employment)	0.17	0.25	-0.09	-0.03	0.02	1		
lnFPINTER (capital)	0.10	0.22	-0.01	0.09	0.13	0.94	1	
lnFPINTER (sales)	0.03	0.14	0.13	0.23	0.30	0.90	0.88	1

Finally, when we turn to the sales measure, we see some interesting results. Both intra-industry reverse spillover and inter-industry FDI spillover are statistically significant in the fixed-effects models while they still remain statistically insignificant in the random-effects model. The Hausman test suggests that the random-effects specification cannot be rejected at 5% significance between model 1 and 2 ($P\text{-value}=0.0532$). However, the random-effects specification can be rejected at 5% significance between model 3 and 4 where we use a lagged measure of intra-industry domestic presence and inter-industry foreign presence ($P\text{-value}=0.0254$). When we focus on fixed-effects models only, it seems that the intra-industry domestic presence measured by sales share generates some negative productivity spillover for FIEs. In other words, if the sales share better captures the competition effects, then the negative spillover due to competition (increasing average cost due to reduced demand) outweighs the positive spillover (reduced X-inefficiency) for FIEs. As mentioned earlier, if the output (sales) measure of inter-industry spillover captures all spillover channels through which inter-industry could occur. Our results indicate that this spillover is statistically significant and large in scale. A 1% increase in inter-industry FIE sales could lead to a 12.33% (or 15.53% for lagged measure in model 3) increase in total value-added for FIEs. Being suppliers to FIEs in other industries helps FIEs achieve economies of scale which improve their efficiency. Being the customers of FIEs in other industries exposes FIEs to advanced intermediate goods which improve their efficiency as well. However, the results need to be interpreted with caution since we do not find any spillover effects from our random-effects specifications.

Table 20: Production Function Regression for all FIEs (35 industries, 1999-2007)

Variables	Model 1	Model 2 [®]	Model 3 ^{®®}	Model 4 ^{®®®}
Labour	0.195**(0.0968)	0.386*** (0.0543)	0.261** (0.111)	0.420*** (0.0571)
Capital	0.654*** (0.0669)	0.575*** (0.0444)	0.611*** (0.0756)	0.551*** (0.0471)
DPINTRA(employment)	0.229 (0.224)	0.222(0.194)	0.210(0.245)	0.190(0.267)
FPINTER(employment)	-2.44(2.29)	-2.13 (1.66)	-1.41(2.66)	-0.954(1.79)
Constant	0.359(4.37)	0.65(3.24)	2.75(5.10)	3.22(3.51)
Industry Dummy	Yes	No	Yes	No
Year Dummy	Yes	Yes	Yes	Yes
Sample Size	315	315	280	280
Adjusted R ²	0.76	0.77	0.76	0.77
Hausman Test (Prob(>0))		0.813		0.939
Labour	0.170*(0.0919)	0.381*** (0.0498)	0.228** (0.109)	0.406*** (0.0543)
Capital	0.679*** (0.0625)	0.588*** (0.0405)	0.633*** (0.0725)	0.566*** (0.0435)
DPINTRA(capital)	0.371*(0.206)	0.219(0.168)	0.238(0.247)	0.147(0.188)
FPINTER(capital)	-3.02*(3.39)	-1.77(1.22)	-2.29(1.82)	-1.06(1.33)
Constant	-0.005(2.63)	1.73(2.10)	1.67*** (2.99)	3.20(2.28)
Industry Dummy	Yes	No	Yes	No
Year Dummy	Yes	Yes	Yes	Yes
Sample Size	315	315	280	280
Adjusted R ²	0.76	0.77	0.75	0.75
Hausman Test (Prob(>0))		0.0159		0.887
Labour	0.127(0.0921)	0.331*** (0.0508)	0.206* (0.107)	0.371*** (0.0555)
Capital	0.682*** (0.0619)	0.602*** (0.0406)	0.636*** (0.0710)	0.578*** (0.0438)
DPINTRA(Sales)	-0.890*** (0.296)	-0.362(0.234)	-1.05*** (0.347)	-0.298(0.247)
FPINTER(Sales)	12.33*** (3.31)	1.86(1.75)	15.53*** (3.66)	2.31(1.85)
Constant	21.39*** (4.49)	7.16*** (2.41)	25.89*** (4.92)	7.99*** (2.53)
Industry Dummy	Yes	No	Yes	No
Year Dummy	Yes	Yes	Yes	Yes
Sample Size	315	315	280	280
Adjusted R ²	0.75	0.74	0.76	0.75
Hausman Test (Prob(>0))		0.0532		0.0254

Note: Foreign Presence was measured by employment, capital and sales shares of FIEs respectively

[®] Random Effects Specification

^{®®} Both intra-industry domestic presence and inter-industry foreign presence were lagged for one year.

^{®®®} Both intra-industry domestic presence and inter-industry foreign presence were lagged for one year (random effects specification).

*, **, *** denote significance at the 10%, 5% and 1% levels respectively.

7. Potential Drawbacks

One of the important econometrics issues facing empirical studies in FDI spillover is the possibility of endogeneity. As mentioned earlier, FIEs may be attracted to high productivity industries without creating any spillovers. Most of the literatures used a lagged measure of foreign presence to tackle this problem (Table 21). There are two exceptions however. Ran et al (2007) used the real exchange rate of Chinese Yuan (RMB) against US dollars Instrumental Variable (IV) to tackle the endogeneity issue. Liu (2002) used “the annual growth rate of public streets and highways in the city of Shenzhen” to tackle the potential endogeneity problem. Both of them argued that the real exchange rate and public infrastructure IVs are highly correlated with their measures of foreign presence but not with the error terms in their regressions. However, as mentioned by Wang et al (2008), it was very difficult to find an effective set of instruments. Very few of them are truly exogenous. For instance, one of the possible instruments is the real exchange rate. However, as mentioned by Russ (2004), there are many conflicting empirical studies concerning the significance and even the sign of the real exchange rate variable. In this paper, we take the most common approach (a lagged measure of foreign presence) to tackle the potential endogeneity problem. However, our approach is far from perfect and therefore the results must be interpreted with caution.

Another possible drawback of our analysis is the use of industry level data. Aggregation bias was inherently present in industry-level panel data due to the loss of firm-specific characteristics. China has not published any comprehensive firm-level dataset since 1995 industry census. Most post-1995 firm-level datasets were created by private consulting firms which only cover a few industries and thus could not give us a clear picture of FDI spillover in the whole manufacturing sector. Last but not least, the use of Ordinary Least Square (OLS) relies on the facts that the variables being used are stationary. In case of instationarity, the use of OLS can produce spurious regressions. Unit root test could be used to test whether time series variables are non-stationary. However, due to the short time period covered (9 years), the power of standard unit root test would be very small.

Table 21: How did other studies tackle the potential endogeneity problem?

Author	How to Tackle Endogeneity Issue
Liu and Wei(2006)	A Lagged measure of Foreign Presence
Wang et al (2008)	A Lagged measure of Foreign Presence
Ran et al (2007)	A Lagged measure of Foreign Presence/Real Exchange Rate IV
Liu (2002)	A Lagged measure of Foreign Presence/Public Infrastructure IV
Atiken and Harrison (1999)	A Lagged measure of Foreign Presence
Lin and Cheung (2003)	A Lagged measure of Foreign Presence
Haskel et al(2007)	A Lagged measure of Foreign Presence
Djankov and Hoekman (2000)	A Lagged measure of Foreign Presence
Javorcik (2004)	A Lagged measure of Foreign Presence

Note: IV=Instrumental Variable.

8. Policy Implications and Conclusion

If we look back over the 30 year history of economic reform in China, we will find that the government has regarded FDI as a tool to be used to achieve different economic development objectives in different reform stages. At the initial stage of reform, export-oriented FIEs and FIEs using advanced technologies were given priority. Labour-intensive export-oriented FDI has played a major role in Chinese economy since the late 1980s. A large amount of public funds were used to attract those FIEs, by offering tax incentives, providing other forms of subsidies, giving privileged access to natural resources and the provision of interest-free loans from state-owned financial institutions. Since China has a comparative advantage in labour-intensive activities due to its abundant labour supply, export-oriented FDI helps China alleviate unemployment pressure and also generated revenues which have built up foreign reserves (Chen, 2007). On the other hand, FIEs with advanced technology were also preferred due to the belief that such FDI could benefit domestic firms the most in terms of spillover effects.

Since World Trade Organization (WTO) accession in 2001, there has been a sharp rise in both export-oriented and import-substituting FDI. After a two-digit FDI growth for six years in a row following WTO accession, the challenge the government faces is no longer one of simply attracting FDI, but rather meeting the needs of a rapidly developing economy (OECD Investment Policy Review: China 2008). Recently, China has adopted a more selective approach towards FDI. Environmentally damaging FDI is now being restricted or even prohibited. On the other hand, the Chinese government has already accumulated a huge amount of foreign reserve after several years of huge trade surplus and now regards export-oriented FDI as a low priority which would not benefit the country in the long run. As a result, the export performance requirement for FIEs was removed in almost all sectors due to the low priority now given by the government in promoting exports (OECD Investment Policy Review: China 2008). Nevertheless, import-subsidizing FDI in most industries is still encouraged by the government due to the high and rapidly increasing domestic demand. Hi-tech industries are also encouraged due to the belief that domestic firms could benefit from cutting edge technologies embodied within the capital of those FIEs.

Thus, do our econometric results support current policy? Firstly, our results show that domestic firms indeed benefit from the presence of FIEs both in the same industry and in other industries. Domestic firms seem to benefit more from inter-industry spillover. FIEs in the same industries may exert a huge amount of effort to prevent or minimize any potential intra-industry spillover. Secondly, domestic firms who are more technologically lagged seem to benefit less from the presence of foreign firms in the same industry; but more from the presence of foreign firms in other industries. On the other hand, domestic firms who are less technological lagged seem to benefit more from the presence of foreign firms in the same industry while benefiting less from the presence of foreign firms in other industries. Thus, the policy of encouraging FDI with advanced technology seems debatable. Domestic firms in the same industry could benefit more from FIEs with a similar technology level due to the potential effect of increasing competition. Thirdly, comparing domestic firms in export-oriented industries to those in import-substituting industries, the latter seem to benefit more from the presence of intra-industry FIEs and less from the presence of inter-industry FIEs. Thus, our results suggest that both forms of FDI should be equally treated.

Finally, there seems to be little evidence of reverse spillover to FIEs in China which means that the government does not need to worry about any potential “technology sourcing” FDI at this stage. However, the Chinese government should encourage more domestic firms to invest in developed countries for any potential reverse spillovers.

In conclusion, if China’s economic miracle since 1978 is a story of industrialization, then the core of that industrialization is domestic ownership reform and FDI. The first “small” part of this paper reviews the whole process of domestic ownership reform since 1978. We reveal that the reason why public ownerships dominated the initial stage of reform is due to the slow “legitimacy building” process of private ownerships. The second “large” part of the paper uses the most updated industry-level data to search for any potential FDI spillover in the manufacturing sector. Our results indicate that: (1) domestic firms indeed benefit from the presence of FIEs both in the same industry and in other industries. Domestic firms seem to benefit more from inter-industry spillover; (2) domestic firms who are more technologically lagged seem to benefit less from the presence of FIEs in the same industry; but more from the presence of FIEs in other industries. On the other hand, domestic firms who are less technological lagged seem to benefit more from the presence of FIEs in the same industry while benefiting less from the presence of FIEs in other industries; (3) comparing domestic firms in export-oriented industries to those in import-substituting industries, the latter seem to benefit more from the presence of intra-industry FIEs but less from the presence of inter-industry FIEs; (4) there seems to be little evidence of reverse spillover to FIEs in China which means that the government does not need to worry about any potential “technology sourcing” FDI at this stage.

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