FOREIGN DIRECT INVESTMENT AND MANUFACTURING PRODUCTIVITY IN CHINA

Yu Chen[1] and **Sylvie Démurger**[2]

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[Preliminary results – comments welcome]

Abstract: This paper provides empirical evidence on the links between foreign direct investment and manufacturing productivity in China's provinces. Using a sample of 23 manufacturing industries in 29 Chinese provinces during 1988-94, it provides estimates of total factor productivity (TFP) by manufacturing industry and relates them to FDI inflows. Our results show no significant differences in TFP growth between manufacturing industries dominated by foreign investment and manufacturing industries dominated by domestic investment. This finding, while non-usual, might be partly explained by the short and unstable time period under study. However, comparisons of TFP dispersion among Chinese provinces show a substantial difference between the two groups of manufacturing industries, indicating that the inflow of FDI might have induced greater regional disparities for those opened sectors. It confirms usual findings on the driving role of FDI in regional growth divergence.

[1] CERDI – Université d'Auvergne. E-mail: Yu.Chen@u-clermont1.fr.

[2] CERDI – CNRS. E-mail: S.Demurger@u-clermont1.fr.

INTRODUCTION

Since China adopted its opening-up policy in 1979, the inflows of foreign direct investment (FDI) have progressively taken momentum and reached outstandingly large amounts in the nineties. The reasons for these huge foreign capital inflows and their impact on the Chinese economy have given rise to an important body of literature. A number of empirical studies have investigated the determinants of these FDI inflows and the different strategies of foreign investors, as well as the impact of FDI on economic growth and on the foreign trade expansion in China. It is usually recognised that FDI can increase the productivity of all inputs in the production process by bringing new technologies and know-how that can spill over the rest of the economy. On the opposite, it is also acknowledged that FDI can have an adverse impact on growth if it crowds out domestic investment. Therefore, from a policy point of view, it might be that not only the total amount of investment matters, but also the way it is distributed between domestic and foreign capital.

Up till recently, however, relatively few studies have provided detailed analyses of the effect of FDI on the structure and efficiency of China's industries. This gap in the literature is primarily due to the absence of relevant data to directly test for the impact of FDI on the performances of China's industries. The only data available at industry-level by ownership (including foreign-invested firms) come from the third industrial census conducted in 1995, but the low level of desegregation provided in the data does not allow to give any detailed analysis by ownership. Using the available data for 23 Chinese industries over the period from 1988 to 1994, this paper is intended to indirectly assess the relationship between foreign direct investment inflows and the performance of China's manufacturing industries, by emphasising the relative performance of those manufacturing industries where FDI have mainly been directed during the reform period.

The first section provides a brief review of China's industrial development in the pre-reform and reform periods, the characteristics of FDI inflows in China and their distribution in different Chinese industries. The second section presents the main findings put forward by recent research work assessing FDI impact on China's industry. The last section proposes a quantitative assessment of China's industrial performance, based on a sample of 23 manufacturing industries in 29 Chinese provinces during 1988-94.

I. CHINA'S INDUSTRIAL STRUCTURE AND FOREIGN DIRECT INVESTMENT

1.1. China's industrial development

According to World Bank estimates, China's economy is adding more industrial production each year than any other economy in the world, including the United States (World Bank, 1997). China's industry grew at an average annual rate of 15% from 1980 to 1999 and more than tripled its employment figures. Up from about 50 million workers in 1978, the secondary industry[3] employs 162 million persons in 1999, nearly equal to the combined industrial work force of the 28 OECD economies (Jefferson and Singh, 1999).

China's industrial policy

1. Priority for heavy industry in the pre-reform period and its impact

In the 1950s, similar to a number of other developing countries, China adopted a strategy based on the rapid development of heavy industry. On one hand, on analysing the development history and the structure of advanced economies, China's leaders saw the important weight of heavy industry in these economies and believed that their development phase could be reduced to the rapid development of heavy industry (Lin *et al.*, 1996). On the other, and perhaps more urgently, the strategy of developing heavy industry was the result of the political and military constraints perceived at that time by the Chinese leadership. The Korean War and Vietnam War that broke out in the 1950s and 1960s, the uneasy relationships with the United States and the Soviet Union as well as with the Kuomintang in Taiwan made the Chinese leaders anxious to quickly build up a rather comprehensive and self-reliant industrial and military structure, whose core was heavy industry (Naughton, 1988).

However, the strategy of developing heavy industry, which is intensive in capital and technology, was in conflict with China's economic reality at that time, with the scarce capital and abundant labour endowments, and with agriculture accounting for 70% of total GDP and industry for less than 30% (within which heavy industry represented less than 10%; Lin *et al.*, 1996). Market mechanisms would not have worked for the choice of this strategy, so central planning played a crucial role in the process of heavy industrialisation in China. The State adopted important policy measures in favour of heavy industry, including: (1) low interest rate policy so as to bring down the cost of capital utilisation; (2) low exchange rate (overvaluation of domestic currency) policy to allow for a substantial amount of imported capital-intensive equipment necessary for the development of heavy industry; (3) low wages and low prices for raw materials, agricultural products, living necessities and services, so as to reduce costs for the heavy industry. Compatible with, or necessary for the functioning of, such distorted price systems, resource allocation was also highly centralised, and the State monopolised the financial and trade sectors. Down to the domain of microeconomic management, industrial enterprises became overwhelmingly state-owned.

The development of heavy industry was at its peak during the Third Front period, between 1964 and 1971 (Naughton, 1988). Geographically, many heavy industrial enterprises were allocated in the interior and north-western provinces, including Shaanxi, Sichuan, Guizhou, Qinghai, Gansu and Ningxia, under the consideration that in case of war, these regions were hard for foreigners to reach.

Important consequences resulted from the above-described policy measures favouring heavy industry, which are still felt in today's Chinese economy. Heavy industry did grow faster than

[3] The secondary industry includes mining and quarrying, manufacturing, electricity, gas and water supply as well as construction.

light industry, with an average annual growth rate of the former being 1.47 times that of the latter for the whole period of 1953-79 (Lin *et al.*, 1996), but the economy was left with: (1) a highly unbalanced industrial structure inconsistent with the comparative advantage of the Chinese economy, and (2) lack of incentives and thus low economic efficiency. Capital construction investment in heavy industry was 5.6 times that in light industry in the first Five-Year plan period (1953-57) and this figure reached a maximum of 11.7 during the Third front period (1963-65 and 1966-70 period average, Table 1). Within the manufacturing industry, the share of coarse processing was very large and that of refined processing very small (Lin *et al.*, 1996). As State planned for investment, production, product prices and wages, enterprises faced no competition, managers and workers lacked incentives to improve their productivity, and industrial efficiency was generally low. In addition, the dispersed allocation of many heavy industrial enterprises in the remote, interior and mountainous regions prevented the economies of scale and spill-over effects of these enterprises (Naughton, 1988).

Table 1 – Structure of capital construction investment in China before 1978 (%)

	Agriculture	**Light industry**	**Heavy industry**	**Other sectors**
1953-57	2.7	6.3	35.2	55.9
1958-62	4.4	6.1	53.8	35.7
1963-65	8.1	3.9	46.0	42.1
1966-70	3.7	4.4	51.1	40.8
1971-74	4.3	5.9	49.2	40.6
1975-78	3.3	5.9	50.0	40.8

Notes: "Other sectors" include construction, distribution and services.

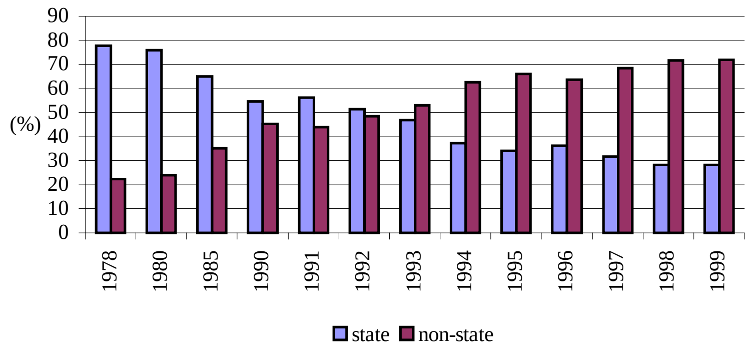
Source: *China Statistical Yearbook on Investment in Fixed Assets* (1950-95).

2. Industrial development in the reform period

China began important economic reforms in 1979. Market mechanisms were gradually introduced, and the tight control of the central government in many economic domains was gradually reduced, reflected by policy measures such as: (1) changing from financial suppression to financial deepening; (2) changing from exchange rate control to a system of multiple exchange rates and then to a system of single, flexible exchange rate; (3) liberalisation of the price and wages systems. Incentives, competition and vitality are found increasing in the economy. Industrial development priorities shifted to the coastal areas, and the development of light industry.

A variety of industrial enterprise types gradually emerged, including township and village enterprises (TVEs), foreign-funded enterprises, individual and private enterprises, while the dominance of state-owned enterprises diminished (Figure 1). In 1998 and 1999, the share of the non-state sector in total industrial output exceeded 70%.

Figure 1 – Gross industrial output, by ownership



Source: China Statistical Yearbook 1999, 2000.

An important element in the development of China's industry since the 1980s is the rapid growth of the TVEs in rural areas. They created 107 million new jobs during the 1978-96 period (Park, 2001), which resulted in a dramatic increase of their share in rural employment: up from 9% in 1978, employment in TVEs accounted for more than a quarter of total rural employment in 1999 (and 18% of total employment). In terms of national GDP, TVEs accounted for 31% of total industrial output in 1999 (up from 13% in 1990).

Another important element in the development of China's industry since the 1980s is the increasing participation of foreign capital. With practically no presence in 1978, foreign-funded enterprises (FIEs) accounted for about 16% of total industrial output in 1999 (NBS, 2000). There are mainly three kinds of FIEs, co-managed (co-operated and co-developed), co-funded and solely foreign-funded enterprises. During the 1979-84 period, the Chinese economy just began to open up to foreign investors. As co-management was a more flexible and less risky type than co-funding and solely foreign funding, co-managed enterprises developed the fastest. Foreign investors provided capital and the Chinese part provided factory, existing equipment and labour. Co-managed enterprises developed mainly in the tertiary sector. During the period of 1985-89, co-funded enterprises developed the fastest, especially after 1986, when the government promulgated more preferential measures to encourage foreign investment, placing emphasis on production-related projects. In the 1990s, with foreign investors' increased knowledge about China's market and systems, improvement in China's investment environment and more encouraging government policies, solely foreign-funded enterprises developed rapidly, especially after Deng Xiaoping South Tour in 1992 (Table 2).

Table 2 – Actual utilisation of FDI by type of FIEs (%)

Year	Co-operated	Co-developed	Co-funded	Solely foreign-funded
1979-83	28.3	29.4	6.4	3.1
1984	32.8	36.9	18	1.1
1986	35.4	11.6	35.8	0.7
1988	20.9	5.7	52.8	6
1990	17.9	6.5	50.2	18.2
1992	18.8	2.2	54.2	22.3
1994	21	2	52.8	23.7
1996	19.2	0.6	49.3	29.9
1998	20.4	0.4	38.6	34.6

Source: *China Economic Yearbook* 1999, page 947.

Industrial structure in China's provinces in the reform period

The industrial policies implemented during the last 50 years have had a substantial impact on the industrial structure of China's provinces and resulted in huge differences in per capita GDP level across Chinese provinces (Table 3). As a general rule, the richest provinces during the 1985-98 period tend to be those with a more developed industrial structure. Apart from the municipalities of Beijing, Tianjin and Shanghai (whose city-status is particular), the coastal provinces of Jiangsu, Shandong, Guangdong, Liaoning, and Zhejiang generate 39% of the national industrial GDP and 35% of the value-added for Chinese manufacturing as a whole. While Liaoning was one of the biggest heavy industry investment recipient during the pre-reform period, the other 4 coastal provinces industrial development mainly took place during the reform period and is characterised by a greater diversification, as reflected in the share of consumer goods, intermediate goods and equipment goods in the manufacturing value-added of these provinces.

On the opposite, those provinces where many heavy industrial enterprises were located during the Third Front period, such as Qinghai, Gansu, and Ningxia, intermediate goods still account for a huge part of total manufacturing value-added (around 70%), while consumer goods production is hardly developed (around 15% of manufacturing value-added, which is two times lower than the national average).

Table 3 – Industrial structure of Chinese provinces

		1985-98 average			Share in provincial manufacturing value-added (1995)		
		Per capita GDP (1)	**Ind. GDP/ GDP** (2)	**Prov. Ind. GDP/ Nat. Ind. GDP** (3)	**Consumer goods** (4)	**Intermediate goods** (5)	**Equipment goods** (6)
9	Shanghai	14 509	51.1	6.3	21	41	37
1	Beijing	9 150	37.6	2.6	18	49	33
2	Tianjin	8 066	50.0	2.4	19	35	46
19	Guangdong	5 828	33.5	8.0	35	32	33
11	Zhejiang	5 684	39.0	6.0	38	33	29
6	Liaoning	5 500	44.4	6.6	13	57	30
10	Jiangsu	5 255	43.5	10.0	31	37	32
13	Fujian	4 809	28.2	2.6	49	32	19
8	Heilongjiang	4 538	47.4	5.4	30	48	22
15	Shandong	4 162	36.4	8.2	35	43	22
30	Xinjiang	3 870	26.2	1.1	46	47	7
21	Hainan	3 667	11.4	0.2	40	35	25
7	Jilin	3 532	34.1	2.0	19	43	38
3	Hebei	3 353	37.2	5.0	27	55	18
17	Hubei	3 230	35.1	4.1	31	45	24
5	I. Mongolia	3 001	29.5	1.3	31	61	8
28	Qinghai	2 985	28.6	0.3	16	72	11
4	Shanxi	2 885	41.6	2.4	16	67	17
29	Ningxia	2 822	33.9	0.3	13	69	18
18	Hunan	2 772	27.9	3.2	34	44	22
12	Anhui	2 580	33.6	3.2	41	40	19
16	Henan	2 542	35.4	5.2	56	28	15
22	Sichuan	2 489	22.3	4.3	27	43	30
20	Guangxi	2 447	25.0	1.7	37	39	24
24	Yunnan	2 380	35.7	2.2	74	20	6
14	Jiangxi	2 347	25.6	1.5	31	42	27
26	Shaanxi	2 344	29.9	1.6	24	28	48
27	Gansu	1 842	40.6	1.2	17	73	10
23	Guizhou	1 521	29.8	1.0	38	45	18
	National average	*4 142*	*34.3*		*32.5*	*40.6*	*26.8*

Notes: GDP (both total and industrial) is given at 1995 constant prices (columns (1) to (3)). Moreover, to account for any change in the component structure, total GDP is calculated as the sum of GDP main components (i. e. primary, secondary and tertiary industries), expressed at 1995 constant prices (using differentiated indexes). In columns (2) and (3), industrial GDP includes mining and quarrying, manufacturing, and electricity, gas and water supply. “Consumer goods” include sectors 1 to 12, “intermediate goods” include sectors 13 to 22 and “equipment goods” include sectors 23 to 28. See Appendix 1.
Provinces are ranked according to their per capita GDP average level from 1985 to 1998.

Sources: NBS (1999) and *Third National Industrial Census of the PRC in 1995* (sector volume).

1.2. FDI inflows in China

FDI inflows in China in its reform era has been the subject of numerous studies[4]. Several distinctive features of these inflows are worth mentioning.

Rapid growth

In the past decade China has experienced an FDI boom unknown to any other developing country in the world. With practically no FDI inflows at the beginning of the reform period in the late 1970s, China has today become the largest FDI recipient second only to the United States and by far the largest FDI recipient among developing countries (Table 4).

Table 4 - FDI inflows (Millions of US $ / %)

	1986-91	*1992*	*1993*	*1994*	*1995*	*1996*	*1997*	*1998*	*1999*
World total	159 331	175 841	217 559	255 988	331 844	377 516	473 052	680 082	865 487
Developing countries	29 090	51 108	72 528	104 920	111 884	145 030	178 789	179 481	207 619
*China**	3 105	11 156	27 515	33 787	35 849	40 180	44 236	43 751	40 400
China in total*	1.9%	6.3%	12.6%	13.2%	10.8%	10.6%	9.4%	6.4%	4.7%
China in developing countries*	10.7%	21.8%	37.9%	32.2%	32.0%	27.7%	24.7%	24.4%	19.5%

*: not including Hong Kong.
Source: United Nations World Investment Report, 1998, 2000.

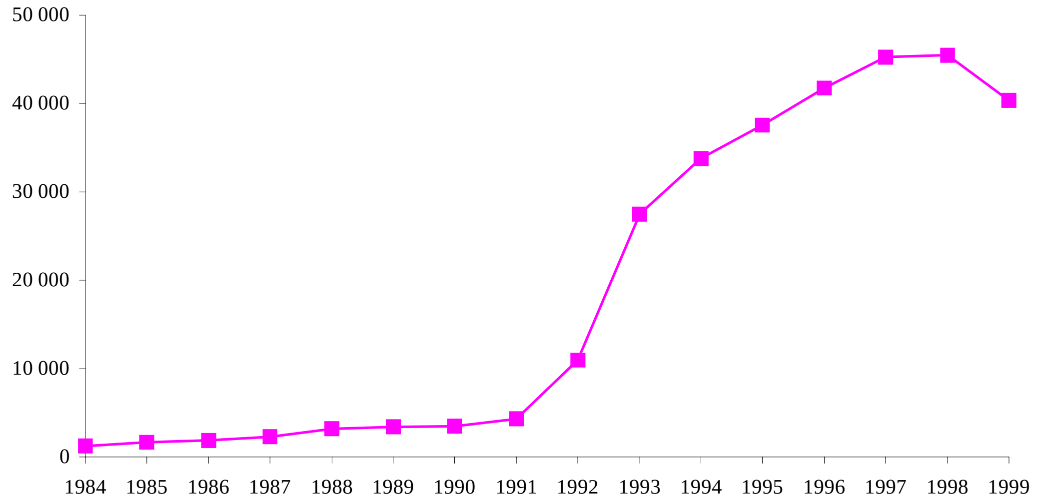
Such rapid growth of FDI inflows in China is mainly attributable to the following factors: (1) China's rapid economic growth in the reform period; (2) the abundance of labour and its low costs; (3) the immense size and the rapid expansion of China's domestic market; (4) the role of the overseas Chinese investors from Hong Kong, Taiwan and Macao; (5) China's increasing integration with the world economy and its willingness and efforts to attract FDI as embodied in its preferential policies offered to foreign investors.

As shown in Figure 2, FDI inflows in China grew steadily in the 1980s, then experienced the most spectacular increase in 1991-1993, with an annual increase rate of 150%, followed by still very high growth rates until 1997. The surge of FDI inflows in 1992-93 was mostly driven by Deng Xiaoping encouraging speech in Spring 1992 calling for further economic liberalisation

[4] For a recent and documented survey, see Lemoine (2000).

and opening-up, and the following round of new measures issued by the government to further attract FDI.

Figure 2 - FDI inflows in China (million US$, 1984-99)



Source: China Statistical Yearbook 2000.

FDI inflows slowed down from 1997 to 1999,which may be caused by the following factors:

(1) A slowdown of China's economic growth, as FDI tends to be positively related to GDP growth (Lemoine, 2000).

(2) An excessive capacity in a number of industries such as some consumer electrical and electronic products, textile and clothing, and other light industrial products, which would have resulted from the massive -foreign and domestic- investment of the recent past (United Nations, 1998), while the capacity of these industries to absorb FDI is limited.

(3) Wage increases, especially in coastal provinces, are eroding incentives to foreign investors.

(4) Reduced investment by Asian neighbours whose economies have been severely affected by the Asian financial crisis in 1997; at the same time, the international competitiveness of some of China's exports was reduced as these countries have devaluated their currencies.

On the other hand, FDI cannot be expected to grow at extremely high rates forever. The recent slowdown of FDI inflows in China may be indicating that FDI is heading for a more normal growth pattern in the Chinese economy.

Concentration of source regions

The lion share of total FDI inflows in China comes from Hong Kong, Macao and Taiwan, accounting for over 60% of total FDI inflows in the periods of 1986-88 and 1992-94 (Table 5). The Asian financial crisis in 1997 has not affected China directly, but the deterioration of the economic situation in the South-East Asian countries has resulted in the decline of their investment capacity, so that FDI from this region to China slowed down from 1997 to 1999.

Table 5 - Source regions of FDI inflows in China (%)

Source region	*1983-85*	*1986-88*	*1989-91*	*1992-94*	*1997*	*1999*
Hong Kong &Macao	50.7	64.5	58.4	63.4	46.4	41.3
Taiwan				10.4	7.3	6.4
Japan	16.9	13.1	12.6	5.8	9.6	7.4
U.S.	16.2	9.8	8.9	7.0	7.2	10.5
Europe	9.5	5.2	5.3	3.4	9.8	11.9
Others	6.7	7.5	14.8	10.1	19.8	22.5

Source: China Foreign Economic Yearbook.

Regional disparity of FDI inflows

Another remarkable characteristic of FDI inflows in China is their very uneven regional distribution. About 90% of total FDI were concentrated in the coastal areas (Table 6), especially in South China (Guangdong, Fujian, Jiangsu).

Table 6 - Regional distribution of FDI in China (%)

	1983-85	*1989-91*	*1992-94*	*1999*
Total	100	100	100	100
Coastal	**92.58**	**92.05**	**88.19**	**87.8**
Guangdong	61.14	42.91	28.93	29.2
Fujian	6.67	10.08	11.19	10.1
Jiangsu	2.25	4.25	11.27	15.2
Shanghai	5.82	6.56	8.56	7.1

Source: China Foreign Economic Yearbook.

Such outstanding regional disparity of FDI inflows is largely attributable to both the geographical advantage of the coastal provinces and preferential policies implemented in favour of these areas, though in general the low level of labour costs and the potential of the Chinese market also motivate the inflows of FDI in China. In the early 1980s, four Special Economic Zones (SEZs) were established in two coastal provinces, Guangdong and Fujian, neighbours of Hong Kong, Macao, and Taiwan, to attract the overseas Chinese investors. In 1984, fourteen cities were opened up in the coastal region. SEZs and open cities benefit from preferential policies such as exoneration or reduction of import duties on the equipment and materials imported by foreign firms or joint-ventures located in these zones or cities.

More recently, the gap in terms of FDI inflows between the coastal and interior regions shows some diminishing tendency as the Chinese government encourages FDI to flow into the interior regions and as the labour costs in the coastal regions have gradually grown.

Concentration of FDI in industry and its distribution among manufacturing industries

As shown in Table 7, the FDI inflows in industry accounted for about 70% of total FDI inflows in China in 1999. Within the industry sector, FDI is by far concentrated on manufacturing industries.

Table 7 - FDI in China's sectors in 1999

		Amount (USD)	Share (%)
Agriculture		**71 015**	**1.8**
Industry		**2 777 980**	**68.9**
	Mining	55 714	1.4
	Manufacturing	2 260 334	56.1
	Electric power, Gas and Water	370 274	9.2
	Construction	91 658	2.3
Service		**1 086 365**	**26.9**
	Transport, Post and Telecommunication	155 114	3.8
	Wholesale and retail	96 513	2.4
	Real estate	558 831	13.9
	Social service	255 066	6.3
	Health, sports, education, culture	20 841	0.5
Other sectors		**96 511**	**2.4**
Total		**4 031 871**	**100**

Sources: China Statistical Yearbook 2000.

Table 8 – Foreign-invested enterprises and industrial value-added

Manufacturing industries	Share in value added			Relative representation of FIEs in each sector
	FIEs	SOEs	TOEs	
27 Electronic and Telecommunications Equipment	65.0	27.2	7.8	3.44
6 Garments and Other Fibre Products	53.1	6.7	40.3	2.81
7 Leather, Furs, Down and Related Products	51.7	7.7	40.6	2.74
12 Cultural, Educational and Sports Goods	48.6	14.5	36.9	2.57
28 Instruments, Meters, Cultural and Office Machinery	43.5	42.5	14.0	2.30
18 Plastic Products	40.4	13.7	45.9	2.13
9 Furniture Manufacturing	36.1	10.4	53.5	1.91
2 Food Manufacturing	34.8	38.0	27.3	1.84
26 Electric Equipment and Machinery	32.9	32.5	34.6	1.74
15 Medical and Pharmaceutical Products	30.6	55.6	13.8	1.62
22 Metal Products	30.5	20.0	49.5	1.61
8 Timber Processing, Bamboo, Cane, Palm Fibre and Straw Products	28.1	21.0	51.0	1.48
17 Rubber Products	27.7	46.5	25.8	1.46
25 Transport Equipment Manufacturing	26.8	59.4	13.8	1.41
3 Beverage Manufacturing	23.4	63.9	12.8	1.24
5 Textile Industry	22.9	41.0	36.1	1.21
1 Food Processing	22.1	49.6	28.3	1.17
11 Printing and Record Medium Reproduction	21.5	59.5	19.0	1.14
10 Papermaking and Paper Products	19.2	45.8	35.0	1.01
16 Chemical Fibre	19.1	55.0	25.9	1.01
23 Ordinary Machinery Manufacturing	18.1	51.2	30.7	0.96
14 Raw Chemical Materials and Chemical Products	15.7	64.8	19.6	0.83
19 Non-metal Mineral Products	13.4	40.1	46.5	0.71
24 Special Purpose Equipment Manufacturing	12.2	60.4	27.4	0.65
21 Smelting and Pressing of Non-ferrous Metals	10.8	68.2	21.0	0.57
20 Smelting and Pressing of Ferrous Metals	5.2	84.3	10.6	0.27
13 Petroleum Processing and Coking	0.8	95.4	3.8	0.04
4 Tobacco Processing	0.6	99.4	0.1	0.03

Notes: FIEs = Foreign-invested enterprises; TOEs = township-owned enterprises; SOEs = State-owned enterprises. “Relative representation of FIEs” in sector *s* is measured as the ratio of the share of sector *s* in FIEs total value-added over the average share of sector *s* in total value-added.

Sources: *Third National Industrial Census of the PRC in 1995* (ownership volume).

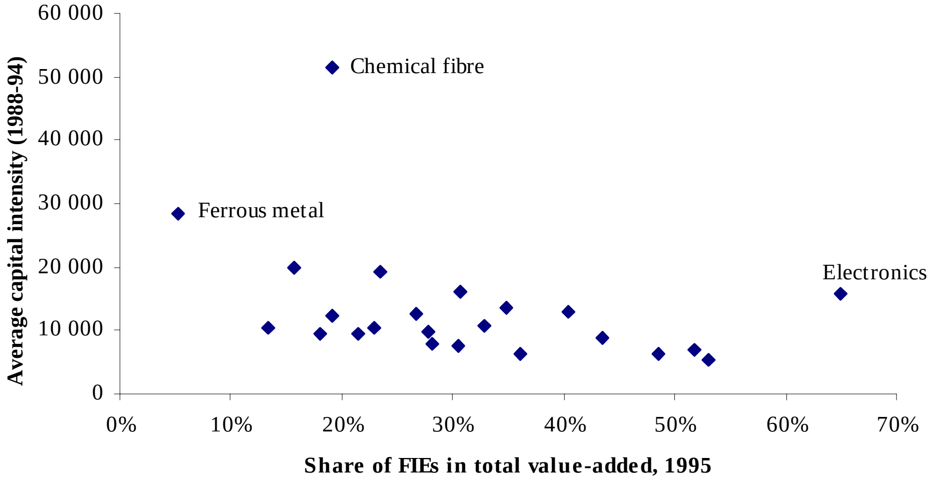
The distribution of FDI among Chinese manufacturing industries can be seen using the Third national industrial census data (Table 8). Among manufacturing industries, FDI is mainly concentrated in labour-intensive and consumer goods activities[5], such as garment and leather products, or sports goods (FIEs account for around half of the value-added in these industries), but also in a few technology-intensive industries such as electronic and telecommunication

[5] This particular distribution of foreign direct investment has been extensively pointed out and discussed in relation to its expected transfer technology effects [see, among others, Sun (1998), Fan (1999)].

equipment (sector 27) and instruments and other office machinery (sector 28). On the opposite, more capital-intensive activities such as metal smelting or chemical industries received less investment from abroad, with a relative share of FIEs in value-added less than 20% in 1995.

The foreign "preference" towards labour-intensive activities is illustrated in Figure 3 that compares the share of FIEs in total value-added in 1995 and the average capital intensity of each manufacturing industry from 1988 to 1994. As can be seen from this figure, foreign-invested firms tend to be more represented in industries with a lower capital intensity.

Figure 3 - Share of foreign-invested firms and capital intensity, by industry



Note: "Capital intensity" is measured as the ratio of net fixed assets over the number of staff and workers.
Sources: China Industrial Yearbook (1989 and 1995) and Third National Industrial Census of the PRC in 1995 (ownership volume).

II. FOREIGN DIRECT INVESTMENT IN INDUSTRY: A SURVEY OF LITTERATURE

The importance of FDI in the economic performance of China since the implementation of its open-door policy has been extensively discussed in the economic empirical literature. Analyses may be divided in two main categories: those looking at the determinants of FDI (and its location) in China and those looking at the impact of FDI on the domestic economy. Within the first group[6], main determinants of FDI inflows in China are found to have been the relative size of the (local) economy (measured by GDP, GDP per capita or GDP growth), labour costs (wages differential corrected by productivity levels), the education level, infrastructure availability and preferential policies implemented in coastal areas. The second group includes an increasing amount of empirical papers studying at various levels of aggregation, how FDI influenced China's economic transition and growth process. Our main focus being on the particular impact of FDI on the industrial structure, the following survey concentrates on the literature investigating the role of FDI in the Chinese industrial development process[7]. Within this literature, two different approaches can be distinguished. One aims at measuring the contribution of FDI to industrial output growth and productivity. The other assesses the performance of FIEs in comparison with domestic firms, in order to appreciate their potential impact on industrial structure and efficiency. Both approaches put forwards the positive effect of FDI on China's industry. They find a positive correlation between FDI and industrial growth and efficiency and highlight the superior performance of FIEs compared to domestic ones.

FDI impact on industrial growth

In a first set of studies, the relation between FDI and industrial growth is analysed at a city (Démurger 1995 and 1996a, Wei 1994 and 1996) or a provincial level (Démurger 1996b and 2000, Mody and Wang 1997). Wei's studies are based on cross-section data for a sample of 484 Chinese towns and cities over the 1988-90 period. During this period of a relatively slow growth, these cities registered a high rate of industrial growth. The share of foreign-invested firms in the cities' industry was still tiny (4%) but varied widely across the cities. Wei (1994) shows that between 1988 and 1990 the level of FDI contributed more to differences in nominal industrial output than did exports. He specifically notes that such investment results in a spill-over of technological and managerial know-how between firms in the same city. Moreover, Wei (1996) finds that a 1 percent increase in the share of FIEs in output in 1988 has been associated with a 0.32 percent higher growth rate in output between 1988 and 1990 and that about 20% of the difference between the cities' output growth could be explained by the difference in the share of FIEs in output.

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[6] Recent studies on the determinants of FDI in China include Broadman and Sun (1997), Chen (1996), Coughlin and Segev (2000), Démurger (2000), Wang and Swain (1995), Yang (1999), and Zhang (1995).

[7] This means that we will not cover the voluminous literature stressing the role of FDI on the aggregate economy and we will limit the review to very recent papers only.

Using the same source as Wei throughout the 1988-93 period, Démurger (1996a) confirms, within an augmented production function framework, the predominant short-term impact of FDI in annual average growth rates of real industrial output. Moreover, the paper not only points out the overall predominance of FDI but also indicates that in the short run, the contribution of FDI to industrial growth tends to dominate, and even replace, that of exports. It thus tests whether the influence of export growth on industrial growth depends upon the relative size of foreign investment. Results indicate that the marginal effect of export growth on industrial growth is reduced where FDI is relatively high and thus suggest that FDI could have been a substitute to exports as a growth factor, at least at the end of the 80s.

At a provincial level, Démurger (1996b) investigates the relation between industrial growth and opening-up for 19 provinces over the 1983-92 period. The results show that *i)* both FDI and exports have a positive contribution to industrial productivity and that, at least in the short term, FDI has a higher contribution than exports and that *ii)* FDI has a positive effect on the domestic accumulation of capital. It indeed explains almost half of the variations in total investment and does not appear as a substitute for domestic capital, but rather as a stimulus. The hypothesis of a crowding-out effect on domestic investment can thus be rejected for the studied period. Furthermore, Démurger (2000)[8] gives an explanation of the economic growth of Chinese provinces up to the mid-90s based on the dynamics between FDI and growth, as well as on a dynamics due to the geographical propagation of growth itself. The evaluation of the interdependence of growth between Chinese provinces and, within provinces, between cities gives an additional explanation for the Chinese growth process since inter-provincial propagation of growth reinforces the dynamism of coastal provinces, but also contributes to the overall growth process.

Finally, using sector data, Mody and Wang (1997) also show that FDI – as a percentage of population – has a significant impact in the short-term on industrial output growth[9]. However, they also observe that the effect of FDI tends to decrease in a longer term. Their interpretation of this result is that in the short-term, FDI is the most mobile factor and is therefore a dominant driving force for growth. On the other hand, over the longer term, variables such as education and infrastructure respond to the rise in demand for complementary assets and the contribution of FDI diminishes. Finally, they underline the fact that the effectiveness of education is enhanced when it is associated with the foreign expertise that accompanies investment.

Foreign-funded firms efficiency

Another part of the empirical literature on the role of FDI in Chinese industry focuses on the relative efficiency of foreign-funded firms and their impact on domestic firms. Within this literature, the research work carried out by Sun (1998) provides an extensive assessment of FDI impact on China's economy, and more precisely on industry. Sun (1998, chapter 5) notably highlights the differences between the characteristics and performances of FIEs and those of domestic firms, especially SOEs. FIEs have a higher capital intensity than domestic firms do in

[8] See also Démurger (1996b).

[9] Their sample comprises 23 industrial sectors in seven coastal provinces over the period from 1985 to 1989.

all sectors, indicating a higher technology content of the production process. Moreover, the investigation of productive efficiency in different categories of firms, carried out on the basis of the 1995 Census data, shows that the average productivity of both labour and capital in FIEs is respectively 2.8 and 2.2 times higher than that of State-owned enterprises. It also shows that the elasticity of output with regard to labour and capital is greater in FIEs than in SOEs, thus suggesting a better technical and management efficiency.

In a similar perspective, Fan (1999, chapter 5) gives estimations of total factor productivity (TFP) growth by ownership categories (state-owned, collective and foreign-funded enterprises). Using industrial level data on 28 manufacturing industries for 20 provinces throughout the 1993-95 period, she particularly shows that the "foreign category" experienced the highest TFP growth[10] (with an average of 4.9 % per year), the gap between domestic and FDI firms being higher in capital intensive industries. Furthermore, investigating the issue of technological spill-over from foreign to domestic firms, Fan (1999, chapter 7) shows that positive and significant spill-over appears only in industries "which are mainly labour-intensive and have a low to moderate technology gap between Chinese and foreign firms" (p. 169).

In a comparative perspective too, Zhang and Zheng (1998) carry out an investigation centred on the impact of multinational enterprises (MNEs) on industrial structure and efficiency. They note that since 1992 the pattern of FDI inflows has undergone significant changes, due to the fact that MNEs have massively entered the Chinese market and initiated a structural adjustment in the form of a reallocation of resources from labour intensive to more capital intensive sectors. They compare the performance of a selected sample of MNEs' affiliates in China with that of all enterprises and other FIEs on the basis of the 1995 census. MNEs' affiliates are found to be more profitable (profit/sales) and less export-oriented than other FIEs. Compared to all industrial firms and to all FIEs, their production is more concentrated in the sectors with the highest degree of capital intensity (assets per capita). Their distribution across sectors shows that they are relatively specialised in transport equipment, electric and electronic goods. Estimating the statistical relation between several structural variables, and the sector distribution of MNEs and large and medium-sized domestic enterprises, the study finds a positive correlation between the share of MNEs in sales and labour productivity, profitability, average wage, the level of education of employees, R&D expenditures, concentration ratio and size effects. Although these relations do not give any information about the direction of causation, they suggest that marginal changes in MNEs sales share will be associated with an increase in the related variables.

The in-depth analysis of the determinants of technical efficiency in Chinese manufacturing industries, made by Sun *et al.* (1999), confirms the observation of a higher efficiency in FIEs. Using the Data Envelopment Analysis approach (DEA), Sun *et al.* (1999) compute technical efficiency scores[11] for 28 manufacturing industries across 29 provinces in 1995 and compare

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[10] Sun (1998) also finds evidence on a generally higher level of productivity growth of foreign-funded firms (which are also largely export-oriented) in China as compared to domestic firms.

[11] Technical efficiency is defined as the ability of a firm to produce maximum output from a given set of inputs. In this study the level of technical efficiency is defined relative to the best practice in China for a given size of enterprise in a particular enterprise in 1995.

them across sectors and provinces. The industry-based comparison indicates that on average, textile, timber processing and non-ferrous metal industries have lower technical efficiency scores while the provincial comparison shows that the most efficient provinces are on average coastal ones. Sun *et al.* then look at the determinants of technical efficiency differentials across provinces and industries and find some evidence on the role of economic openness. Their results thus generally confirm the positive relationship between economic openness, measured either by the export-output ratio or the share of FDI in total equity, and technical efficiency in light manufacturing industries located in the coastal region (rather than in hinterland).

The presence of FIEs has thus a direct positive effect on industrial performance. As shown by Sun (1998, chapter 6), FIEs also have indirect effects through their linkages with domestic sectors. According to this investigation, FIEs are located in industrial sectors which have high backward linkage indices and output multipliers (as derived from input-output table of China in 1992) and thus, have strong potential linkage effects on the domestic economy. FIEs, which are now important industrial producers, contribute to growth of the domestic sectors through their input demand to domestic firms. The case studies of car industry and electronic sectors confirm this observation as they show the relatively high local content of inputs used in FIEs. The localisation of inputs in major automobile FIEs has considerably increased in the 90s (and reached 80% in Shanghai Volkswagen in 1993). In electronic industry, the top ten FIEs also show high rates of input localisation. The localisation rates are generally higher in TV production, and lower in more technically complex products, indicating that there is still scope for improving the technological capacities of domestic firms.

Finally, the analysis made by Wu (2000) on 10 coastal provinces over the period from 1983 to 1995 gives a complementary view of the temporal evolution of FDI efficiency. The performance indicator for FDI, derived from a production frontier method, particularly shows a few interesting patterns. First, for all provinces, it follows an increasing trend over time, which indicates that while FDI efficiency was relatively poor in the 80s, it has improved and converged across the 10 provinces during the 90s. By 1995, all coastal provinces thus tended to use foreign capital rather efficiently. Second, on a province-to-province basis, Shanghai appears as the best performer in terms of FDI efficiency since the late 80s.

III. MANUFACTURING PRODUCTIVITY IN CHINESE PROVINCES

3.1. FDI and performance indicators in Chinese manufacturing industries

As a first step in examining the relative importance of FDI in China's industrial performances, Table 9 presents some economic indicators for manufacturing industry as a whole by ownership: state-owned enterprises (SOEs), township-owned enterprises (TOEs) and foreign-invested enterprises (FIEs). As indicated by the average number of employees per enterprise, the size of FIEs is quite small as compared to SOEs but is twice bigger than that of TOEs. Similarly, the production size (measured either through gross output value per enterprise or value-added per enterprise) ranks FIEs between SOEs and TOEs and indicates a tendency for FIEs to use relatively more intermediate goods in their production process than SOEs: while their gross output value per enterprise represents 73% of that of SOEs, their value-added per enterprise only represents 55% of that of SOEs. However, in terms of labour productivity, measured by value-added per worker, comparisons are quite different: FIEs labour productivity in 1995 is more than twice that of SOEs and of TOEs, despite the fact that SOEs have the highest percentage of employees with superior education levels. This may reveal the important role of managerial know-how to stimulate employees' working efforts.

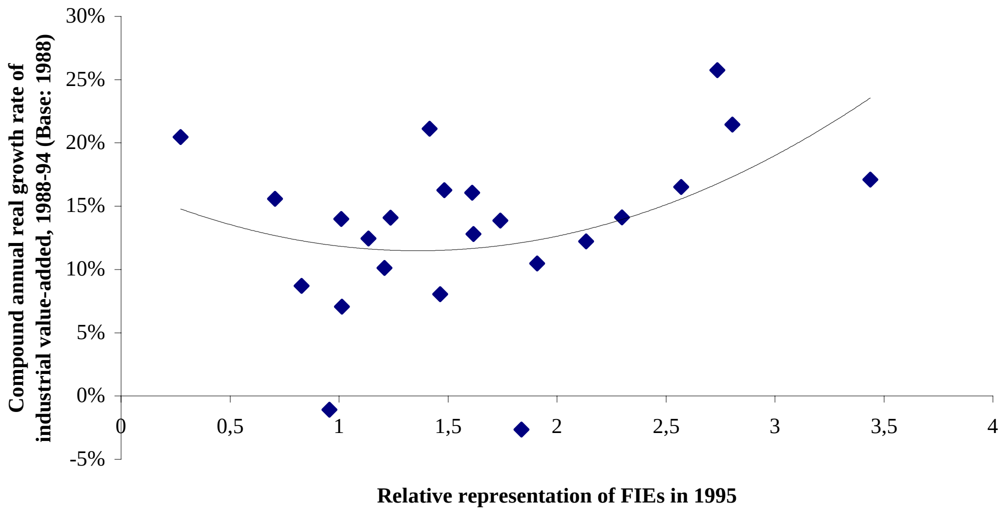
Table 9 - Main economic indicators in manufacturing industry by ownership, 1995

	FIEs	*TOEs*	*SOEs*
Number of employees per enterprise	131	76	504
Gross output value per enterprise	21 618 616	5 150 270	29 452 170
Value added per enterprise	5 218 850	1 225 002	9 450 191
Value added per employee	39 769	16 143	18 734
Education level (%)			
College and over	6.4	1.2	8.0
Specialised secondary	4.8	2.4	6.9
Technical secondary	5.2	3.8	8.1
Senior High	25.5	20.5	22.9
Junior High	50.1	53.9	45.2
Primary and illiterate	8.0	18.1	8.9

Notes: FIEs = Foreign-invested enterprises; TOEs = township-owned enterprises; SOEs = State-owned enterprises.
Sources: *Third National Industrial Census of the PRC in 1995* (ownership volume).

Figure 4 shows a somehow positive relationship at the manufacturing industry level between the relative importance of foreign-invested firms in a sector in 1995 and the annual growth rate of value-added in the sector between 1988 and 1994. This positive relationship indicates that sectors that received more foreign direct investment up to 1995 are those that tended to grow on average the most rapidly during the 1988-94 period. It is the case for electronics and telecommunication equipment (sector 27), garments and other fibre products (sector 6) and leather, furs, down and related products (sector 7) that respectively experienced value-added growth rates reaching 17.1%, 21.4% and 25.7% per year over the period. It should however be noticed that at the bottom of FIEs representation scale, such sectors as non-metal mineral products (sector 19) and smelting and processing of ferrous metals (sector 20) also experienced high growth rates during the period (15.6% per year for the former and 20.5% per year for the latter). These two capital-intensive industries are dominated by state-owned enterprises (to a lesser extent in the case of non-metal mineral products) and received a high share of capital investment during the period.

Figure 4 - Relative importance of foreign-invested firms and industrial growth, by industry (1988-94)



Sources: China Industrial Yearbook (1989 and 1995) and Third National Industrial Census of the PRC in 1995 (ownership volume).

3.2. Manufacturing production function estimates

A large part of the empirical literature on the role of FDI in China's industrial growth has stressed the importance of the higher productivity of foreign-funded firms as a growth engine[12]. By bringing in new technology and management skills as well as international competition, FDI inflows are indeed said to have positively contributed to improving the level of China's productivity. Limited data availability at the industry-level does not allow directly estimating this relationship by sector, but industry-level data by province reported in the *China Industrial Yearbook* allow to account for productivity performance differences among industrial sectors, by the estimation of a production function for each manufacturing industry. Output elasticities obtained from these estimations can then be used to compute and compare TFP levels and growth rates by province and by sector. The length of the estimated period is however constrained by the fact that annual industrial data are only available from 1988 to 1994; in 1995

[12] See among others, Sun (1998) and Fan (1999).

and 1996, the State Statistical Bureau did not publish industry-level data[13]; the 1997 figures are not quite consistent with the 1988-94 period data, and since then, no industrial data have been published.

If we assume the usual Cobb-Douglas form for the production technology, with two different production factors (capital and labour), the estimated equation is the following:

$$LnY_{it} = A + \gamma t + \alpha LnK_{it} + \beta LnL_{it} + u_{it} \qquad (1)$$

where *Y* represents the industrial value-added, A the technology level, *t* the time trend, K capital, *L* labour, *i* any province and *t* any year.

The industry-level data set used in the estimation comes from the *China Industrial Yearbook* (various editions from 1989 to 1995) for all the variables. It contains data on 23 manufacturing industries across 29 provinces over 7 years (sectors and provinces are listed in Appendix 1). Due to numerous missing observations, Tibet is not included in the statistical analysis. Concerning the number of manufacturing sectors included in the statistical analysis, five sectors –food processing (sector 1), tobacco processing (sector 4), petroleum processing and coking (sector 13), smelting and pressing of non-ferrous metals (sector 21) and special purpose equipment manufacturing (24)– are not included in the statistical analysis due to data availability problems (see Appendix 2). Among these five industries, four (sectors 4, 13, 21 and 24) received substantially less FDI than the other manufacturing industries (Table 6)[14].

The data set being a panel of provinces over years, the error term can be expressed as follows:

$$u_{it} = \mu_i + \varepsilon_{it} \qquad (2)$$

where μ is a province-specific parameter. The Breush and Pagan LM test for specific effects indicates that for all industries a specific-effect model has to be preferred to a pooled specification. Moreover, the Hausman test indicates that in 13 over 23 industries, the fixed-effect specification has to be preferred to a random-effect one (see Table 10). Both specification estimations are however presented to allow for comparison, and as can be seen in the following sub-section, for 7 out of the 8 sectors kept in the TFP analysis, the random-effect model is preferred.

As can be seen from Tables 10 and 11, an additional variable is used, and referred to as "vintage". Following Jefferson (1990), this variable is used to account for the problem of a non-deflated capital stock. Indeed, available capital stock data for China's manufacturing industry do not adjust for inflation and in the absence of investment data (and investment deflators) by manufacturing industry, by province over time, it is not possible to re-calculate a capital stock using the permanent inventory method (as usually done at the aggregate level). The age (or vintage) structure of the capital stock is thus used to account for inflation. It is measures as the ratio of the net fixed assets to the original value of fixed assets. Hence, the higher this ratio, the youngest the capital stock. As highlighted by Jefferson (1990, p. 337), "since the rate of

[13] The industrial census was conducted in 1995, but census data are not directly comparable with the annual data published in the Industrial yearbook.

[14] In the case of the petroleum industry, Fan (1999, p. 91) notes that it "is dominated by large scale state-owned enterprises and has always been considered one of the key sectors in the Chinese economy".

inflation in investment goods has been positive, and has been particularly pronounced during the 1980s, enterprises with a young investment age structure will, relative to enterprises with an old investment structure, tend to overstate the quantity of productive capital on hand. This will be the case unless recent vintages of capital have become sufficiently more productive than older vintages to warrant higher prices for the newer vintages".

Estimation results by manufacturing industry are reported in Tables 10 and 11. They give economically consistent figures for the output elasticity with respect to capital and labour, with however substantial differences among industries. We can see from these Tables that in most industries the output elasticity with respect to capital ranges from 0.3 to 0.7, with some exceptions, which might result from data problems for the concerned sectors (sectors 3, 5 7, and 25)[15]. Among the 19 industries for which estimations seem consistent, 12 industries exhibit an output elasticity with respect to capital between 0.6 and 0.7 (in the random-effect specification[16]), most of them (but not all) being consumer goods industries. While relatively high compared to usual estimations on an international basis[17], the magnitude of these estimated output elasticities is rather consistent with most findings in China's growth accounting literature at the national aggregate level (Chow 1993, Borensztein and Ostry 1996). An explanation for this result may lie in the relative scarcity of capital in China (as compared to labour) which would imply a comparatively high remuneration rate for capital. Among the 7 remaining industries for which the elasticity is closer to the international norms (0.4-0.5), 3 are among the most capital-intensive industries in China (see Appendix 3): chemical fibre (sector 16), smelting and pressing of ferrous metals (sector 20) and medical and pharmaceutical products (sector 15).

Estimation results also exhibit a negative and significant capital age structure effect for 13 over 23 manufacturing industries, mostly consumer goods and equipment goods industries, for both random and fixed-effect specifications. The negative parameter indicates a tendency to overestimate capital stock in these industries, that may come from a substantial inflation on capital goods prices at the end of the 80s. Only 2 industries show a positive and significant capital vintage effect: chemical fibre (sector 16) and smelting and pressing of ferrous metals (sector 20). Following Jefferson (1990) interpretation, this would mean that in these two highly capital-intensive industries, productivity improvements in young vintages of capital would have more than offset higher prices for the newer vintages.

Tests for constant returns to scale on capital and labour indicate that the hypothesis of constant returns to scale cannot be rejected for 11 out of 23 sectors in the fixed-effect estimation and only 3 out of 23 sectors in the random-effects estimation. Among the 6 sectors for which the constant returns to scale hypothesis can not be rejected in the "preferred" specification (given the Hausman test results), 4 are intermediate goods industries and only 2 are consumer goods industries.

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[15] Correspondingly, the output elasticity with respect to labour force goes from 0.3 to 0.7, depending on sector estimations. As data on the education level of the labour force are not available for each sector and each province, it is impossible to test for productivity differences between qualified and non-qualified workers.

[16] In the fixed-effect specification, most sectors exhibit the same magnitude of coefficients, except the following sectors: timber processing (sector 8), printing and record medium production (sector 11), plastic products (sector 18), non-metal mineral products (sector 19) and smelting and pressing of non-ferrous metals (sector 20). However, for sectors 8 and 20, the random-effect specification is to be preferred, according to the Hausman test.

[17] See, among others, Nehru and Dhareshwar (1994).

Similarly, production function estimates given in Tables 10 and 11 highlight the differences in the pattern of productivity growth across industries. Time trend estimates turn out to be significantly positive for 7 industries only (sectors 8, 11, 15, 16, 19, 20, and 23), among which 5 are from heavy industry (intermediate goods and equipment goods). Hence, during the short period from 1988 to 1994, the Chinese manufacturing industry has been characterised by rather low productivity gains, with the exception of a few industries, mostly from heavy (and capital-intensive) industry.

Table 10 – Production function estimation (random-effect model)

	Manufacturing industries																						
	2	**3***	**5**	**6***	**7***	**8***	**9**	**10**	**11**	**12***	**14***	**15**	**16**	**17**	**18**	**19**	**20***	**22**	**23***	**25**	**26**	**27***	**28***
Capital	0.58	0.97	0.93	0.75	1.07	0.59	0.71	0.73	0.58	0.4	0.64	0.46	0.36	0.42	0.74	0.7	0.5	0.7	0.5	1.11	0.74	0.68	0.37
	6.99	*10.97*	*9.33*	*7.46*	*9.15*	*7.18*	*8.59*	*7.31*	*9.15*	*4.7*	*11.32*	*4.53*	*5.48*	*5.51*	*10.87*	*8.03*	*5.99*	*9.08*	*6.15*	*9.7*	*9.65*	*6.1*	*3*
Labour	0.33	0.12	0.17	0.36	0.19	0.45	0.42	0.36	0.53	0.7	0.42	0.55	0.72	0.65	0.42	0.44	-1.75	0.38	0.39	0.003	0.36	0.44	0.7
	3.68	*1.51*	*1.93*	*3.54*	*1.61*	*5.51*	*5.02*	*3.5*	*7.94*	*7.61*	*5.83*	*5.27*	*9.3*	*7.67*	*6.36*	*5.73*	*-5.45*	*4.8*	*4.75*	*0.02*	*4.69*	*3.7*	*5.42*
Vintage	-2.13	-1.18	-0.75	0.67	-1.42	-2.41	-1.79	-0.77	-0.68	-0.22	-1.5	-0.15	0.18	0.01	-0.45	-0.39	0.05	-0.08	-1.64	-0.99	-0.62	-1.05	-0.12
	-7.1	*-2.84*	*-2.37*	*1.28*	*-2.43*	*-4.44*	*-3.72*	*-2.68*	*-2.93*	*-1.05*	*-5.89*	*-0.3*	*0.45*	*0.35*	*-0.86*	*-1.09*	*3.5*	*-0.2*	*-4.01*	*-1.93*	*-2.18*	*-2*	*-0.36*
Trend	0.006	-0.48	-0.09	-0.01	-0.06	0.04	0.016	-0.07	0.005	0.02	-0.04	0.006	0.002	-0.008	-0.04	0.039	0.05	0.012	0.02	-0.015	-0.04	-0.06	-0.005
	0.49	*-2.76*	*-5.87*	*-0.56*	*-2.98*	*2.38*	*1.07*	*-4.84*	*0.5*	*1.58*	*-4.82*	*0.35*	*0.1*	*-0.74*	*-3.12*	*2.65*	*3.5*	*0.8*	*2.55*	*-0.85*	*-3.66*	*-2.58*	*-0.29*
Constant returns to scale	no	no	no	no	no	yes	no	no	no	no	yes	yes	no	no	no	no	no	no	no	no	no	no	no
BP- LM test	84.65	107.74	83.9	69.68	61.41	70.4	68.32	157.26	65.15	101.27	362.35	127.08	39.83	215.49	17.49	50.08	69.91	43.22	247.54	192.85	89.7	144.76	111.37
Hausman test	51.18	6.17	16.02	2.08	5.5	4.28	15.05	13.71	39.04	0.65	5.38	23.7	35.28	12.15	31.73	10.91	0.65	21.37	0	11.16	18.18	3.18	6.16
# Observations	203	203	203	203	202	203	203	202	202	197	203	203	196	203	203	203	203	203	203	203	203	201	198
R^2	0.91	0.93	0.96	0.96	0.92	0.9	0.92	0.93	0.95	0.96	0.92	0.92	0.9	0.92	0.96	0.95	0.95	0.96	0.93	0.92	0.96	0.92	0.93

Notes: The dependent variable is the logarithm of value-added, measured at the 1988 prices. The values shown in italics are the Student *t* values. Constant terms are not reported. The Breush and Pagan (BP) LM test is distributed as chi-squared with one degree of freedom. The Hausman test is distributed as chi-squared with four degrees of freedom. Sectors marked with an * are those for which the Hausman test indicates a preference for the random-effect specification.

Table 11 – Production function estimation (fixed-effect model)

	Manufacturing industries																						
	2*	3	5*	6	7	8	9*	10*	11*	12	14	15*	16*	17*	18*	19*	20	22*	23	25*	26*	27	28
Capital	0.68	0.92	1.01	0.82	1.21	0.5	0.58	0.59	0.3	0.35	0.6	0.28	0.18	0.28	0.5	0.44	0.61	0.7	0.5	1.2	0.64	0.61	0.34
	7.44	*8.13*	*6.83*	*7.28*	*9.04*	*4.98*	*5.83*	*5.15*	*3.6*	*3.5*	*9.71*	*2.55*	*2.42*	*3.29*	*4.72*	*3.6*	*6.8*	*7.37*	*6.47*	*9.65*	*7.68*	*5.09*	*2.24*
Labour	0.008	0.14	-0.25	0.25	0.06	0.82	-0.09	0.036	0.4	0.68	0.31	0.07	0.83	0.69	-0.02	0.8	0.62	-0.21	0.22	0.27	0.14	0.39	0.65
	0.07	*0.96*	*-1.68*	*1.58*	*0.39*	*4.1*	*-0.54*	*0.17*	*2.61*	*5.13*	*3*	*0.43*	*5.98*	*4.77*	*-0.2*	*4.59*	*3.41*	*-1.26*	*2.77*	*1.37*	*1.12*	*2.2*	*3.12*
Vintage	-2.17	-0.85	-0.41	0.46	-1.67	-2.02	-1.31	-0.61	-0.58	-0.17	-1.4	0.4	1.14	0.014	0.84	0.13	-1.8	-0.09	-1.72	-1.28	-0.7	-1.24	-0.31
	-7.23	*-1.87*	*-1.23*	*0.75*	*-2.45*	*-3.3*	*-2.35*	*-2.1*	*-2.64*	*-0.72*	*-5.22*	*0.75*	*2.38*	*0.48*	*1.38*	*0.32*	*-5.09*	*-0.18*	*-4.56*	*-2.38*	*-3.01*	*-2.19*	*-0.87*
Trend	-0.03	-0.03	-0.1	-0.02	-0.09	0.04	0.007	-0.04	0.05	0.02	-0.03	0.075	0.039	0.008	0.014	0.074	0.04	0.2	0.004	-0.04	-0.025	-0.05	-8E-04
	-2.33	*-1.6*	*-4.8*	*-1.07*	*-3.65*	*2.4*	*0.41*	*-2.49*	*3.89*	*1.72*	*-3.09*	*3.21*	*2.01*	*0.74*	*0.64*	*3.69*	*2.08*	*1.15*	*0.45*	*-2.2*	*0.159*	*-2.04*	*-0.04*
Constant returns to scale	no	yes	yes	yes	no	no	no	no	no	yes	yes	no	yes	yes	no	yes	yes	no	no	no	no	yes	yes
# Observations	203	203	203	203	202	203	203	202	202	197	203	203	196	203	203	203	203	203	203	203	203	201	198
R^2	0.68	0.72	0.3	0.69	0.76	0.67	0.44	0.34	0.71	0.66	0.67	0.66	0.48	0.48	0.55	0.79	0.78	0.75	0.67	0.79	0.61	0.39	0.92

Notes: The dependent variable is the logarithm of value-added, measured at the 1988 prices. The values shown in italics are the Student *t* values. Constant terms are not reported. R^2 gives the share of the within variance which is explained. Sectors marked with an * are those for which the Hausman test indicates a preference for the fixed-effect specification.

3.3. Manufacturing total factor productivity performance in Chinese provinces

TFP performance

At this stage, we can calculate the level and growth rate of total factor productivity for each manufacturing industry in each province throughout the whole period and compare TFP performances across provinces as well as across sectors. Table 13 reports the contribution of capital, labour and TFP growth to the annual value-added average growth rate for a selection of 8 manufacturing industries. Our choice is driven by our objective to highlight the role of foreign direct investment in manufacturing industries performances. We thus selected 4 industries for which the share of foreign-invested enterprises (FIEs) is the highest among all industries and 4 industries dominated by State-owned enterprises (SOEs), in which foreign-invested enterprises are under-represented (see Table 6). TFP is measured by using the output elasticity with respect to capital and labour estimated from the random-effect specification (Table 10), which is the preferred specification in 7 cases (the only exception is sector 19, non-metal mineral products).

As Table 13 shows, Chinese manufacturing industries differed greatly in terms of value-added growth and TFP growth throughout the 1988-94 period. Two episodes are further distinguished: the 1988-91 period, during which China experienced a strong economic slowdown, which affected nearly all industries, while at different pace; and the 1991-94 period, characterised by an upsurge in economic activity and a return to high growth paths.

The results show that on average, capital-intensive industries tended to exhibit better performance than labour-intensive industries. As FDI is highly concentrated on the latter, the results did not prove that FDI-intensive industries performed significantly better than industries where FDI is quasi-absent.

Surprisingly, these results do not allow us to corroborate the usual findings on the leading role of FDI in Chinese economic growth and the higher efficiency of foreign-funded firms (Sun 1998, Fan 1999 and Wu 2000). However, it should be noted that the short period under study makes the comparison rather rough, this all the more so as during this period, huge short-term cyclical variations affected the economic activities throughout the whole country. Largely the result of the Tian'anmen square events, the unfavourable environment for trade and FDI, to which FDI-intensive industries were more sensitive, probably affected more deeply those industries than industries "intensive" in domestic investment.

In addition, two potential drawbacks are worth mentioning here. First, the capital stock we use is not deflated (see Appendix 2), so that the growth decomposition exercise may under-estimate TFP growth, as the output elasticity with respect to capital may be over-estimated. This would bring an additional (statistical) reason for the low productivity performance found in the manufacturing industry. Second, for industries that are dominated by state-owned enterprises, it should also be noted that capital growth might be over-estimated since a non-negligible share of the capital in SOEs is non-productive: figures provided in the Industrial Census made in 1995 report that on average one fifth of the capital stock in state-owned enterprises is non-productive.

Table 13 - Contribution of production factors and TFP to the annual value-added average growth rate

		Average annual growth rates (%)											
		1988-91				1991-94				1988-94			
	Manufacturing industry	**Y**	**αK**	**βL**	**PGF**	**Y**	**αK**	**βL**	**PGF**	**Y**	**αK**	**βL**	**PGF**
27	Electronic and Telecommunications Equipment	8.1	14.5	2.2	-8.6	23.4	14.9	1.3	7.3	15.8	14.7	1.7	-0.6
6	Garments and Other Fibre Products	12.5	16.4	1.4	-5.2	26.3	21.9	1.5	2.9	19.4	19.2	1.4	-1.1
12	Cultural, Educational and Sports Goods	10.8	7.8	4.3	-1.3	19.8	11.1	6.0	2.7	15.3	9.5	5.1	0.7
28	Instruments, Meters, Cultural and Office Machinery	4.1	3.7	0.8	-0.4	22.3	9.3	5.5	7.5	13.2	6.5	3.2	3.5
20	Smelting and Pressing of Ferrous Metals	5.7	8.2	1.1	-3.7	31.5	10.6	2.7	18.3	18.6	9.4	1.9	7.3
19	Non-metal Mineral Products	4.2	8.7	-0.7	-3.8	24.7	15.6	1.9	7.2	14.5	12.2	0.6	1.7
14	Raw Chemical Materials and Chemical Products	5.1	12.2	1.6	-8.7	11.6	9.2	0.8	1.6	8.4	10.7	1.2	-3.5
23	Ordinary Machinery Manufacturing	1.3	4.4	0.3	-3.4	-3.5	-4.8	-8.9	10.3	-1.1	-0.2	-4.3	3.4

Notes: Computed from estimation results given in Table 10.

TFP convergence

Cross-province standard deviation of the logarithm of TFP gives an overview of the evolution of TFP level dispersion. Figures 5 and 6 illustrate this regional TFP level dispersion among two groups of manufacturing industries, respectively, one FDI-intensive and the other domestic investment-intensive. As can be seen from these figures, dispersion patterns are quite different from one group to the other: while Figure 5 exhibits a clear divergence trend of TFP level among Chinese provinces, Figure 6 does not show any clear divergent tendency from 1988 to 1994 for the 4 selected industries. Thus, the presence of FDI seem to have contributed to unequal productivity improvements across provinces, which might reflect the fact that being highly concentrated along the coast, these investments would have benefited mostly to coastal based industries and that, during this short time period, productivity spill-over across provinces within specific industries would not have been at work.

Figure 5 – Regional TFP level dispersion among FDI-intensive manufacturing industries (1988-94)

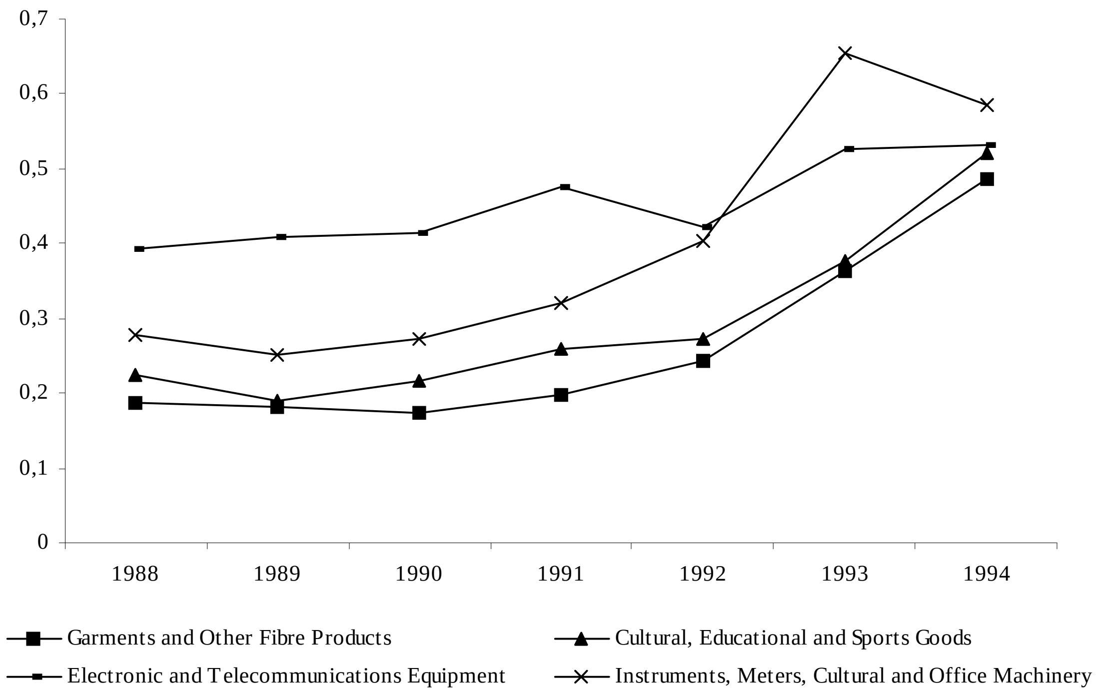
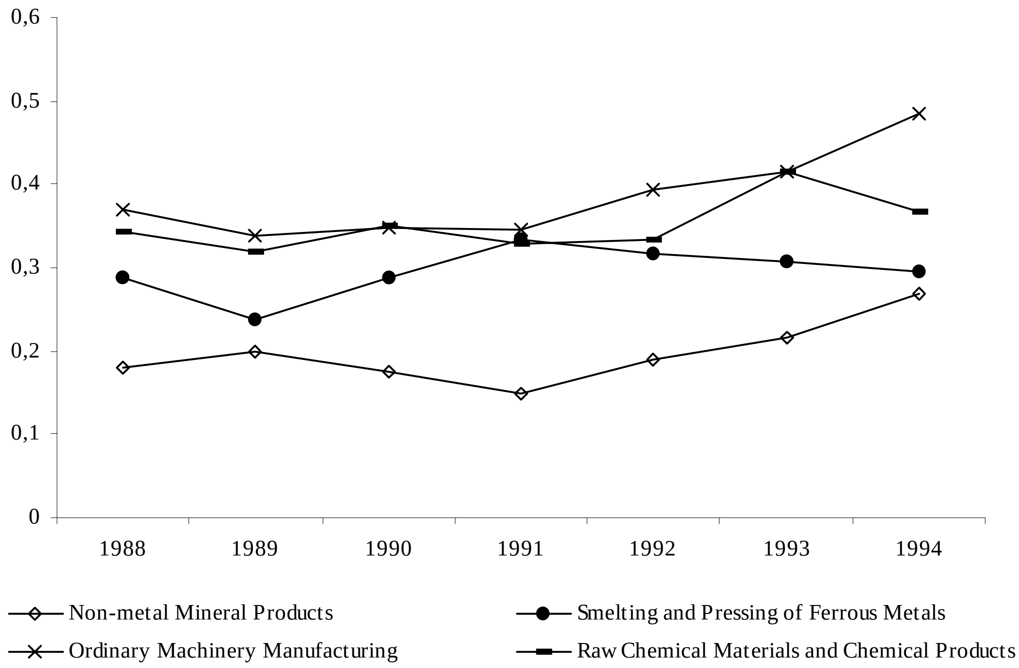


Figure 6 – Regional TFP level dispersion among domestic investment-intensive manufacturing industries (1988-94)



Concluding remarks

This paper set out to investigate the relationship between FDI and total factor productivity performance in China's provinces manufacturing industry, where FDI inflows are concentrated. Data availability has unfortunately limited the estimated period to 1988-94, during which FDI-intensive manufacturing industries are not found to exhibit significantly better TFP performance than their domestic-investment-intensive counterparts. This finding does not coincide with the usual findings in the literature on the impact of FDI on China's economic growth, although the short and specific estimated period should be taken into account in the result interpretation.

A possible explanation may lie in the labour-intensive nature of most FDI-intensive industries: FDI in these industries put to play China's comparative advantage but did not bring about significantly higher technological progress in these industries than domestic investment in other industries, so that total factor productivity performance of FDI-intensive industries was not better than industries dominated by domestic investment, though labour productivity alone is higher in the former than in the latter.

Moreover, a clear divergence trend among provinces is noticed for FDI-intensive industries, while no significant divergence is found for industries basically funded by domestic investment. This means that the inflow of FDI might have induced greater regional disparities for those opened sectors, which tends to confirm usual findings on the driving role of FDI in regional growth divergence at the aggregate level. For an economy where the amount of FDI inflows ranks the first among developing countries and second in the world, this result is quite important since with its accession to WTO, even more FDI are expected to come, which could participate to growing inequalities between a coastal successful model and interior lagging provinces.

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Appendix 1 - Manufacturing industries and provinces

		Manufacturing industries		**Provinces**
Consumer goods industry	1	Food Processing	1	Beijing
	2	Food Manufacturing	2	Tianjin
	3	Beverage Manufacturing	3	Hebei
	4	Tobacco Processing	4	Shanxi
	5	Textile Industry	5	Inner Mongolia
	6	Garments and Other Fibre Products	6	Liaoning
	7	Leather, Furs, Down and Related Products	7	Jilin
	8	Timber Processing, Bamboo, Cane, Palm Fibre and Straw Products	8	Heilongjiang
	9	Furniture Manufacturing	9	Shanghai
	10	Papermaking and Paper Products	10	Jiangsu
	11	Printing and Record Medium Reproduction	11	Zhejiang
	12	Cultural, Educational and Sports Goods	12	Anhui
Intermediate goods industry	13	Petroleum Processing and Coking	13	Fujian
	14	Raw Chemical Materials and Chemical Products	14	Jiangxi
	15	Medical and Pharmaceutical Products	15	Shandong
	16	Chemical Fibre	16	Henan
	17	Rubber Products	17	Hubei
	18	Plastic Products	18	Hunan
	19	Non-metal Mineral Products	19	Guangdong
	20	Smelting and Pressing of Ferrous Metals	20	Guangxi
	21	Smelting and Pressing of Non-ferrous Metals	21	Hainan
	22	Metal Products	22	Sichuan
Equipment goods industry	23	Ordinary Machinery Manufacturing	23	Guizhou
	24	Special Purpose Equipment Manufacturing	24	Yunnan
	25	Transport Equipment Manufacturing	26	Shaanxi
	26	Electric Equipment and Machinery	27	Gansu
	27	Electronic and Telecommunications Equipment	28	Qinghai
	28	Instruments, Meters, Cultural and Office Machinery	29	Ningxia
			30	Xinjiang

Notes: Sichuan province includes Chongqing municipality.

Appendix 2 – Data

Data on value-added, fixed assets and labour are drawn from the *China Industrial Statistical Yearbook*, from 1988 to 1997 (except 1995 and 1996, for which no data were published by the State Statistical Bureau). They are available on an annual basis per province for 28 manufacturing industries (see Appendix 1 for a list of these industries).

China is composed of 31 administrative units (excluding Hong Kong and Macao Special Administrative Regions, and Taiwan), among which 4 municipalities, 5 autonomous regions and 22 provinces. Tibet is not included in the dataset, due to missing observations. Chongqing municipality, which has been given a provincial level status in 1997 is considered as part of Sichuan and thus included in Sichuan data.

Moreover, several manufacturing industries have been dropped off due to a change in industrial nomenclature in 1993. This is the case for sector 1 (Food Processing), sector 21 (Smelting and Pressing of Non-ferrous Metals) and sector 24 (Special Purpose Equipment Manufacturing). Moreover, sector 4 (tobacco processing) and sector 13 (petroleum processing and coking) are not included in the analysis since numerous data were missing. These two industries are highly concentrated in a few provinces: 83.5% of the total value-added of tobacco processing was made in only 11 provinces in 1994 and 94.3% of the total value-added of petroleum processing and coking was made in only 10 provinces in 1994.

Lastly, a few comments have to be made on available data on capital stock. Capital stock is measured using the net value of fixed assets. A change in data reported from 1993 onwards implies that for 1994, the net value is under-estimated. However, the 1993 data, which give both calculations, indicate that the bias should not be too big.

A more important drawback comes from the fact that capital stock data reported in *China Industrial Statistical Yearbooks* do not account for inflation on capital goods, which means that they are certainly over-estimated. Jefferson (1990) proposes a method to account for this bias in the estimation of the production function, by introducing a "vintage ratio", measured as the ratio of the net value of fixed assets over the original value of fixed assets. It gives an estimation of the age structure of capital and its introduction into the production function regression serves as a proxy for inflation in capital goods.

Appendix 2 –Factor productivity and capital intensity in Chinese manufacturing industries (1988-94 averages)

Type of goods		Manufacturing industries	Capital productivity	Labour productivity	Capital intensity
I	16	Chemical Fibre	3 518	17 298	51 438
I	20	Smelting and Pressing of Ferrous Metals	4 670	13 652	28 561
I	14	Raw Chemical Materials and Chemical Products	4 742	8 980	19 773
C	3	Beverage Manufacturing	5 581	10 513	19 178
I	15	Medical and Pharmaceutical Products	8 150	12 182	15 954
E	27	Electronic and Telecommunications Equipment	7 202	10 914	15 824
C	2	Food Manufacturing	4 763	6 470	13 734
I	18	Plastic Products	5 555	6 887	12 961
E	25	Transport Equipment Manufacturing	6 347	8 162	12 556
C	10	Papermaking and Paper Products	5 040	5 830	12 248
E	26	Electric Equipment and Machinery	8 400	8 797	10 831
I	19	Non-metal Mineral Products	5 023	5 194	10 299
C	5	Textile Industry	5 689	5 644	10 277
I	17	Rubber Products	8 711	8 257	9 859
E	23	Ordinary Machinery Manufacturing	6 404	6 176	9 571
C	11	Printing and Record Medium Reproduction	6 001	5 463	9 344
E	28	Instruments, Meters, Cultural and Office Machinery	7 037	6 233	8 981
C	8	Timber Processing, Bamboo, Cane, Palm Fibre and Straw Products	4 859	3 922	8 005
I	22	Metal products	8 114	6 125	7 720
C	7	Leather, Furs, Down and Related Products	7 861	5 509	6 987
C	12	Cultural, Educational and Sports Goods	9 204	5 631	6 409
C	9	Furniture Manufacturing	7 344	4 515	6 296
C	6	Garments and Other Fibre Products	10 584	5 563	5 451
Total			*6 557*	*7 735*	*13 577*

Note: "Capital intensity" is measured as the ratio of net fixed assets over the number of staff and workers. Industries are grouped according to the final destination of their production into 3 categories : consumer goods (C), intermediate goods (I) and equipment goods (E).