SPILLOVERS FROM TAIWAN, HONG KONG, AND MACAU INVESTMENT AND FROM OTHER FOREIGN INVESTMENT IN CHINESE INDUSTRIES

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In its analysis of the impact of foreign investment on China's productivity, this article develops two empirical models: one using labor productivity and the other using total factor productivity (TFP). Using cross-provincial data on Chinese industries for 1993, 1994, and 1997 to regress the empirical models, it is concluded that the impact of investment differed depending on its source, with that from these overseas Chinese enterprises contributing to the spillover effect in regions with a high technology gap, whereas that from other foreign enterprises tending to improve productivity and TFP primarily in regions with a low technology gap. (*JEL* D24, F13, F15, L60)

I. INTRODUCTION

Since mainland China opened its doors to outside investment in 1979, strenuous efforts have been made to attract foreign investment, resulting in a significant increase in foreign direct investment (FDI) in China.[1] This is manifested by the fact that according to official Chinese statistics, the actual amount of foreign capital invested up to 1999 was US$305.99 billion. Despite a gradual decline in FDI in China from overseas Chinese communities, namely, those of Taiwan, Hong Kong, and Macau (THM), these economies have remained the major source of investment in recent years. Well documented by Dees (1998) is that China's open-door policy has encouraged investment by foreign enterprises and that the resulting growth in FDI is undeniably a primary component of China's current success. The influence of FDI on industrial productivity in China has therefore become an issue of lengthy discussion and a topic of a great deal of industrial economic research.

Take some of the findings presented here as examples of the research that abounds. For one, Sun (1998) indicated that FDI is clearly a potential growth determinant not only in China but also in other developing nations. Meanwhile, with their focus solely on China, Zhu and Lu (1998) confirmed the causal linkage between FDI and the growth in productivity. Along the same lines, Zhang (2001) has also recently demonstrated that FDI seems to have been boosting China's growth in income, thereby facilitating transition in terms of economic development, and they have shown that the positive effects of this growth seem to have been mounting over time and becoming more strengthening in coastal than in the inner

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1. FDI in China can be in four forms: joint ventures, cooperative developments, cooperative operations, and foreign enterprises. The objectives behind providing foreign enterprises with incentives to invest in China are fivefold: to develop a diversified industrial base; to introduce and transfer new technology; to stimulate economic growth; to upgrade managerial and labor skills; and to increase exports, particularly of manufactured goods.

ABBREVIATIONS

FDI: Foreign Direct Investment
HTG: High Technology Gap
LTG: Low Technology Gap
OFC: Other Foreign Countries
SOE: State-Owned Enterprise
TFP: Total Factor Productivity
THM: Taiwan, Hong Kong, and Macau

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regions. Though agreeing that FDI stimulates growth in China, in general, Zhang and Felmingham (2002) nevertheless have recently shown that this is particularly true in all of the eastern, central, and western regions.

Although studies like these have supported the positive role of FDI in China's economic development, none has distinguished the different sources of FDI and the impact the different sources have had on China's economy. To be sure, the investment behavior of enterprises from THM and from other foreign countries (OFCs) are quite different in many ways, such as in the scale of investment, the extent of cooperative operation, productivity, and in the ability to transfer technology. It is thus reasonable to expect that the impact of FDI on China's industries from each of these two sources might be different. Given that China has made tireless efforts to attract more investment from foreign economies, investigating this issue identifies and defines the forms of the contribution made by the different sources of FDI on the one hand. On the other hand, the findings are also most valuable for the government of China as it attempts to set up more effective industrial mechanisms vis-à-vis foreign investment. These benefits aside, the findings of this study supplement the conclusions drawn in previous studies that have dealt with spillovers from FDI in China.

The primary purpose of this article is to identify the differences in the impact of FDI sourced from THM and that from OFC with respect on labor productivity and total factor productivity (TFP) in the industrial sector of China. To explore the primary issue of this study, the official cross-provincial data on Chinese industries covering 1993, 1994, and 1997 provided by the *China Industrial Economic Statistical Yearbook* (National Statistical Bureau) and the *China Statistical Yearbook* (National Statistical Bureau) are adopted to examine the following three questions. First, does FDI increase Chinese labor productivity and TFP? Second, what are the differences in the spillover effects of THM investment and of OFC investment? Third, do the spillovers differ within different regions of China?

After the regional labor productivity function and the regional TFP function are regressed, the estimation results make it clear that positive spillovers from THM investment existed only in 1993 and decreased after that and that OFC investment did not have any spillover effects on Chinese industries as a whole whatsoever during the periods studied. The results from the difference-in-difference approach further suggest that THM investment contributes to the spillover effect in regions with a high technology gap but that other foreign enterprises tend to improve productivity and TFP mostly in regions with a low technology gap in China.

The remainder of this article is organized as follows. Section II provides the theory and evidence of spillovers from FDI, and section III presents the distinct characteristics of FDI in China from the two sources investigated. Section IV introduces the data and methodology, and section V outlines the analysis of the empirical evidence. Section VI presents and discusses the conclusions drawn from this study.

II. THE THEORY AND EVIDENCE OF SPILLOVERS FROM FDI

The influence of FDI on a host economy can theoretically be categorized into two parts—the direct effect and the indirect effect. The direct effect of FDI has been discussed in classical international economics and endogenous growth theory. According to the former, factor and output movement leads to factor price equalization, a process that enhances the efficiency of resource allocation for the countries involved. MacDougall (1960) demonstrated that capital movement across nations and industries narrows the gap in the marginal productivity of capital and thus improves the total output of capital. In addition, based on the endogenous growth model constructed by Grossman and Helpman (1990), an economy or a particular industry may benefit from any designated FDI that jump-starts a sustainable learning-by-doing process.

In addition to the direct effect of FDI, the indirect effects from the so-called spillovers have important implications on a host country. With regard to spillovers, Globerman (1979) reported that FDI contributes a number of potential indirect (or spillover) economic benefits to a host country. FDI, for example, results in a greater efficiency throughout the economy by increasing competition in the industries of a host country. Foreign firms also train and transfer their skills to workers and managers who may later be employed by local firms. Other spillover economic benefits of FDI include a faster adoption of new technology by local firms, improved management practices throughout the host country's economy, and an increased mobility of resources, particularly financial capital, in the host country. Further, Haddad and Harrison (1993) added that other benefits from FDI are increased capital flow, higher employment, and new technology brought in by foreign firms. Technology transfer in fact occurs in many different ways: New technology is sold directly through licensing agreements; it is included in imported inputs and capital goods; and it is transferred to exporters who learn about new technology from their foreign buyers.[2]

Although a number of empirical studies have attempted to directly measure the spillover effects of foreign direct investment, the conclusions they reach with respect to the significance of spillovers are inconsistent. On the one hand, several studies of aggregate manufacturing, such as those of Cave (1974), Globerman (1979), Blomström and Persson (1983), Kokko (1994), and Chuang and Lin (1999), have found that foreign presence has a positive impact on the productivity of local firms and therefore concluded that spillovers are generally significant and important. Some studies, such as those of Haddad and Harrison (1993), Kokko et al. (1996), and Tsou and Liu (1997), on the other hand, have concluded that spillovers are insignificant and unimportant and that in some industries they may not even exist.

As mentioned earlier, the way FDI affects industrial productivity in China has become a primary concern in recent industrial economic studies, and how it affects Chinese industrial productivity has become a primary topic in recent industrial economic research. Zhao (1995) suggested that increased import of technology expedited the development of indigenous technology both in the dimension of technology generation (research and development and innovation) and technology utilization (output of and exports of the capital good industries). Zhu and Lu (1998) found that the spillovers from FDI have a greater impact and are more effective in promoting labor productivity than in boosting TFP. Using data from the *China Statistical Yearbook* and *the National Census of the People's Republic of China in 1995*, Qin (1998) studied the spillover effect from FDI among Chinese manufacturers and supported the hypothesis of the existence of spillovers. To cite another example, Chuang and Hsu (2001) used plant-level data from the *National Census of the People's Republic of China* in 1995 to examine spillovers in China, and their main finding provided evidence of the positive impact of FDI on Chinese industries. Moreover, they found that although positive spillovers exist in both high and low technology gap sectors, spillovers are greater in low technology gap sectors than in high technology gap sectors.

All these observations equally support the existence of spillovers from FDI on China's economy. Nevertheless, the existing literature concerning spillovers in China provides only general conclusions. For the purpose of understanding the role of FDI in China's economic development in greater detail, this study further investigates the differences in the impact of FDI sourced from THM and from OFCs.

III. DISTINCT CHARACTERISTICS OF FDI FROM THE TWO SOURCES

Clearly, FDI from THM and that from OFCs in industries in China have distinct characteristics. According to the official data provided by the *China Statistical Yearbook*, THM have played a more important role in terms of FDI in China than have OFCs. The FDI originating from Hong Kong, traditionally the major investor in China, accounts for 59% of the realized FDI during the 1991–95 period compared to 44% during the 1996–98 period.[3] Taiwan began to invest heavily in China from the early 1990s onward, becoming the second most important source of foreign capital in China during 1991–95, with a 10% share of all realized FDI inflow.

With regard to FDI from other foreign countries, the United States remained the third largest investor in the same subperiods (1991–95 and 1996–98), with a realized share of FDI inflow of 7.4% and 7.8%, respectively.

2. Mansfield and Romeo (1980) suggested that the technology transferred via multinationals is more up to date than that sold through licensing agreements.

3. Dees (1998) pointed out that FDI from Hong Kong becomes overvalued because of a substantial share of its domestic capital round-tripping its way through Hong Kong and back to China, thus benefiting from tax privileges made available to foreign investors in Hong Kong.

Japan became the fourth most important investor in China, with a 6.9% share of actual FDI inflow during 1991–95. Japan was elevated to the second most important investor with a share of 8.11% during 1996–98. Western Europe, the world's main source of international direct investment, does not as yet play a major investment role in China, with a relatively small share of realized FDI inflow into China.[4]

With regard to the spatial distribution of FDI, according to the official data provided by the *China Industrial Economic Statistical Yearbook*, the shares of value-added output of FDI from THM and from OFCs by region in 1993, 1994, and 1997 are presented in Table 1. It is shown that Guangdon Province enjoyed the largest share of FDI's value-added output in 1993, 1994, and 1997. However, FDI from THM seemed to be much more concentrated in Guangdon than that from OFCs. In addition, THM enterprises preferred Jiangsu and Fujian than other regions, but FDI from OFCs was distributed more in Shanghai, Jiangsu, and Beijing than in other regions. Simply put, as far as location preference for FDI goes, clear-cut distinctions between THM and OFC are evident.

Of particular interest, too, based on a newer sample survey of foreign enterprises in China conducted by Kao et al. (1994), compared with THM enterprises, OFC firms have a greater potential for higher profits in China, a conclusion also supported by Kao (1996).[5] Furthermore, the average scale of THM investment is smaller than that of OFC investment, and FDI from Taiwan, for instance, is more likely to be in the form of wholly owned firms, unlike that of foreign countries.[6] Joint ventures exhibit higher levels of productivity than their domestic counterparts, thus implying that FDI in joint ventures (as opposed to wholly owned firms) is more likely to produce positive spillovers. The cross-regional sample used in this study also supports these arguments. According to Table 1, the average labor productivity—defined as the value-added output per employee—is much higher for each region in OFCs than in THM enterprises. This is true for most regions. Furthermore, Huang et al. (2003) also found that after controlling other explanatory variables, the technical efficiency of OFCs was better than that of THM in 1994.[7] It is thus concluded that investment from THM and that from OFCs took on different forms of investment behavior and performance in 1993, 1994, and 1997.

In the scope of cooperative operations, THM enterprises have a tendency to prefer to cooperate with collectively owned and town/village enterprises, whereas OFC enterprises tend to prefer to cooperate with Chinese state-owned enterprises (SOEs). In addition, Chuang and Hsu (2001) found that labor productivity in industries funded by THM enterprises is lower than in those funded by OFC enterprises. In light of these findings, this study is confident to state that the different characteristics of FDI and the investment behavior of the two sources of FDI (THM enterprises and other foreign-funded enterprises) produce different spillover effects in the Chinese industrial sector.

To sum up, investments from THM and from OFCs indeed have heterogeneous properties, namely, pertaining to firm scale, location preference, labor productivity, cooperative operation, and profitability. The distinct properties of the two investors might very well bring about different effects on domestic Chinese firms. The data and methodology used in this study to investigate the possibly different spillovers on Chinese domestic firms from THM and OFC investments are explained next.

IV. DATA AND METHODOLOGY

As mentioned earlier, three issues are examined in this study: whether FDI increases Chinese productivity; the differences, if any, between the spillovers from THM investment

4. Among all Western European countries, the largest current investor in China is the United Kingdom, whose share of FDI stock was, however, just 1.65% during 1991–95 and 3.05% during 1996–98.

5. In this new survey, which began in 1993, annual interviews were carried out in 1066 foreign enterprises over a five-year period.

6. Haddad and Harrison (1993) recognized that a major benefit often attributed to FDI was the knowledge transferred from foreign to local firms. The transfer of technology from foreign to local firms is more likely to take place if FDI is in the form of joint ventures rather than in the form of wholly owned firms.

7. However, there is no difference in technical efficiency between THM and OFCs in 1993 and 1997. This result also implies that the cultural factor didn't help the technical efficiency of THM to be better than that of OFCs. This result is quite different with the conclusion of Chen (2001).

TABLE 1
Share of Value-Added Output and Average Labor Productivity by Region

	Share of Value-Added Output (%)						Labor Productivity (Thousand RMB)					
	THM			OFC			THM			OFC		
Provinces or Regions	**1993**	**1994**	**1997**	**1993**	**1994**	**1997**	**1993**	**1994**	**1997**	**1993**	**1994**	**1997**
Beijing	4.39	4.58	1.82	8.50	10.12	6.49	28.02	34.02	29.22	52.25	73.70	69.77
Tianjin	1.94	3.29	2.59	4.19	3.52	7.43	23.48	17.65	47.34	39.06	28.23	70.98
Hebei	1.98	2.31	2.46	2.28	2.34	2.13	16.65	15.36	33.86	21.74	23.69	34.72
Shanxi	0.69	0.91	0.37	0.46	0.37	0.46	15.10	18.56	23.46	26.18	19.50	26.35
Inner Mongolia	0.18	0.36	0.41	0.29	0.24	0.39	8.66	13.95	22.65	13.64	10.91	20.09
Liaoning	2.97	1.97	2.43	5.07	6.39	4.40	27.10	19.07	36.05	37.40	25.35	35.76
Jilin	0.09	0.08	0.33	1.68	1.69	0.79	10.20	10.42	25.11	31.54	30.88	19.24
Heilongjiang	0.29	0.43	0.79	1.00	1.06	0.82	15.14	9.89	28.06	15.42	16.75	15.63
Shanghai	7.13	7.50	6.62	18.65	18.48	15.88	31.06	29.37	47.92	75.03	70.01	78.77
Jiangsu	8.73	15.33	9.01	12.35	9.05	11.32	24.69	29.14	44.35	34.80	32.27	54.44
Zhejiang	5.21	4.35	3.43	5.58	4.47	4.02	27.21	20.33	30.14	26.44	22.00	36.50
Anhui	0.26	0.36	0.6	0.58	0.63	1.46	13.06	15.74	20.71	25.96	14.36	44.62
Fujian	6.36	12.33	13.59	7.12	6.13	4.60	15.24	23.33	34.76	21.55	18.73	31.64
Jiangxi	0.33	0.27	0.24	0.67	0.92	0.85	19.53	18.13	20.96	29.24	30.80	34.55
Shandong	2.36	3.25	3.88	4.17	5.52	8.21	19.22	20.60	27.66	25.84	20.72	31.78
Henan	0.43	1.15	2.55	1.74	2.93	1.44	10.93	18.60	31.62	25.43	36.06	31.28
Hubei	1.91	1.49	1.47	1.73	1.54	1.96	21.27	15.72	35.34	56.89	29.38	50.99
Hunan	0.24	0.28	0.47	1.03	0.75	0.81	7.47	9.10	15.92	45.35	37.70	29.27
Guangdong	49.63	37.59	43.3	19.45	19.23	21.37	24.16	23.59	39.34	40.62	35.57	61.85
Guangxi	0.47	0.65	0.31	0.75	1.21	0.89	17.57	22.32	15.24	15.82	24.08	27.08
Hainan	0.57	0.38	0.29	0.41	0.46	0.15	37.82	25.94	31.00	80.30	53.45	24.68
Sichuan[a]	2.72	0.22	1.19	0.35	1.07	1.83	42.62	5.92	32.72	39.35	19.82	51.71
Guizhou	0.27	0.03	0.06	0.39	0.23	0.28	36.24	9.36	16.95	40.27	27.57	31.00
Yunnan	0.09	0.2	0.35	0.16	0.21	0.40	13.28	15.21	23.94	17.64	18.62	38.65
Tibet	0	0	0.04	0.00	0.01	0.01	NA[b]	NA	200.40	7.26	9.98	19.43
Shaanxi	0.54	0.45	0.72	1.03	0.85	0.99	50.86	44.18	65.30	76.74	52.58	79.32
Gansu	0.05	0.05	0.4	0.12	0.15	0.23	9.75	8.10	43.85	41.25	79.11	28.66
Qinghai	0	0	0.01	0.00	0.00	0.01	0.00	0.00	10.26	2.41	6.49	14.66
Ningxia	0.1	0.08	0.03	0.02	0.26	0.30	21.51	8.78	13.41	8.91	22.45	38.39
Xinjiang	0.07	0.12	0.22	0.23	0.18	0.10	5.35	8.79	19.10	15.59	17.17	19.17
Total	100	100	100	100	100	100						

[a]In this study, all information for Sichuan in 1997 includes that for Chongqing, which became the fourth municipality in 1997.

[b]NA indicates data are not available.

Source: *China Industrial Economic Statistical Yearbook* and the *China Statistical Yearbook*, 1994, 1995, and 1998 (National Statistical Bureau of China).

and that from OFC investment; and whether the spillovers differ among different Chinese regions. The official Chinese 1993, 1994, and 1997 cross-provincial data adopted in this research cover 30 regions and are sourced from various annual editions of the *China Industrial Economic Statistical Yearbook* and the *China Statistical Yearbook*. All variables were measured for industrial enterprises with independent accounting systems at the township and higher levels. The reasons for limiting the discussion of the spillover effects exclusively to 1993, 1994, and 1997 is that the definitions of some of the variables have been changed since 1993, and the information on THM and OFC investments in all Chinese industrial sectors is only complete for those three years.

To make the empirical results comparable across years, all information on Sichuan for 1997 includes Chongqing, whose information has been separated from that of Sichuan Province since 1997 due to becoming China's fourth municipality in 1997. The number of observations for each year is 30, representing the 30 regions in this study. This cross-provincial data provide the input, output, and other relevant information for Chinese domestic enterprises, THM economy, and OFC economy.[8] This study therefore broadens the scope of related researches by comparing the different spillover effects from the different sources of FDI, and in so doing, provides a better understanding of the effects of these alternative sources of FDI on the different regions using the difference-in-difference approach.

An empirical approach is required to find answers to the questions at hand.[9] This study first adopts labor productivity as one dependent variable in order to investigate the primary issues. However, as discussed by Zhu and Lu (1998), labor productivity may not reflect the overall effects of spillover efficiency. Hence this study further employs another measurement of productivity, TFP, as a dependent variable. What TFP reflects is not only technology efficiency but also the so-called X-efficiency in the production process. The TFP index is measured using the standard growth accounting approach initially proposed by Solow (1957) and also adopted by Jefferson et al. (2000). First, this study estimates the separate Cobb-Douglas production function of Chinese industries for each year. Then, the estimated output elasticity of input is used to calculate the weight of each input and the TFP index for each region in a specific year. The Cobb-Douglas production function is defined as follows:

$$(1) \qquad Y_j = A\left(\prod_{i=1}^{2} X_{i,j}^{\alpha_i}\right)\eta_j$$

$$(2) \qquad \beta_i = \alpha_i \Big/ \sum\nolimits_{i=1}^{2} \alpha_i$$

In equation (1), Y represents the real value added in domestically owned plants for each region in a specific year, and X is the vector of input, including labor and capital, defined as total employment in domestically owned plants and the real net value of fixed assets in domestically owned plants in each area, respectively.[10] α is the output elasticity of input,[11] β in equation (2) is the weight measuring factor income share used to calculate the composite Cobb-Douglas index of total factor productivity, η is the error term satisfying the usual properties with zero mean and standard deviation σ_η. Then, equations (3) and (4) are used to calculate TFP of each region in a specific year.

$$(3) \qquad u_j = \ln Y_j - \sum_{i=1}^{2} \beta_i \ln X_{i,j}$$

$$(4) \qquad TFP_j = \exp(u_j - u_{\max}).$$

As mentioned earlier, this research adopts two empirical models with labor productivity and TFP as the respective dependent variables.

8. According to the *China Statistical Yearbook*, a foreign-funded economy includes Sino-foreign joint ventures, Sino-foreign cooperative enterprises, and foreign ventures exclusively with their own investment. An economy funded by entrepreneurs from THM, on the other hand, includes joint ventures and cooperative enterprises with the mainland as well as ventures exclusively with their own investment.

9. Tsou and Liu (1997) indicated that generally, two alternative empirical models can be used to directly estimate the spillover effect of FDI on a host country's industries. One involves the use of industrial labor productivity in the host country as the dependent variable in the regression; the other uses estimated industrial technical efficiency. However, this study adopts TFP in lieu of industrial technical efficiency.

10. McGuckin et al. (1992) indicated that the use of net value added output as the dependent variable in the production function is for macroanalysis and that the use of gross value output is for firm-level analysis. In the former model, the input vector includes labor and capital, whereas in the latter, it includes labor, capital, and intermediate inputs.

11. The author agrees that it is not clear how the output elasticity of input estimated from industries would be applied to location-related equations. However, this study employs regional data due to the unavailability of industrial and firm-level data. Many studies facing the same problem, such as those by Zhu and Lu (1998), Zhang and Felmingham (2002), and Brun et al. (2002), have also used regional data to estimate the production function and the regional economic growth function derived from the production function. It is also true that industries in China tend to cluster in certain regions. To control for the heterogeneity of the industrial structure among provinces, this study distinguishes between coastal and inner provinces by adding a coastal dummy variable in the regression model.

The two empirical models are defined as:

$$(5)\quad \ln LP = \alpha_0 + \alpha_1 \ln(K/L) + \alpha_2 State\text{-}owned + \alpha_3 Exports + \alpha_4 Imports + \alpha_5 Coast + \alpha_6 OFC + \alpha_7 THM + \alpha_8 Scale + \varepsilon$$

$$(6)\quad TFP = \alpha_0 + \alpha_1 State\text{-}owned + \alpha_2 Exports + \alpha_3 Imports + \alpha_4 Coast + \alpha_5 OFC + \alpha_6 THM + \alpha_7 Scale + \varepsilon.$$

Equations (5) and (6) represent Chinese industrial labor productivity and TFP as the dependent variables in two empirical models, respectively. Labor productivity is defined as the real average value added per worker of local firms in each of the 30 regions (in 1990 dollars and in log form). TFP of local enterprises in each of the regions comes from the estimated results of equation (4), which are presented in the appendix. There, it is shown that Yunnan has the highest level of TFP in all three years. The definition of the variables and the expected sign of their estimated coefficients are discussed later and shown in Table 2.

Where labor productivity is the dependent in the model, because the value added per worker includes the contributions from capital, according to Tsou and Liu (1997), the capital labor ratio is expected to have a positive influence on labor productivity. In addition, Wu (1995) concluded that China's SOEs, as opposed to other types of enterprises, have inferior levels of productive performance; thus it can be stated that the higher the SOE's share of total real domestic added value in a specific area is, the lower are its labor productivity and TFP.

Chuang and Lin (1999) and Chuang and Hsu (2001) have indicated that "trade-induced learning by doing" is an important means of improving productivity, management, and marketing technology among local enterprises as they attempt to overcome competition in the international market. Hence, if such a trade-induced learning by doing effect does exist in Chinese industries, it follows that a region with a high share of exports in total real domestic value added should have higher levels of productivity. In addition, if locally owned enterprises import mainly advanced production equipment, then their share of imports should have a potentially positive relationship with both labor productivity and TFP.

The average production scale of firms may also play an important role in both labor productivity and TFP. The larger the scale of firms, the higher are labor productivity and TFP due to the economies of scale. Finally, relative to other regions, coastal regions should find it is easier to obtain advanced production and management technology and, as a result, improve their productivity.[12] Therefore, the sign of the coefficient of the dummy variable for coastal regions is expected to be positive.

To investigate the primary issue concerning spillovers from the different sources of FDI in Chinese industries, this study defines two main explanatory variables representing the spillover effects from FDI as the THM enterprises' and OFC enterprises' shares of employment within each region adopted in Cave (1974), Blomström and Persson (1983), Kokko (1994), Tsou and Liu (1997), and Chuang and Hsu (2001). If FDI from both THM and OFCs has a spillover effect on Chinese industries, the signs of both coefficients of the spillover variables should be positive. On the basis of the estimated results, this study is indeed able to distinguish differences in the spillover effects from THM and from OFC investments in China.[13]

To examine spillovers from the different sources of FDI in the different regions of China, the difference-in-difference approach is adopted. This study categorizes the 30 regions into two groups, namely, regions with a high technology gap (HTG) and with

12. These coastal regions include Bejing, Tianjin, Hebei, Liaoning, Shanghai, Jiangsu, Zhejiang, Fujian, Shandong, Guangdong, Guangxi, and Hainan. In this study, Guangxi is classified as a coastal region in accordance with a standard way used in many other studies. To illustrate, Brun et al. (2002) classified Guangxi as a coastal province, and so did Zhang (2001). Although Guangxi is not one of the special economic zones, most studies classify it as a coastal region due to its coastal location.

13. The author thanks an anonymous referee for pointing out the issue that attributing the spillover effects solely to FDI without controlling for domestic investment or at least fixed asset investment may be misleading. The domestic investment measured for all firms in each region is incompatible with all of the variables measured for only industrial enterprises with the independent accounting systems at the township and higher levels. This inconsistency in the measurements across variables might have resulted distortions in the estimations. The capital-labor ratio variable may have possibly conquered any shortcoming arising from the omission of the domestic investment in the regression model. In addition, adding the inconsistently measured domestic investment into the model does not change the primary findings of this study.

TABLE 2
Descriptions and Statistics of the Variables

Variable	Definition	1993 Mean (SD)	1994 Mean (SD)	1997 Mean (SD)	Expected Sign
Y	The real value added in domestically owned plants in each area (in 1990 dollars, RMB millions)	33,238.40 (27,945.48)	34,035.70 (28,877.35)	43,700.53 (36,620.30)	
K	The real net value of fixed assets in domestically owned plants in each area (in 1990 dollars, RMB millions)	42,744.47 (30,756.74)	47,686.27 (35,023.83)	88,609.33 (62,769.15)	
L	The total employment in domestically owned plants in each area. (10 thousand)	265.78 (189.82)	267.57 (194.43)	238.09 (171.12)	
LP	The real value added per employee in domestically owned plants in each area (in 1990 dollars, RMB)	12,032.00 (3277.28)	12,269.05 (4016.98)	17,802.11 (5660.63)	
TFP	The estimated TFP for each area from the Standard growth accounting approach	0.69 (0.17)	0.61 (0.17)	0.63 (0.17)	
K/L	The real net value of fixed assets per employee in domestically owned plants in each area (in 1990 dollars, RMB)	18,048.98 (5923.30)	19,094.00 (4445.40)	41,241.69 (12,936.86)	+
State-Owned	The state-owned plants' share of the real value added of the domestically owned plants in each area	74.32 (13.69)	69.93 (14.71)	64.05 (14.89)	–
Exports	The share of exports of the total output of domestically owned plants in each area (in 1990 dollars, %)	11.35 (14.19)	17.26 (17.92)	18.76 (22.26)	+
Imports	The share of imports of the total output of the domestically owned plants in each area (in 1990 dollars, %)	14.27 (25.30)	46.84 (171.79)	12.40 (18.10)	?
Coast	= 1, coastal regions; = 0, others	0.40 (0.50)	0.40 (0.50)	0.40 (0.50)	+
Scale	Average sales revenues of domestically owned plants in each area (in 1990 dollars)	6.77 (3.95)	6.35 (3.49)	8.78 (4.71)	+
OFC	The ratio of employment in OFC-owned plants to total industry employment in each area	1.68 (2.47)	2.80 (3.80)	4.96 (5.77)	+
THM	The ratio of employment in THM-owned plants to total industry employment in each area	2.15 (4.62)	3.12 (5.97)	5.28 (11.47)	+

Source: Same as in Table 1.

a low technology gap (LTG).[14] The technology gap is measured as the difference between labor productivity of local firms and that of THM and that of OFC firms. If the technology gap of a region is greater than the average gap of the whole nation, this region is categorized as an HTG area; the opposit is true for LTG areas. Using the interactive term of the dummy variable for the HTG and the spillover variables in both THM and OFC investments facilitates understanding of the differences in the spillover effect from the alternative sources of FDI in the different areas of China. Because all economic variables are in real terms, the price index is calculated by the method proposed by Chiu-Chen and Huang (1993) and Huang and Chiu-Chen (1999).[15]

14. Because the spillover effects might vary across industries and the data used in conducting this study are only available for the regional samples, it is very hard to take the role of industrial differences into consideration herein. This article has tried to solve this problem by categorizing all regions into high and low groups in terms of technology gap, which might somehow represent the industrial difference, at least to a certain extent.

15. Chiu-Chen and Huang (1993) and Huang and Chiu Chen (1999) developed a method to calculate the price index for each region or industry in China. In this method, as the *China Industrial Economic Statistical Yearbook* provides the gross output value at current prices and at 1990 constant prices for each region/industry, the ratio of these two kinds

TABLE 3
Spillover Effect from FDI-Separate Estimations for Each Year

	Model 1 (LP as the dependent variable)			Model 2 (TFP as the dependent variable)		
	1993	1994	1997	1993	1994	1997
Constant	6.814*** (7.200)	8.146*** (7.812)	8.321*** (5.400)	1.148*** (8.872)	0.769*** (5.515)	0.931*** (8.861)
K/L	0.300*** (2.824)	0.098 (0.790)	0.152 (1.008)			
State-Owned	−0.007** (−2.720)	−0.002 (−0.606)	−0.008*** (−3.449)	−0.007*** (−4.243)	−0.004** (−2.366)	−0.007*** (−4.503)
Exports	−0.001 (−0.530)	2.6×10^{-4} (0.066)	0.006** (2.737)	0.001 (0.251)	−0.001 (−0.369)	0.004*** (3.220)
Imports	2.5×10^{-4} (0.151)	3.4×10^{-5} (0.242)	0.003 (0.973)	−0.001 (−0.798)	-4.1×10^{-5} (−0.436)	−0.001 (−0.771)
Coast	0.037 (0.343)	0.064 (0.683)	−0.110 (−0.987)	−0.003 (−0.038)	−0.015 (−0.262)	−0.130** (−2.245)
Scale	0.024*** (3.608)	0.052*** (2.837)	0.025*** (4.326)	0.013** (2.645)	0.023** (2.100)	0.014*** (3.404)
OFC	−0.013 (−1.412)	0.012 (0.450)	0.017 (1.194)	−0.007 (−1.111)	0.016 (0.868)	0.008 (0.801)
THM	0.013*** (3.451)	−0.001 (−0.044)	−0.012* (−1.823)	0.006** (2.4905)	−0.007 (−0.416)	−0.007 (−1.530)
Observations	30	30	30	30	30	30
Adj. R^2	0.488	0.582	0.664	0.450	0.366	0.584
Log-likelihood	13.200	12.594	14.575	23.764	22.347	28.406

Notes: The numbers in parentheses are *t*-statistics. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

V. THE ESTIMATED RESULTS

Two specifications of the empirical model are conducted to analyze the spillovers from FDI in Chinese industries. The dependent variable in model 1 is regional labor productivity in log form, whereas in model 2 the dependent variable is regional TFP. The estimations of these two models, taking into account heteroscedasticity, are quite consistent and are reported in Table 3.[16]

It is shown in Table 3 that the sign of the coefficient of most explanatory variables mirrors that which was originally expected. The significantly positive sign of the coefficient of (*K/L*) only in 1993 of model 1 indicates that the capital-labor ratio does not significantly contribute to productivity. This might be the result of overinvestment in Chinese industries and the policy of "limiting production to reduce inventory" during the periods studied. In addition, the output in regions with a high share of SOE demonstrates low levels of labor productivity and TFP, a finding which is consistent with our expectation. With regard to the trade-induced learning by doing effect, the empirical results show that it existed in Chinese industries only in 1997, which implies that the contribution of this effect has recently become more important in Chinese industrial productivity. Not unlike what was anticipated, the average production scale has a significantly positive influence on Chinese domestic labor productivity and TFP. However, imports do not seem to have an important influence on productivity, a conclusion similar to that of Chuang and Hsu (2001). No significant differences in labor productivity are found between coastal and noncoastal regions. However, TFP of coastal regions was lower than that of noncoastal regions in 1997 possibly due to the Asian financial crisis.

of gross output value is the price index for each region/industry (price index = 100 in 1990).

16. The correlation coefficient between THM and OFC in 1994 is the only one greater than 0.85. It is reasonable to be suspicious about the collinearity problem is present in the 1994 regression but not in the regression for other years. In addition, this problem, which only appears in 1994, does not change the primary findings of this article. The author appreciates an anonymous referee has pointed this out.

A. *The Spillover Effect from Different Sources of FDI*

Regarding the spillover effect from THM investment, Table 3 indicates that the THM coefficient was significantly positive in both models, but only in 1993. In other words, the significance of the spillover effects on Chinese industries from THM decreased after 1993. In sharp contrast, the coefficient of OFC was not significant in either model for all three years. That is to say, the foreign countries' investment did not have any spillover effects on Chinese industries as a whole during the periods studied.

The absence of spillovers from FDI found here is surprising and contradicts the conclusions of earlier studies. Positive spillovers could have been canceled out by negative spillovers, however. In addition to the reasons proposed by Globerman (1979),[17] the fact that all foreign enterprises provide higher payoffs might have been another factor producing negative spillovers.[18] In fact, all foreign enterprises with their high payoff lure many local outstanding managers and technicians, especially young new workers, further motivating them to switch their job choices from local firms to THM- or OFC-funded enterprises and eventually lowering domestic productivity. Undoubtedly, FDI has improved Chinese productivity in some ways but, ironically, lowered Chinese productivity in others. Thus it is reasonable to conclude that FDI enhances neither labor productivity nor TFP of Chinese industries during the periods studied.

17. The negative indirect economic benefit of foreign ownership comes about as a result of the centralization of substantive managerial decision making in the parent firm, which could possibly encourage talented managers and technicians to relocate outside the host country, thereby reducing productivity throughout the economy as a whole. In addition, a further explanation for the negative spillovers is that FDI contributes to the fragmented structure of the host country's manufacturing industries. This fragmented structure refers to a condition whereby too many firms operate below optimal size, producing too diverse of an array of output, which therefore lowers productivity in both foreign- and locally owned firms.

18. According to the *China Statistical Yearbook*, for example, the average 1997 annual wages of staff and workers in a foreign-funded economy and in an economy funded by entrepreneurs from THM were 10,361 and 9329 RMB, respectively. However, it was only 6747 and 4512 RMB in state-owned and urban/collective-owned units, respectively.

TABLE 4
Spillover Effect of Different Sources of FDI in Different Areas in China

	1993	1994	1997
Model 1 (LP as the dependent variable)			
A. OFC			
HTG Areas	−0.161	−0.018	−0.025
LTG Areas	2×10^{-4}	0.030	0.033
B. THM			
HTG Areas	0.097	0.013	0.087
LTG Areas	0.001	−0.017	−0.018
Model 2 (TFP as the dependent variable)			
A. OFC			
HTG Areas	−0.108	0.018	−0.025
LTG Areas	−0.001	0.015	0.020
B. THM			
HTG Areas	0.101	−0.014	0.071
LTG Areas	−0.002	−0.007	−0.011

B. *The Spillover Effect in Different Regions*

The other issue—the differences between the spillover effects from alternative sources of FDI in regions with different technology gaps in China—is investigated by adding two interactive terms, the technology gap dummy and THM and OFC as well as the technology gap dummy into both models. The empirical results of both models are summarized in Table 4 and demonstrate that THM investment contributes to spillovers in the HTG regions of China. By contrast, OFC investment might help Chinese industries improve their productivity, primarily in the LTG areas.[19]

The ease of technology transfer from FDI to local firms may partly explain this result. In the HTG regions, the relatively low level of advanced production, managerial, and marketing technologies provided by THM enterprises are more easily distributed than the relatively high level provided by OFC enterprises. In the LTG regions, locally owned enterprises require more advanced technology; hence higher technology OFC enterprises are more helpful in improving the productivity of the host countries than THM enterprises.

On the other hand, attracting local workers may have been another reason. Some investment-preferred regions, such as

19. The detailed estimation results are available on request.

Guangdong, Beijing, and Shanghai, are LTG regions for THM enterprises but HTG regions for OFC enterprises. Because these two FDI sources attract more productive local workers, they produce greater negative spillovers in these regions. Total spillovers from both THM and OFC enterprises in these regions are in fact insignificant. Therefore, THM and OFC enterprises might be helpful in improving productivity in the HTG and LTG regions in China, respectively.

VI. CONCLUSIONS

This study utilizes official Chinese cross-provincial data from various years of the *China Industrial Economic Statistical Yearbook* and the *China Statistical Yearbook* in 1993, 1994, and 1997 to investigate the following three questions: Does FDI increase Chinese productivity? What is the difference between spillovers from overseas Chinese investment and other foreign country investment? Do such spillovers differ in different regions of China?

Using two specifications of the empirical models, this article concludes that foreign countries' investment did not have any spillover effects on Chinese industries as a whole. On the other hand, the THM coefficient of both models was only significantly positive in 1993. In other words, the significance of the spillover effects from THM on Chinese industries decreased after 1993. In addition, using the difference-in-difference approach, THM investment principally contributed to spillovers in regions with an HTG of China. In contrast, OFC investment chiefly helped Chinese industries improve their productivity and TFP in regions with an LTG.

This article makes other contributions in this field. For one, it is found that the capital-labor ratio has a positive effect on productivity; moreover, the output in a region with a high share of state-owned firms demonstrates low productivity. The trade-induced learning by doing effect was only found in Chinese industries in 1997. Imports did not, however, seem to have had any significant influence on productivity. Finally, no significant differences in production performance are noted between coastal and noncoastal regions.

The referred periods of this study are limited to 1993, 1994, and 1997 on account of the paucity of data. This means that the findings of this study are only valid for these years. Provided that the data for later years become available, the analyses here should be expanded to determine whether these conclusions are further supported. Nevertheless, this study provides preliminary conclusions to help us better understand the spillover effects on Chinese industries from investment from THM and that from investment from other foreign countries. In addition, each source of FDI plays a contributory role in improving Chinese industrial productivity in specific regions. In line with the findings of this study, it is suggested that China might be better off if the government devises policies to attract more investment from THM to the HTG regions, but to encourage more investment from OFC to the LTG regions. Drafting and implementing such policies may well help China decrease the gaps brought about by the inequalities in regional development. Obviously, however, now that it has become a member of the World Trade Organization, these policies should not conflict with any of the country's agreements with the organization, such as the most-favored-nation treatment.

Apart from this, it is worth noting that the positive impact of FDI on the host country is not only in the enhancement of productivity but also in other aspects, like the increase in employment. Although this article concludes that the positive effects of spillovers on Chinese industries as a whole from THM investment existed only in 1993 and decreased after that and that for the most part OFC investment did not have any spillover effects, the potential contribution of FDI to the development of the Chinese economy should not be ignored.

APPENDIX TABLE A1

Estimated Production Function for Each Year and TFP for Each Region in 1993, 1994, and 1997

	1993	1994	1997
Constant	0.90	−0.35	0.22
	(0.91)[1]	(−0.27)	(0.17)
Log (L)	0.5***	0.28	0.39**
	(3.48)	(1.33)	(2.35)
Log (K)	0.62***	0.85***	0.72***
	(3.77)	(3.76)	(3.84)
Observations	30	30	30

continued

APPENDIX TABLE A1
continued

	1993	1994	1997
Adjusted R^2	0.97	0.97	0.96
Log-Likelihood	5.09	1.77	0.03
Regions			
Beijing	0.662	0.916	0.618
Tianjin	0.608	0.571	0.513
Hebei	0.646	0.579	0.740
Shanxi	0.543	0.466	0.506
Inner Mongolia	0.449	0.392	0.521
Liaoning	0.705	0.611	0.456
Jilin	0.584	0.494	0.447
Heilongjiang	0.624	0.613	0.692
Shanghai	0.968	0.854	0.872
Jiangsu	0.945	0.870	0.858
Zhejiang	0.916	0.731	0.777
Anhui	0.813	0.693	0.835
Fujian	0.764	0.717	0.688
Jiangxi	0.724	0.616	0.510
Shandong	0.870	0.755	0.865
Henan	0.610	0.577	0.670
Hubei	0.845	0.741	0.867
Hunan	0.588	0.621	0.629
Guangdong	0.972	0.672	0.767
Guangxi	0.871	0.798	0.571
Hainan	0.596	0.449	0.422
Sichuan	0.711	0.584	0.555
Guizhou	0.737	0.535	0.594
Yunnan	1.000	1.000	1.000
Tibet	0.438	0.394	0.553
Shaanxi	0.644	0.475	0.497
Gansu	0.583	0.514	0.480
Qinghai	0.450	0.447	0.284
Ningxia	0.443	0.362	0.447
Xinjiang	0.458	0.363	0.562

Notes: The numbers in parentheses are t-statistics. The null hypothesis of constant return to scale cannot be accepted. Results are corrected for heteroscedasticity.

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