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Do Institutions Matter for FDI Spillovers?

The Implications of China's "Special Characteristics"

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Abstract

The authors investigate how institutions affect productivity spillovers from foreign direct investment (FDI) to China's domestic industrial enterprises during 1998-2007. They examine three institutional features that comprise aspects of China's "special characteristics": (1) the different sources of FDI, where FDI is nearly evenly divided between mostly Organization for Economic Co-operation and Development (OECD) countries and Hong Kong (SAR of China), Taiwan (China), and Macau (SAR of China); (2) China's heterogeneous ownership structure, involving state- (SOEs) and non-state owned (non-SOEs) enterprises, firms with foreign equity participation, and non-SOE, domestic firms; and (3) industrial promotion via tariffs or through tax holidays to foreign direct investment. The authors also explore how productivity spillovers from FDI changed with China's entry into the WTO in late 2001. They find robust positive and significant spillovers to domestic firms via backward linkages (the contacts between foreign buyers and local suppliers). The results suggest varied success with industrial promotion policies. Final goods tariffs as well as input tariffs are negatively associated with firm-level productivity. However, they find that productivity spillovers were higher from foreign firms that paid less than the statutory corporate tax rate.

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I. Introduction

Since opening its economy to the outside world in late 1978, China has absorbed an increasing amount of FDI. It is now among the world's largest hosts for foreign investment, and has in recent years consistently ranked number one as the largest developing country recipient of FDI inflows. Potential technology transfer is likely to have been an important rationale behind the Chinese government's aggressive efforts over the past two decades to attract foreign investment to China (Hu and Jefferson (2002)). Indeed, the Chinese government has intervened extensively to promote industrialization in China, relying on a range of policy instruments. These instruments include tariffs, tax subsidies, and promotion of foreign investors in key sectors.

One typical justification for subsidizing incoming foreign investment is an externality in the form of productivity spillovers. Productivity spillovers take place when the entry or presence of multinationals increases the productivity of domestic firms. If such spillovers occur, then multinationals do not fully internalize the value of these benefits. We define intra-industry spillovers (also called horizontal spillovers) as occurring when domestic firm productivity is positively affected by firms with foreign equity participation located in the same sector, while inter-industry spillovers (vertical spillovers) occur when domestic firms are affected by firms with foreign equity in the upstream (forward linkage) or downstream sectors (backward linkages).

A number of recent papers test for productivity spillovers from foreign investment. Most of these studies, such as papers by Haddad and Harrison (1993) on Morocco, Aitken and Harrison (1999) on Venezuela, and Konings (2001) on Bulgaria, Romania and Poland, either failed to find evidence of horizontal spillovers or reported negative horizontal spillover effects. More recently, Javorcik (2004) and Blalock and Gertler (2008) argued that since multinationals may simultaneously have an incentive to prevent information leakage that would enhance the performance of their local competitors, while at the same time possibly benefitting

from transferring knowledge to their local suppliers or clients, spillovers from FDI are more likely to be negative along the horizontal dimension and positive along the vertical dimension. Javorcik uses firm-level data from Lithuania and Blalock and Gertler (2008) use data for Indonesia to show that positive FDI spillovers take place through backward linkages (between foreign affiliates and their local suppliers); however, there is no robust evidence of positive spillovers occurring through either the horizontal or the forward linkage channel.

One recent manuscript that investigates both horizontal and vertical FDI spillovers in China is Lin, Liu, and Zhang (2009).   In contrast to Javorcik (2004), Lin, Liu, and Zhang find bigger forward and smaller backward spillovers.   Our results will differ from theirs, in part because we focus on total factor productivity and they examine value-added productivity and also use a different estimation method. We also expand the analysis to explore the relationship between trade policies, tax incentives, and externalities from foreign investment.   To our knowledge, ours is the first study to explore—in China or elsewhere--how productivity gains from foreign investment vary with tax and tariff policies.

There are also a set of theoretical studies demonstrating that positive FDI spillovers are more likely to operate across industry rather than within an industry. These studies emphasize efforts to minimize the probability of imitation, especially under imperfect intellectual property rights in the host country. As Markusen and Venables (1998) point out, proximity to potential domestic competitors with absorptive capacity to reverse engineer proprietary technology would be detrimental to a multinational, thus motivating it to set up its subsidiaries where potential rivals cannot erode its market share. By contrast, the multinational can benefit from knowledge diffusion when it reaches downstream clients and upstream suppliers, which will encourage vertical flows of generic knowledge that lead to inter-industry spillovers.

This study goes further by investigating the implications of the institutional context for the nature of spillovers.   In particular, we examine three institutional features that comprise aspects of China's "special characteristics": the different

sources of FDI, which are nearly evenly divided between mostly OECD countries and Hong Kong (SAR of China), Taiwan (China) and Macau (SAR of China) (henceforth, Hong Kong-Taiwan-Macau for short); China's extraordinarily heterogeneous ownership structure, involving state, foreign, and domestic ownership, and tax incentives such as income tax holidays and tariffs. Many foreign investors in China over the last ten years have faced much lower corporate tax rates; before 2008, foreign investors received a 15 percent corporate tax rate while domestic enterprises faced a regular 33 percent corporate tax rate[4]. This policy of promoting foreign investors and other favored firms in China was only discontinued in 2008.

In addition to exploring the differential effects of foreign investment linkages across special characteristics in explaining productivity performance, we also examine how globalization has affected Chinese firm performance. Until 1990, average tariffs on manufacturing in China were as high as 50 percent. There is a rich literature which examines the impact of trade liberalization on productivity, although there are fewer studies that disentangle the effects of input and output tariffs. One example is Amiti and Konings (2007), who use Indonesian manufacturing census data to show that the effect of reducing input tariffs significantly increases productivity, and that this effect is much higher than reducing output tariffs. For China, Brandt, Biesebroeck and Zhang (2008) focus specifically on the impact of trade liberalization on productivity. Using Chinese firm-level data (1998-2005), they suggest that a ten percentage point reduction in final good output tariffs results in an increase in TFP of 0.42 percent.

Our results suggest varied outcomes from promoting domestic productivity growth through these different instruments. The benefits via vertical linkages from foreign investment have been significant and positive, but the impact of tariffs on total factor productivity growth has been negative. We find some horizontal

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[4] However, the government adjusted this preferential policy in 2008. Starting from Jan 1, 2008, the new corporate tax policy for foreign-invested firms is the following: foreign-invested firms that previously receive preferential corporate tax rates will return to the regular tax rate within 5 years. In 2008, the tax rate increases from 15% to 18%; in 2009, the rate keeps increasing to 20%; in 2010, the corporate tax rate is 22% and will finally reach 25% in 2012.

externalities from foreign direct investment (FDI), although the positive effect as well as the significance varies across specifications. We find particularly strong evidence of positive and significant vertical linkages to domestic firms via backward linkages. Productivity of domestically owned firms has been boosted primarily via contacts between domestic suppliers and foreign buyers of their products.

This paper also shows that firm ownership and sources of FDI significantly affect the magnitude of FDI spillovers. After we recalculate sector-level FDI based on its origin[5], we find that investors from Hong Kong-Taiwan-Macauand those from the rest of the world, largely the OECD region, generate completely different horizontal linkages for domestic firms. That is, OECD investors do help domestic firms located in the same industry whereas investors from Hong Kong-Taiwan-Macau hurt their domestic counterparts or have no impact.

For trade policy, our results suggest a negative, significant effect of final goods tariffs on domestic productivity. We also test for the effects of input tariffs on productivity, and find negative and significant effects of input tariffs on productivity. Exploiting the exogenous change in trade policies with China's entry into the WTO at the end of 2001, we find that the magnitude of backward linkages increased with trade liberalization. Since China's entry into the WTO put pressure to phase out domestic content rules (in order to comply with the WTO), we would have expected to find a reduction in backward linkages. Instead, backward linkages became stronger after WTO entry.

Finally, we explore the rationale for tax subsidies bestowed on foreign investors. If the Chinese government correctly targets, through tax concessions, those firms with greater potential for capturing spillovers, we would expect stronger linkages associated with tax breaks. We find statistically significant evidence of stronger productivity externalities associated with firms that received tax breaks.

Our empirical strategy follows Javorcik (2004) and Olley and Pakes (1996) (henceforth OP). First, we use Javorcik's (2004) empirical strategies to calculate

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[5] This means that we will have two sets of sector-level FDI variables. One of them is calculated based on foreign investment contributed by Hong Kong-Taiwan-Macau investors and the other set is obtained based on foreign assets provided by investors from OECD countries.

Backward and *Forward* linkages and follow her estimation models to test whether there are vertical FDI spillovers in the manufacturing sector in China. We address the endogeneity of inputs by applying the strategy proposed by OP. We also apply a variety of specifications to take into account firm-specific fixed effects, and find that our results are robust to these alternative approaches.

The rest of paper is organized as follows. Section II describes the basic framework and the data used in this paper. We also review broad trends for the 1998 through 2007 period. Section III discusses the econometric issues and presents the empirical results. Section IV concludes.

II. Basic Framework and Data

Section II.A describes the analytical framework, estimation equation, and measures for constructing the key spillover variables that we use. Section II.B describes the key features of our firm-level panel data set and the summary statistics for our sample period.

A. Basic Framework

To examine the impact of intra- and inter-industry FDI spillovers and trade policy across various institutional dimensions on firm productivity, we employ the following basic model, inspired by Aitken and Harrison (1999) and Javorcik (2004):

$$\ln Y_{ijt} = \alpha + \beta_1 \ln K_{ijt} + \beta_2 \ln L_{ijt} + \beta_3 \ln M_{ijt} + \beta_4 ForeignShareHKTM_{ijt} + \beta_5 ForeignShareFR_{ijt}$$
$$+ \beta_6 StateShare_{ijt} + \beta_7 Horizontal_{jt} + \beta_8 Backward_{jt} + \beta_9 Forward_{jt} + \alpha_i + \alpha_t + \varepsilon_{ijt} \text{ (1)}.$$

Y_{ijt} is the quantity produced by firm i in sector j at time t. It is calculated by deflating the output value (quantities*prices) by the sector-specific ex-factory price

index of industrial products in order to separately identify quantity[6]. K_{ijt}, capital, is defined as the value of fixed assets, which is deflated by the fixed assets investment index, and L_{ijt} is the total number of employees. M_{ijt} represents the intermediate inputs purchased by firms to use for production of final products, which is deflated by the intermediate input price index.[7] *ForeignShareHKTM$_{ijt}$*, *ForeignShareFR$_{ijt}$* and *StateShare$_{ijt}$* are defined as the share of the firm's total equity owned by Hong Kong-Taiwan-Macau investors, foreign investors, and the state respectively. The omitted share, the non-state domestically-owned share, is represented by the constant term. By construction, these three firm-level controls are continuous variables and range from 0 to 1 in value[8].

The motivation for separating foreign share into two types is two-fold. First, we would like to see whether some types of foreign investment are more likely to result in productivity spillovers than others. Second, anecdotal evidence suggests large quantities of so-called foreign investors in China are actually domestic investors who channel investment through Hong Kong–Taiwan-Macau in order to take advantage of special treatment for foreign firms (so-called "round tripping"). If this is the case, then we would expect that foreign investment of this type might have a smaller impact on domestic firms.

Following Javorcik (2004), we define three sector-level FDI variables. First, *Horizontal$_{jt}$* captures the extent of foreign presence in sector j at time t and is defined as foreign equity participation averaged over all firms in the sector, weighted by each firm's share in sectoral output. In other words,

$$Horizontal_{jt} = \left[\sum_{i\,for\,all\,i\in j} ForeignShare_{it} * Y_{it} \right] / \sum_{i\,for\,all\,i\in j} Y_{it} \ (2),,$$

where *ForeignShare$_{it}$* is the sum of *ForeignShareHKTM* and *ForeignShareFR* . Second, *Backward$_{jt}$* captures the foreign presence in the sectors that are supplied by

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[6] Sector-specific ex-factory price indices for industrial products came from China Urban Life and Price Yearbook (2008, Table 4-3-3). The price indices are published for 29 individual sectors.
[7] Price indices for fixed investment and industry-wide intermediate inputs are obtained from the Statistical Yearbook (2006) (obtained from the website of the National Bureau of Statistics of China).
[8] In some specifications, we run regressions with domestic firms only. In these cases, we use the sample of pure domestic firms, which have zero foreign investment. Then we regress either the log of the firm's output or productivity on sector-level FDI without the variable "Foreign Share".

sector j[9]. Therefore, $Backward_{jt}$ is a measure for foreign participation in the downstream industries of sector j. It is defined as

$$Backward_{jt} = \sum_{k \, if \, k \neq j} \alpha_{jk} Horizontal_{kt} \quad (3).$$

The value of α_{jk} is taken from the 2002 input-output table[10] representing the proportion of sector j's production supplied to sector k. Finally, $Forward_{jt}$ is defined as the weighted share of output in upstream industries of sector j produced by firms with foreign capital participation. As Javorcik points out, since only intermediates sold in the domestic market are relevant to the study, goods produced by foreign affiliates for exports (X_{it}) should be excluded. Thus, the following formula is applied:

$$Forward_{jt} = \sum_{m \, if \, m \neq j} \delta_{jm} \left[\left[\sum_{i \, for \, all \, i \in m} ForeignShare_{it} * (Y_{it} - X_{it}) \right] / \left[\sum_{i \, for \, all \, i \in m} (Y_{it} - X_{it}) \right] \right] (4).$$

The value of δ_{jm} is also taken from 2002 input-output table. Since $Horizontal_{jt}$ already captures linkages between firms within a sector, inputs purchased within sector j are excluded from both $Backward_{jt}$ and $Forward_{jt}$.

B. Data and Broad Trends

The dataset employed in this paper was collected by the Chinese National Bureau of Statistics. The Statistical Bureau conducts an annual survey of industrial plants, which includes manufacturing firms as well as firms that produce and supply electricity, gas, and water. It is firm-level based, including all state-owned enterprises (SOEs), regardless of size, and non-state-owned firms (non-SOEs) with annual sales of more than 5 million yuan. We use a ten-year unbalanced panel dataset, from 1998 to 2007. The number of firms per year varies from a low of 162,033 in 1999 to a high of 336,768 in 2007. The sampling strategy is the same throughout the sample

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[9] For instance, both the furniture and apparel industries use leather to produce leather sofas and leather jackets. Suppose the leather processing industry sells 1/3 of its output to furniture producers and 2/3 of its output to jacket producers. If no multinationals produce furniture but half of all jacket production comes from foreign affiliates, the *Backward* variable will be calculated as follows: 1/3*0+2/3*1/2=1/3.

[10] Input-ouput tables of China (2002) Table 4.2, which divides manufacturing industry into 71 sectors.

period (all firms that are state-owned or have sales of more than 5 million yuan are selected into the sample); the variation of numbers of enterprises across years may be driven by changes in ownership classification or by increases (or reductions) in sales volume in relation to the 5 million yuan threshold. However, the data show that 5 million yuan is not a strict rule. Among non-SOEs, about 6 percent of the firms report annual sales of less than 5 million yuan in 1998; this number rises to 8 percent by 1999 and falls after 2003. In 2007, only 1 percent of non-SOEs have annual sales below 5 million yuan. In terms of the full sample, the percent of firms with sales less than 5 million yuan stays at the same level for 1998 and 1999 and starts falling in 2000. In 2007, around 2 percent of the sample consists of firms with annual sales less than 5 million yuan.

The original dataset includes 2,226,104 observations and contains identifiers that can be used to track firms over time. Since the study focuses on manufacturing firms, we eliminate non-manufacturing observations. The sample size is further reduced by deleting missing values, as well as observations with negative or zero values for output, number of employees, capital, and the inputs, leaving a sample size of 1,842,786. Due to incompleteness of information on official output price indices, three sectors are dropped from the sample[11]. Thus, our final regression sample size is 1,545,626.

The dataset contains information on output, fixed assets, total workforce, total wages, intermediate input costs, foreign investment, Hong Kong-Taiwan-Macau investment, sales revenue, and export sales. These are the key variables from which we obtain measures of firm-level foreign asset shares and the FDI spillover variable, which are discussed in detail in the next section. In this paper, to test the impact of FDI spillovers on domestic firm productivity, we use the criterion of zero foreign ownership to distinguish domestic firms and foreign owned firms, that is, domestic firms are those with zero foreign capital in their total assets. In the dataset,

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[11] They are the following sectors: processing food from agricultural products; printing, reproduction of recording media; and general purpose machinery.

1,197,597 observations meet the criterion[12].

Table 1 reports the summary statistics for the main variables used in the regressions. The summary statistics indicate the mean of the ratios, which is different than weighted means which would give more weight to larger firms. The first three columns report means for levels and the last three columns report means for growth rates of the key variables used in the analysis.

The statistical means highlight the remarkable growth rates exhibited by the manufacturing sector during this period, with average real output growing 13.5 percent a year, and the net capital stock growing 10.7 percent per year. Labor input grew significantly slower, with average annual increases of only 1.3 percent per year. Total factor productivity grew on average 5.6 percent per year, implying a forty percent contribution to overall growth. The means also document that on average foreign-invested assets have been almost evenly split between sources in Hong Kong-Taiwan-Macau and foreign investment originating in other locations. The state continues to play an important role in manufacturing, with a mean asset share of 8.9 percent during the sample period; over the sample period the share of total foreign investment in manufacturing is significantly larger, at 16.8 percent. For the sample as a whole, the average state share during this period fell by approximately 0.7 percentage point per year.

In Tables 2-1, 2-2, 2-3, and 2-4, we provide summary statistics for the four sets of spillover variables. Table 2-1 shows that the share of foreign-invested assets at the sector level, the horizontal foreign share, increased over the sample period from 20.4 to 26.7 percent. To take into account the sources of FDI for sectoral spillovers, we re-calculate sector-level FDI variables from two broad geographic categories. To explore the importance of the source of foreign investment within the firm for productivity, we calculate firm-level foreign investment, horizontal foreign shares,

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[12] Actually, the international criterion used to distinguish domestic and foreign-invested firms is 10%, that is, the share of subscribed capital owned by foreign investors is equal to or less than 10%. In the earlier version of the paper, we tested whether the results are sensitive to using zero, 10%, and 25% foreign ownership. Our results show that between the zero and 10% thresholds, the magnitude and the significance levels of the estimated coefficients remain close, which makes us comfortable using the more restrictive sample of domestic firms for which the foreign capital share is zero. The results based on the 25% criterion exhibit small differences, but the results are generally robust to the choice of definition for foreign versus domestic ownership.

and vertical foreign shares for Hong Kong-Taiwan-Macau FDI, and for foreign investment originating in other locations, i.e. principally the OECD countries. Table 2-2 shows basic summary statistics for these two sets of sectoral spillover variables. The basic summary statistics show that the two sets have exhibited different trends over time. FDI shares for Hong Kong-Taiwan-Macau investment steadily increased over the period of 1998-2003. In contrast, FDI from other regions shows an even faster and steadily increasing pattern of growth over the entire time period, with more than a doubling of foreign investment shares. It is clear from Tables 2-2 that most of the increase in foreign investment over 1998-2007 originated inside the OECD countries.

Table 2-3 reports trends in subsidized and non-subsidized foreign investment. While the standard tax rate across all firms during the sample period was 33 percent, a large share of foreign-owned firms were granted tax subsidies, thus facing tax rates that were significantly lower. In the left panel of Table 2-3, we redefine our sector-level foreign share variables by restricting them to only those foreign firms who paid less than the statutory tax rate. In the right panel of Table 2-3, we redefined sector-level foreign share to restrict it to those firms who paid the full rate. The trends show a steady increase in subsidized foreign investment between 1998 and 2007. By the end of the sample period, the majority of foreign investors received some form of a tax subsidy.

Figure 1 shows the distribution of taxes paid by different types of enterprises for the year 2004. The top left-hand side quadrant shows that a large share of non-SOEs paid the 33 percent tax rate. However, only a small minority of foreign-invested firms paid the statutory rate, as indicated by the bottom right-hand side quadrant. In 2004, 7 percent of foreign-invested firms paid the statutory rate, compared to almost 40 percent for domestically-owned enterprises. In figure 2, we re-plot the tax distribution with the domestic non-SOEs (non-foreign and non-SOE enterprises) and find that more than 35% of firms paid the 33 percent tax rate.

Table 2-4 reports the percentage of firms who were subsidized based on value-added taxes, which are reported separately from income taxes on profits.

Fewer firms receive subsidies in the form of exemptions on value-added taxes. These exemptions increased until 2003, then declined. It is clear from these tables that income tax holidays were a more pervasive form of incentives until the 2008 tax reform.

III. Estimation and Results

A. Baseline Results

We begin the analysis by estimating the model described in equation (1) using ordinary least square (OLS) with and without firm fixed effects. Columns (1) and (2) of Table 3 are estimated with the dependent variable as the log of the firm's deflated output. To study the impact of FDI spillovers on the performance of domestic firms, we are interested in how FDI invested in other firms affect the domestic firms located in the same sector. Therefore, the key parameters in the above specification are β_7, β_8 and β_9.

One possibility that has not been explored in the literature on vertical and horizontal linkages is that foreign investment shares are proxying for different trade policies across sectors. Protected sectors may be more likely to receive foreign investment as these firms may be motivated to relocate in order to circumvent tariff or non-tariff barriers ("tariff-jumping" foreign investment, which leads to immiserizing effects as modeled by Diaz Alejandro (1977)). In this case, the gains from foreign investment could be under-estimated due to omitted variable bias.

To control for the effects of trade policies, we have created a time series of tariffs, obtained from the World Integrated Trading Solution (WITS), maintained by the World Bank. We aggregated tariffs to the same level of aggregation as the foreign investment data, using output for 2003 as weights. We also created forward and backward tariffs, to correspond with our vertical FDI measures. Table 1 and Table A-5 show basic summary statistics for these tariff variables. During the sample period, average tariffs fell nearly 9 percentage points, which is a significant change over a short time period. While the average level of tariffs during this

period, which spans the years before and after WTO accession, was nearly 13 percent, this average masks significant heterogeneity across sectors, with a high of 41 percent in grain mill products and a low of 4 percent in railroad equipment.

We initially pool the data to include both firms with and without foreign investment, reporting results with and without firm fixed effects.   The first column of Table 3, with the application of fixed effects, shows that firm productivity levels are higher for firms with participation from other (OECD) investors than those from Hong Kong-Taiwan-Macao, and lower for firms with state-owned assets.   There are no significant horizontal spillovers, but backward vertical linkages are positive and statistically significant.   Final goods tariffs are negative and significantly associated with productivity in the OLS fixed effect specifications, but not in the fixed effect specifications.   This suggests that tariffs are imposed in sectors where productivity is lower, but the association between changes in tariffs and changes in productivity across all firms is weak.   We will see that the negative significance of tariffs is stronger when we split the sample based on ownership differences later in the paper.

Comparing the fixed effects results in the first column with the second column (where firm fixed effects are omitted), the results are consistent across the two specifications.   As expected, the coefficient on capital's output elasticity is attenuated with the fixed effect estimator.   While foreign-invested firms are much more efficient and state-invested enterprises are much less efficient than the non-state-domestically-invested enterprises that represent the reference, once firm fixed effects are controlled for the differences are much smaller.   Such differences suggest important differences between productivity levels and growth rates of state owned and foreign enterprises versus other types of enterprises.

Also using the entire sample, the third and fourth columns of Table 3 compare OLS and fixed effect estimates using Olley and Pakes (1996) to correct for the potential endogeneity of input choice. The earlier literature on production function estimation shows that the use of OLS is inappropriate when estimating productivity, since this method treats labor, capital and other input variables as exogenous. As Griliches and Mairesse (1995) argue, inputs should be considered

endogenous since they are chosen by a firm based on its productivity. Firm-level fixed effects will not solve the problem, because time-varying productivity shocks can affect a firm's input decisions.

Using OLS will therefore bias the estimations of coefficients on the input variables. To solve the simultaneity problem in estimating a production function, we employ the procedure suggested by Olley and Pakes (1996) (henceforth OP), which uses investment as a proxy for unobserved productivity shocks. OP address the endogeneity problem as follows. Let us consider the following Cobb-Douglas production function in logs:

$$y_{it} = \beta_k k_{it} + \beta_l l_{it} + \beta_m m_{it} + \omega_{it} + \varepsilon_{it}.$$

y_{it}, k_{it}, l_{it}, and m_{it} represent log of output, capital, labor, and materials, respectively. ω_{it} is the productivity and ε_{it} is the error term (or a shock to productivity). The key difference between ω_{it} and ε_{it} is that ω_{it} affects firm's input demand while the latter does not. OP also make timing assumptions regarding the input variables. Labor and materials are free variables but capital is assumed to be a fixed factor and subject to an investment process. Specifically, at the beginning of every period, the investment level a firm decides together with the current capital value determines the capital stock at the beginning of the nest period, i.e.

$$k_{it+1} = (1 - \sigma)k_{it} + i_{it}.$$

The key innovation of OP estimation is to use firm's observable characteristics to model a monotonic function of firm's productivity. Since the investment decision depends on both productivity and capital, OP formulate investment as follows,

$$i_{it} = i_{it}(\omega_{it}, k_{it}).$$

Given that this investment function is strictly monotonic in ω_{it}, it can be inverted to obtain

$$\omega_{it} = f_t^{-1}(i_{it}, k_{it}).$$

Substituting this into the production function, we get the following,

$$y_{it} = \beta_k k_{it} + \beta_l l_{it} + \beta_m m_{it} + f_t^{-1}(i_{it}, k_{it}) + \varepsilon_{it}$$
$$= \beta_l l_{it} + \beta_m m_{it} + \phi_t(i_{it}, k_{it}) + \varepsilon_{it}$$

In the first stage of OP estimation, the consistent estimates of coefficients on labor and materials as well as the estimate of a non-parametrical term (ϕ_t) are obtained. The second step of OP identifies the coefficient on capital through two important assumptions. One is the first-order Markov assumption of productivity, ω_{it} and the timing assumption about k_{it}. The first-order Markov assumption decomposes ω_{it} into its conditional expectation at time t-1, $E[\omega_{it} \mid \omega_{it-1}]$, and a deviation from that expectation, ζ_{it}, which is often referred to the "innovation" component of the productivity measure. These two assumptions allow it to construct an orthogonal relationship between capital and the innovation component in productivity, which is used to identify the coefficient on capital.

The biggest disadvantage of applying the OP procedure is that many firms report zero or negative investment. To address this problem, we also explore the robustness of our results to using the Levinsohn Petrin (2003, henceforth LP) approach. With the OP correction, we can get an unbiased estimate of the firm's productivity. Therefore, the independent variable then becomes total factor productivity (TFP) instead of the log of output. Specifically, this is a two-stage estimation procedure when using TFP as the dependent variable. The first step is to use OP to obtain unbiased coefficients on input variables and then calculate TFP (residual from the production function). Estimates of input coefficients from the first step using both OLS with firm fixed effects as well as the OP procedure are reported in Appendix Table A-1. The second step is to regress TFP on firm-level controls and FDI variables.

Moulton showed that in the case of regressions performed on micro units that also include aggregated market (in this case industry) variables, the standard errors from OLS will be underestimated. As Moulton demonstrated, failing to take account of this serious downward bias in the estimated errors results in spurious findings of

the statistical significance for the aggregate variable of interest. To address this issue, the standard errors in the paper are clustered for all observations in the same industry.

As a robustness check, we also employed the procedure suggested by LP, which uses intermediate inputs as a proxy for unobserved productivity shocks. With LP's correction, the estimation procedure is also two-stage. In the first stage, we obtain input shares and calculate the firm's total factor productivity (TFP) (i.e., the residuals from production function). In the second stage, we regress TFP on the remaining independent regressors in this initial specification. However, to save on space we only report the results using the OP, and not the LP procedure. The results are qualitatively similar using both approaches. The results in the last two columns of Table 3 present the pooled estimates using the OP method. Across all specifications, the coefficient on the backward measure varies between .8 and 1.1. The coefficient, which is significant across specifications, implies that a one percentage point increase in backward FDI would be associated with between a .8 and 1.1 percentage point increase in output. These magnitudes are twice as large as those found by Blalock and Gertler (2008) for Indonesia but smaller than in Javorcik (2004) for Lithuania. Javorcik (2004) found that a comparable 1 % increase in the share of FDI through backward linkages would boost TFP by 3 to 4 %, which is 3 to 4 times bigger.

The coefficients on horizontal and forward are generally not significant. The point estimates, at 0.16, imply that a 1 percentage point increase in the share of (horizontal or forward) FDI would be associated with a .16 percentage point increase in output.

The specifications in Table 3 do not distinguish between domestic firms or foreign-invested enterprises. In all the results which follow, we separate firms into foreign-invested firms—those with some positive foreign ownership—and domestically-owned firms—defined as enterprises with zero foreign ownership. The baseline results, which incorporate firm fixed effects, are presented in Table 4. Comparing the results across three different samples (all, foreign-invested, and

domestic firms) shows differences in the patterns of FDI spillovers across different groups. Horizontal spillovers are significantly positive only for domestic firms. The coefficient estimate, at .19, indicates that a 1 percentage point increase in horizontal FDI would be associated with a .19 percentage point increase in output.

Backward linkages are similar in magnitude to the previous results. The coefficient estimates, around .8, indicate that a percentage point increase in backward FDI would lead to an increase in output for domestic enterprises of .8 percentage points. Foreign-invested enterprises benefit from other foreign investment through both backward and forward linkages, indicating benefits to foreign-invested enterprises from purchasing inputs from other foreign firms. The magnitudes of the vertical linkages are generally larger for foreign-invested firms, suggesting that firms with foreign equity are even more likely to benefit from being near other joint ventures.

The F-tests listed at the bottom of the Table 4 identify whether these differences are statistically significant. As reported in the F-tests, the magnitudes are significantly larger for foreign-invested firms vis-à-vis forward linkages but not significantly different with regards to backward linkages. This implies that foreign-invested firms benefit more than domestically-invested firms from interacting with upstream foreign suppliers. Due to these significant differences, in the rest of the paper we separately report the effects of horizontal and vertical spillovers on firms according to their degree of foreign asset participation.

Our results show that positive externalities are operating via all of the linkages: horizontal, forward and backward. The positive forward linkages imply that enterprises benefit from foreign firms that are upstream to their operations. The evidence is also consistent with strong backward linkages, suggesting that enterprises benefit from foreign firms that are downstream, who may use domestic firms as input suppliers. With the sample of all and domestic firms, the coefficient on the state's share in equity in Table 4 is negative and statistically significant, indicating that increases (decreases) in state-invested shares are associated with falling (increasing) productivity. We discuss the different effects of spillovers

across ownership categories in more detail in subsection C below. The results on the state share are consistent with rising productivity for privatizing enterprises. We also find that the coefficients on the final goods tariff measures are generally negative and statistically significant; our expanded discussion on the role of trade policy is in subsection D below.

Our results differ significantly from Javorcik (2004) and other studies of vertical linkages through foreign investment; all previous studies find significant and positive coefficients for "*Backward*" but not for "*Forward*", and they explain that the vertical spillovers occurred through contracts between multinational consumers and domestic suppliers. In our case, an additional linkage occurs—vertical spillovers take place through contracts between domestic firms who source inputs from multinational suppliers as well.

One possible explanation is that the foreign participation in the upstream sectors may increase the variety of inputs and provide more sources of inputs to the downstream firms and thus lead to a higher productivity in downstream firms. Ethier (1982) provides theoretical support for this argument, showing that access to a greater variety of inputs results in a higher productivity of downstream industries. Arnold, Javorcik and Mattoo (2008) also show that FDI can improve the performance of downstream firms by increasing the range of intermediate inputs available. Since costs of intermediate inputs account for a much larger share of output than is typically the case in other countries, it is not surprising that access to lower cost or higher quality inputs has such a significant impact on domestic firm productivity.

To the extent that foreign investors induced additional competition among supplying enterprises, we would expect that foreign firms would have led to downward pressure on prices in those sectors where backward linkages are greatest. Without proper deflators, this would have appeared as falling productivity in those sectors, with falling prices being misinterpreted as falling output instead. One way to test if this possibility is correct is to examine whether sector-level prices during the sample period were systematically related to foreign activity. Appendix Table

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A-2 shows that this is indeed the case. Price levels fell significantly in sectors where foreign firms exerted a significant downward pressure via backward linkages. Since industry-level fixed effects are included in the estimation, the results can be interpreted to suggest that one important vehicle through which foreign firms played a key role was by exerting downward pressure on prices of domestic suppliers. The evidence on the competition effect induced by foreign firms on prices of input suppliers reported in Table A-2 is also useful in another respect. It illustrates the importance of using sector-specific price deflators (or prices) when identifying the spillovers from foreign investment, and explains why previous work on China failed to identify backward spillovers.

In Table A-1, we compare the coefficient estimates using OLS with firm fixed effects and the OP approach. OP, as well as LP predict, after implementing these two-stage procedures, that the coefficient on L should decrease, the coefficient on intermediate inputs should decrease and the coefficient on capital should increase. The results are generally consistent with these predictions across ownership classes. The coefficient on capital inputs is higher using OP across all specifications. We also generally find that the coefficient on the labor shares and material shares are lower with OP. What is unusual across all specifications is that the labor share is very low, compared to estimates for other countries, while the coefficient for input costs is very high. As a robustness check, we performed two tests. First, we calculated the share of labor expenditures in total output—the labor share in output according to the data. Under certain plausible restrictions (i.e., Cobb-Douglas production function, perfect competition) the coefficients on the factor inputs in our estimating equations should equal the factor shares. Imposing these restrictions, the estimate of labor's share over the sample period is around 10 percent (reported in column (5) of Table A-3), which is similar to the underlying OLS fixed effect estimates reported in Table A-1. Second, we compare the implied average wages from our sample (calculated by dividing total wages by the number of employees with average wages reported in the Chinese Statistical Yearbook for 1998 through 2007. The results are listed in Appendix Table A-3. From Table A-3, we

can see that the average wages from the dataset are close to that from the statistical yearbook, although there are some differences.   We also compute in column (6) of Table A-3 the ratio of both wages and non-wage costs to total output, and the average is not much different than 10 percent.   While labor's share could be too low and the share of intermediate inputs too high, we feel confident that the factor shares implied by the OLS and OP coefficient estimates are broadly consistent with the factor shares in our data as well as external evidence.

B.   The Effects of Different Sources of Foreign Investment

In many FDI spillover studies, all domestic firms are assumed to benefit equally from FDI. However, different indigenous firms have varying absorptive capacities and the effectiveness of technology diffusion depends on technological capacities of indigenous firms as well as the characteristics of the foreign investors. To provide insights into the effect of this externality of FDI spillovers, we divide sector-level FDI variables into two groups based on their sources. The results are reported in Table 5.

The results point to significant and large differences in vertical as well as horizontal linkages which depend on the origin of the foreign investors.   While horizontal linkages, which are not differentiated by country of ownership of the foreign investors, are sometimes insignificant, this average hides significant and contrasting effects.   Horizontal linkages are negative but not significant for sectors with large shares of foreign investors originating in Hong Kong-Taiwan-Macau, suggesting that these firms act as competitors for domestically-owned firms.   In contrast, horizontal linkages are positive and significant for foreign investment originating in other countries, suggesting that there are positive linkages within the same sector for foreign investment coming from further afield.   The coefficient estimate, at .35, indicates that a 1 percentage point increase in horizontal FDI from sources other than Hong Kong-Taiwan-Macau is associated with an increase in output of .35 percent.

The results are also different for vertical linkages. There are strong, positive and significant backward and forward linkages for foreign investors originating from OECD countries. These differences are statistically significant for horizontal and vertical forward linkages, as indicated by the formal tests of equality reported at the bottom of Table 5. These results point to clear differences in the pattern of productivity spillovers depending on the source of foreign investment. Foreign firms coming from nearby regions act as competition in the same industry. Firms coming from further away are not direct competitors and convey positive horizontal and vertical externalities.

C.   The Effect of State Ownership

In China, state-owned firms include firms that are formally classified as state-owned enterprises (SOEs), state-owned jointly operated enterprises and wholly state-owned companies. Non-state-owned enterprises (non-SOEs) include collectively- and privately-owned firms. Compared to non-SOEs, SOEs are typically larger and often technically competitive but less market-oriented; they also face softer budget constraints and limited access to private financial capital. Indigenous Chinese firms of different ownership typically behave differently with respect to imitation, innovation and competition, and have different technological capabilities for knowledge absorption from the presence of foreign firms (Li et al. 2001).

In Tables 3 and 4, we saw that the coefficient on the state's share in equity in Table 4 is generally negative and statistically significant, indicating that increases (decreases) in state-invested shares are associated with falling (increasing) productivity. The coefficient estimates, which vary from -.02 to -.13, suggest that after controlling for other factors, moving from 100 percent SOE to 100 percent private would be associated with a gain in productivity of 2 to 13 percentage points. Now we will explore whether productivity spillovers differ with ownership type.

In Table 6, we divide the sample of all, foreign-invested, and domestic firms into two groups, SOEs and non-SOEs, to test whether the formal ownership structure

and the composition of asset ownership matter for FDI spillover effects and trade policies.   In columns (1) and (2), which present the results from OLS regressions with firm fixed effects, both enterprises with and without foreign equity participation are included in the analysis together.   Columns (3) and (4) show the results using the sample of foreign-invested firms, and columns (5) and (6) present the results using the sample of purely domestic firms, defined as enterprises with zero foreign equity participation. All specifications allow for firm-specific effects and year effects.

The first two columns allow us to compare the impact of firm-level equity participation by foreign investors on the productivity of SOEs relative to non-SOEs. The coefficient on foreign participation from foreign investors outside of Hong Kong-Taiwan-Macau for SOEs is .098 relative to .0052 for non-SOEs.   This suggests that foreign equity participation is associated with an improvement in productivity which is twenty times greater for SOEs.   The much larger and statistically significant coefficient associated with foreign equity participation in SOEs is consistent with the hypothesis that firms with foreign equity have played an important role in improving the performance of some SOEs.

There is also evidence that SOEs benefit more from vertical linkages, as the magnitudes on backward as well as forward linkages are greater for SOEs.   The coefficients are larger for SOEs, suggesting that foreign investment has played a particularly large role in enhancing productivity of SOEs, including those without foreign equity participation.   The only exception is with horizontal spillovers. Horizontal spillovers are restricted to domestic non-SOEs, suggesting that SOEs may not be able to benefit from productivity spillovers through firms with foreign equity participation located in the same sector.

D. Trade and FDI Spillovers

While there is a large literature which investigates the impact of FDI on productivity, as well as an even larger literature that explores the relationship between trade policies and productivity (for an overview of both these topics, see Harrison and Rodriguez-Clare (2010)), we are not aware of any study which examines how changing trade policies affect the magnitude of FDI spillovers. In this section, we begin by summarizing the impact of tariffs on firm-level productivity from the previous tables, then explore the interaction between productivity spillovers from foreign investment and changes in trade policy.

The coefficient on the final good tariff measure in Tables 3 through 5 is generally negative and statistically significant. These results are somewhat different from Brandt et al. (2008), who found weak evidence of a significant relationship between tariffs and total factor productivity for Chinese enterprises. There are several reasons why the negative impact of input or final goods tariffs on productivity may be under-estimated. A large fraction of firms are granted exemptions from paying tariffs; without additional information on which firms pay input tariffs, it is difficult to identify the negative effect of tariffs on inputs. Second, average tariffs may be imposed for a number of reasons. If tariffs are successfully imposed in sectors where there are externalities in production, then the average effect of tariffs reflects both (beneficial) targeting and (harmful) disincentives associated with x-inefficiency. Third, to the extent that Melitz (2003) is correct, then many of the productivity gains associated with trade reform occur through reallocation of production towards more efficient firms, rather than within-firm productivity increases associated with greater exposure to international competition.

In Table 6, we do find significant but different responses across SOEs and non-SOES to trade policy. Higher final goods tariffs are associated with significantly lower productivity for SOEs, relative to non-SOEs. The point estimates on final goods tariffs, which is -.0676 for SOEs with foreign investment and -.0519 for those with no foreign assets, suggests that a 1 percent reduction in tariffs (ceteris paribus) would increase productivity by .05 to .07 percent. One possible interpretation of the larger effect of final goods tariffs on SOE performance is the greater importance

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of international competition for SOEs, which are often shielded from competition or supported by the government through a variety of subsidies.

In Table 7, we report the basic specification (column 5 of Table 6) in the first column. In the second column, we interact the vertical and horizontal FDI measures with our tariff measures. The three interaction terms are all negative, indicating that higher tariffs are associated with lower vertical and horizontal spillovers from FDI. The addition of the interaction term for the horizontal measure doubles its magnitude. To the extent that horizontal FDI is likely to have stronger positive effects on productivity when tariffs are low, then omitting the interaction term can lead to under-estimating horizontal linkages.

We continue to explore the role of trade in understanding the importance of vertical and horizontal linkages in columns (3) and (4) of Table 7. We divide the sample across exporting and non-exporting firms. Since exporters are more likely to benefit from associations with firms in other countries, we might expect smaller linkages. On the other hand, exporters may be more likely to exploit knowledge gained from association with foreign investors. The results in Table 7 suggest that backward linkages are no different across exporting and non-exporting enterprises. However, horizontal linkages are much larger for non-exporters and only significant for that group. These results suggest that horizontal linkages in China were highest for firms which would not normally have had contact with international markets through export sales.

In Table 8, we explore how vertical and horizontal linkages vary over the ten-year sample period. With China's entry into the WTO in the middle of the sample period, at the end of 2001, domestic content rules became illegal and tariffs were significantly reduced. The results in Table 8 suggest that vertical linkages were strengthened during the second half of the sample period, when tariffs were lowered and domestic content restrictions relaxed. Backward linkages only become large in magnitude and significant with China's entry into the WTO. Forward linkages also become significant and positive later in the sample period.

E. The Effects of Tax Incentives for FDI

In Tables 9 and 10 we explore the extent to which subsidized foreign investment is more likely to convey spillovers relative to unsubsidized foreign investment. While the standard tax rates across all firms during the sample period was 33 percent, a large share of foreign-owned firms were granted tax subsidies and faced tax rates that were significantly lower. Indeed, the means reported in Tables 2-3 and 2-4 suggest that the majority of foreign investment in China during the sample period benefited from income tax subsidies and a significant fraction benefited from subsidies on value-added taxes. To the extent that the Chinese government was able to target successfully firms more likely to convey positive externalities, we would expect different effects for these subsidized firms.

To test for this possibility, we split our sector-level foreign share variables into two groups: one is calculated based on foreign investment being subsidized (those paid less than the statutory tax rate)[13] and the other one is computed based on non-subsidized foreign investment. The results based on income tax incentives are presented in Table 9.

There is strong evidence that foreign firms receiving tax subsidies are more likely to generate positive externalities than other kinds of foreign firms. While the coefficients on backward linkages are positive and statistically significant for foreign firms which received incentives in the form of lower income taxes, the coefficients on backward linkages for other types of foreign firms are negative. These differences are significant for backward linkages but not for forward or horizontal linkages, where the formal F-tests fail to reject that the effects are the same.

In Table 10, we test whether the results are different when we explore tax holidays on value-added taxes as a form of fiscal incentive instead. We define firms as subsidized when they were exempted from paying value-added taxes altogether. The results in Table 10 are consistent with differences in the effects of

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[13] As discussed earlier, the statutory tax rate in China is 33%. However, foreign-invested firms receive a preferential tax break of 15%. In this paper, we use the cut-off of 20% to distinguish whether a foreign-invested firm is being subsidized.

foreign investment based on income tax incentives.   In particular, forward linkages are significantly stronger when foreign investors received tax incentives in the form of exemptions on value-added taxes.

F.   Robustness Tests

Since our dependent variable is firm-level productivity and the focus of the analysis is on how sector-level foreign investment affects domestic firm productivity, endogeneity is less likely to be an issue.   It is difficult to make a case that firm-level productivity affects sector-level foreign investment, particularly upstream and downstream foreign investment.   To the extent that foreign ownership could be attracted to sectors where suppliers or users are more productive, this is accounted for by the use of firm-level fixed effects.   However, some critics might argue that foreign investors are drawn to sectors where they expect higher productivity growth in the future.   To address this unlikely but nevertheless potential source of endogeneity, we apply instrumental variables (IV) techniques. We use future tariffs (tariffs at time t+1) as instruments. For instance, *lnTariff* (at time t+1) is used to instrument *Horizontal*; *lnTariff_backward* (at time t+1) is used to instrument *Backward*; and *lnTariff_forward* (at time t+1) is used to instrument *Forward*. Since our tariff data is from 1998-2007, we lose one year of observations when we apply the future tariffs as instruments. All identification tests show that the equations are exactly identified.

The results are reported in Table A-4.   The point estimates are magnified for backward linkages, confirming the importance of the linkages between domestic suppliers and foreign-owned buyers of their inputs.   However, the coefficients for non-SOE domestic enterprises on both forward and horizontal linkages become negative and statistically significant.   The negative and significant coefficient on the horizontal variable confirms previous work by Aitken and Harrison (1999) and others suggesting that foreign firms in the same sector act as competitors for domestic enterprises.   The switch in sign for the coefficient on horizontal FDI calls

into question the positive coefficient for horizontal FDI in other specifications reported elsewhere in this paper, but confirms the positive vertical linkages between domestic suppliers and foreign users of their products.

IV.   Concluding Comments

In this paper, we explore the ways in which a range of institutional features, some general and some unique to China, affect the direction and magnitude of FDI spillovers.   Specifically, we examine the role played by foreign investors in generating productivity spillovers via horizontal and vertical linkages, as these spillovers affect the reform of state enterprises through joint venture activity. We also explore the different impacts of spillovers that originate from FDI aggregations that embody different mixes of investment from Hong Kong-Taiwan-Macau on the one hand and largely OECD sourced investment on the other.   Finally, our study investigates the implications of tariff protection for the nature of productivity spillovers and explores whether the Chinese government's targeting through the selective imposition of tax holidays to attract foreign investors is consistent with larger externalities.   The focus on the heterogeneity of spillovers across different policies, such as differences in the tax and tariff regime, is a primary innovation of this paper.

We use a firm-level dataset from China for the 1998-2007 period, Across a variety of specifications, and controlling for firm and year effects, we find that positive productivity spillovers from FDI take place through contacts between foreign affiliates and their local clients in upstream   (backward) or downstream sectors (forward linkages).   We also find evidence that positive productivity spillovers occur through horizontal foreign investment, but these types of spillovers are less robust, and become negative when we instrument for FDI.

We also highlight the different effects played by the sources of sectoral foreign direct investment on domestic firm productivity. While at the firm level foreign equity participation is generally associated with higher productivity, this is not the

case for foreign equity participation that originates in Hong Kong-Taiwan-Macau. There are several possible explanations for this. One major reason could be that such investments actually originate in China, and are simply rechanneled through nearby locations to take advantage of special incentives offered to foreign investors. Another possible explanation is that nearby foreign investors are not sufficiently different technologically during the last decade for which we have data.

Finally, we also take into account trade policies and tax policies. Controlling for differential tariffs across sectors is useful because some foreign investors may have invested in China in order to access protected domestic markets, which could have led to a bias in estimating the effects of foreign investment linkages on firm productivity. We find that tariffs are associated with negative and significant effects on firm productivity. We also find that backward and forward linkages were much stronger after China's entry into the WTO, and that tariffs are associated with a dampened effect of vertical and horizontal linkages. Finally, we also explore the extent to which foreign investors who were targeted via special tax incentives generated different effects on domestic firms than others. We find significantly higher effects of targeted FDI on productivity growth relative to other kinds of FDI.

In several respects the Chinese experience with FDI has been unique. Our results indicate that the institutional framework is critical for understanding the presence as well as the magnitude of gains from FDI. The example of how foreign investment originating from Hong Kong-Taiwan-Macau, is associated with zero spillovers, while foreign investment from other regions generates significant vertical and horizontal linkages is one vital example of the important role of this institutional analysis.

To our knowledge, this is the first study to examine whether fiscal incentives in the form of tax subsidies are associated with stronger linkages from foreign firms to domestic enterprises. We find strong evidence that subsidized foreign investment generates greater productivity spillovers than unsubsidized firms. The magnitudes imply that a 1 percentage point increase in the share of foreign investors in downstream sectors raises the supplying firm's productivity by 2 to 3 percentage

points. The evidence also suggests that foreign firms put significant downward pressure on the prices of the supplying firms.   Across our sample spanning a ten year period, vertical linkages accounted for an important source of productivity gains for all types of enterprises.

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Table 1 Summary Statistics for All Years, 1998-2007

	Levels			Growth Rates		
	Number of observations	Mean	Std. Dev.	Number of observations	Mean	Std. Dev.
logY	1,545,626	10.015	1.343	1,086,616	0.135	0.563
logL	1,545,626	4.808	1.152	1,086,616	0.013	0.503
logK	1,545,626	8.468	1.719	1,086,616	0.107	0.753
lnTFP	1,545,626	1.828	0.367	1,086,616	0.056	0.308
Foreign share (contributed by HK-Taiwan-Macau investors)	1,545,626	0.089	0.267	1,086,616	0.012	0.377
Foreign share (contributed by other investors)	1,545,626	0.079	0.249	1,086,616	0.0003	0.146
Stateshare	1,545,626	0.089	0.272	1,086,616	-0.007	0.147
Horizontal	1,545,626	0.254	0.142	1,086,616	0.004	0.046
Backward	1,545,626	0.077	0.046	1,086,616	0.002	0.015
Forward	1,545,626	0.103	0.173	1,086,616	0.004	0.066
Tariff	1,545,626	12.691	6.600	1,086,616	-0.869	2.295
Tariff_backward	1,545,626	8.191	3.769	1,086,616	-0.319	1.611
Tariff_forward	1,545,626	9.185	4.064	1,086,616	-0.359	2.066

Notes: We define firm-level foreign share according to its different sources. Foreign share contributed by HK-Taiwan-Macau is defined as the share of firms' total equity owned by investors from HK-Taiwan-Macau. Foreign share contributed by other countries is defined as the share of firms' total equity owned by investors outside HK-Taiwan-Macau, principally from OECD countries. State share is defined as the proportion of the firm's state assets to its total equity. Horizontal captures the intra-industry FDI spillover while backward and forward represent inter-industry FDI spillovers. We define horizontal, backward, and forward in equation (2), (3), and (4) respectively. The unit for the tariff variable is percentage.

Table 2-1 Summary Statistics for Spillover Variables

Year	Number of Observations	Horizontal		Backward		Forward	
		Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
1998	96,135	0.204	0.125	0.059	0.034	0.068	0.103
1999	104,253	0.220	0.132	0.066	0.038	0.077	0.120
2000	102,745	0.233	0.134	0.071	0.040	0.085	0.136
2001	114,735	0.240	0.135	0.071	0.041	0.089	0.142
2002	122,464	0.242	0.132	0.073	0.042	0.090	0.143
2003	138,377	0.250	0.139	0.075	0.044	0.099	0.166
2004	202,735	0.270	0.146	0.082	0.049	0.109	0.180
2005	194,274	0.273	0.149	0.083	0.049	0.117	0.199
2006	217,062	0.275	0.146	0.085	0.048	0.120	0.201
2007	255,042	0.267	0.143	0.083	0.048	0.119	0.199

Table 2-2 Summary Statistics for Spillover Variables that are calculated based on sources of FDI

Year	Number of Obs	Horizontal_HK		Backward_HK		Forward_HK		Horizontal_FR		Backward_FR		Forward_FR	
		Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
1998	95,879	0.097	0.068	0.026	0.015	0.033	0.037	0.059	0.069	0.033	0.021	0.037	0.059
1999	103,945	0.106	0.070	0.030	0.016	0.036	0.041	0.075	0.073	0.036	0.023	0.041	0.075
2000	102,465	0.112	0.072	0.033	0.018	0.038	0.048	0.089	0.077	0.038	0.024	0.048	0.089
2001	114,461	0.114	0.070	0.033	0.017	0.038	0.049	0.095	0.086	0.038	0.026	0.049	0.095
2002	122,218	0.112	0.070	0.032	0.018	0.041	0.052	0.097	0.082	0.041	0.026	0.052	0.097
2003	138,158	0.117	0.073	0.033	0.018	0.042	0.057	0.113	0.089	0.042	0.029	0.057	0.113
2004	202,551	0.116	0.067	0.034	0.019	0.048	0.065	0.126	0.102	0.048	0.033	0.065	0.126
2005	194,120	0.115	0.068	0.034	0.020	0.048	0.071	0.135	0.102	0.048	0.031	0.071	0.135
2006	216,924	0.114	0.067	0.034	0.019	0.051	0.074	0.144	0.104	0.051	0.032	0.074	0.144
2007	254,905	0.109	0.063	0.033	0.018	0.050	0.074	0.139	0.103	0.050	0.031	0.074	0.139

Table 2-3 Summary Statistics for Subsidized and non-Subsidized Spillover Variables (calculated based on income tax)

Year	Number of Obs	Subsidized						Non-Subsidized					
		Horizontal		Backward		Forward		Horizontal		Backward		Forward	
		Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
1998	95,879	0.076	0.060	0.022	0.015	0.024	0.047	0.112	0.068	0.033	0.018	0.038	0.050
1999	103,945	0.083	0.067	0.025	0.018	0.027	0.056	0.125	0.069	0.040	0.020	0.046	0.064
2000	102,465	0.096	0.072	0.029	0.020	0.033	0.070	0.130	0.070	0.041	0.021	0.049	0.068
2001	114,461	0.102	0.075	0.031	0.020	0.034	0.057	0.130	0.067	0.039	0.021	0.052	0.083
2002	122,218	0.107	0.080	0.035	0.025	0.041	0.091	0.128	0.066	0.037	0.018	0.047	0.059
2003	138,158	0.110	0.078	0.034	0.023	0.042	0.083	0.131	0.069	0.039	0.021	0.053	0.080
2004	202,551	0.132	0.090	0.041	0.027	0.054	0.110	0.129	0.063	0.038	0.020	0.051	0.070
2005	194,120	0.132	0.096	0.041	0.028	0.055	0.110	0.131	0.064	0.039	0.021	0.058	0.092
2006	216,924	0.138	0.094	0.043	0.028	0.057	0.101	0.126	0.061	0.039	0.020	0.057	0.097
2007	254,905	0.138	0.089	0.044	0.026	0.062	0.111	0.119	0.061	0.036	0.021	0.054	0.086

Table 2-4 Summary Statistics for Subsidized and non-Subsidized Spillover Variables (calculated based on value added tax)

Year	Number of Obs	Subsidized						Non-Subsidized					
		Horizontal		Backward		Forward		Horizontal		Backward		Forward	
		Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
1998	95,879	0.053	0.062	0.014	0.011	0.009	0.018	0.151	0.078	0.045	0.024	0.059	0.085
1999	103,945	0.049	0.056	0.013	0.012	0.007	0.012	0.169	0.089	0.052	0.027	0.069	0.107
2000	102,465	0.049	0.053	0.013	0.011	0.009	0.019	0.182	0.094	0.058	0.030	0.076	0.118
2001	114,461	0.049	0.050	0.013	0.011	0.008	0.017	0.187	0.095	0.057	0.029	0.080	0.123
2002	122,218	0.063	0.064	0.017	0.014	0.008	0.016	0.178	0.088	0.055	0.028	0.081	0.127
2003	138,158	0.070	0.075	0.018	0.018	0.013	0.038	0.177	0.083	0.056	0.027	0.085	0.130
2004	202,551												
2005	194,120	0.061	0.058	0.017	0.015	0.014	0.035	0.207	0.102	0.064	0.034	0.101	0.162
2006	216,924	0.054	0.054	0.015	0.014	0.015	0.045	0.214	0.103	0.069	0.034	0.102	0.153
2007	254,905	0.047	0.056	0.013	0.015	0.012	0.038	0.214	0.097	0.068	0.032	0.105	0.159

Notes: Since the information on value added is missing for 2004, we leave the summary statistics for 2004 with blank.

Table 3 OLS and Olley-Pakes Regression with Contemporaneous Spillover Variables with Tariff controls: with vs. without firm-fixed effects (sample: all firms)

	Dependent variable: logY		Dependent variable: lnTFP	
LogL	0.0914***	0.0755***		
	(0.0036)	(0.0041)		
LogK	0.0278***	0.0347***		
	(0.0016)	(0.0024)		
LogM	0.766***	0.865***		
	(0.0069)	(0.0042)		
Foreignshare (by HK-Taiwan-Macau)	-0.0018	-0.0018	-0.00353	0.0231***
	(0.0031)	(0.0052)	(0.0031)	(0.0049)
Foreignshare (by other countries)	0.0076**	0.0644***	0.0054*	0.115***
	(0.0032)	(0.0057)	(0.0032)	(0.0089)
Stateshare	-0.0168***	-0.0586***	-0.0201***	-0.126***
	(0.0036)	(0.0060)	(0.0032)	(0.0108)
Horizontal	0.162*	0.128	0.164*	0.0771
	(0.088)	(0.116)	(0.0871)	(0.110)
Backward	0.813***	0.956***	0.807***	1.096***
	(0.259)	(0.331)	(0.256)	(0.328)
Forward	0.163*	0.185	0.160*	0.190
	(0.0869)	(0.114)	(0.0865)	(0.119)
lnTariff	-0.0385**	0.00198	-0.0381**	-0.0129
	(0.0150)	(0.0319)	(0.0151)	(0.0319)
lnTariff_backward	-0.0276	-0.0061	-0.0289	-0.0236
	(0.0188)	(0.0312)	(0.0189)	(0.0319)
lnTariff_forward	-0.0064	-0.0396**	-0.0066	-0.0410**
	(0.0080)	(0.0173)	(0.0079)	(0.0178)
Constant	1.921***	0.956***	1.721***	1.749***
	(0.0704)	(0.123)	(0.0577)	(0.118)
Firm-fixed effect	Yes	No	Yes	No
Observations	1,545,626	1,545,626	1,545,626	1,545,626
R-squared	0.831	0.949	0.179	0.237

Notes: Robust clustered standard errors are presented in parentheses. In estimates using logY (i.e., in column (1) and (2) as the dependent variable, logL, logM, and logK are included as regressors along with the firm-level controls, sector-level FDI and tariff variables. When the dependent variable is lnTFP (i.e. as in column (3) and (4)), the estimation procedure is two-stage. In the first stage, we use the OP regression method to obtain estimates for the input coefficients and then calculate lnTFP (the residual from the production function). In the second stage, we regress lnTFP on the remaining controls (firm-level foreign share, state share, sector-level FDI variables, and tariff variables).

*Significant at 10-percent level

**Significant at 5-percent level

***Significant at 1-percent level

Table 4 Olley and Pakes Regressions with Contemporaneous Spillover Variables and Tariff Controls: all firms, foreign-invested, domestic firms with zero foreign investment

	All firms	Foreign-invested firms	Domestic firms (0 foreign share)
Foreign share (by HK-Taiwan-Macau)	-0.0035	0.003	
	(0.0031)	(0.0048)	
Foreign share (by other countries)	0.0054*	0.0132***	
	(0.0032)	(0.0049)	
State share	-0.0201***	0.0023	-0.0193***
	(0.0032)	(0.0075)	(0.0034)
Horizontal	0.164*	0.115	0.191**
	(0.0871)	(0.0991)	(0.0883)
Backward	0.807***	0.860***	0.801***
	(0.256)	(0.276)	(0.268)
Forward	0.160*	0.246***	0.0920
	(0.0865)	(0.0876)	(0.0920)
lnTariff	-0.0381**	-0.0241	-0.0417**
	(0.0151)	(0.0182)	(0.0164)
lnbwTariff	-0.0289	-0.0167	-0.0350
	(0.0189)	(0.0176)	(0.0211)
lnfwTariff	-0.0066	-0.0203*	-0.0027
	(0.0079)	(0.0116)	(0.0072)
Constant	1.721***	2.002***	2.053***
	(0.0577)	(0.0598)	(0.0416)
Observations	1,545,626	348,029	1,197,597
R-squared	0.179	0.204	0.166
Horizontal*dummy		-0.124***	
		(0.046)	
F-stat (Horizontal*dummy=0)		7.14	
Prob $> F$		0.010	
Backward*dummy		0.011	
		(0.009)	
F-stat (Backward*dummy=0)		0.62	
Prob $> F$		0.433	
Forward*dummy		-0.011*	
		(0.006)	
F-stat (Forward*dummy=0)		19.81	
Prob $> F$		0	
F-stat (interaction term jointly zero)		7.76	
Prob $> F$		0.0002	

Notes: Robust clustered standard errors are presented in parentheses. The dependent variable lnTFP. Each regression includes firm-fixed effects and year dummies. The bottom of the table reports the results of tests, which compares whether three sector-level FDI variables are different across the two sub-samples of foreign-invested firms and domestic firms. The dummy is defined as 1 if firm i has non-zero foreign share at period t, 0 otherwise.

Table 5 Olley and Pakes Regressions with Contemporaneous Spillover Variables and Tariff controls: all firms, foreign-invested, and domestic firms with zero foreign investment (sector-level FDI are calculated based on sources of FDI)

	All firms	Foreign-invested firms	Domestic firms (0 foreign investment)
Foreign share (HK-Taiwan-Macau)	-0.0028	0.00312	
	(0.003)	(0.0047)	
Foreign share (by other countries)	0.0059*	0.013***	
	(0.0032)	(0.0048)	
Horizontal_HK	-0.0198	0.0143	-0.0647
	(0.099)	(0.106)	(0.105)
Backward_HK	0.570	0.339	0.697
	(0.580)	(0.581)	(0.659)
Forward_HK	-0.227	-0.241	-0.162
	(0.177)	(0.154)	(0.217)
Horizontal_FR	0.284**	0.183	0.350***
	(0.132)	(0.149)	(0.131)
Backward_FR	0.872*	1.110**	0.764*
	(0.445)	(0.522)	(0.437)
Forward_FR	0.332**	0.457***	0.214
	(0.148)	(0.116)	(0.179)
lnTariff	-0.0263*	-0.00987	-0.0313*
	(0.0154)	(0.0180)	(0.0165)
lnTariff_backward	-0.0379	-0.0265	-0.0413*
	(0.0231)	(0.0259)	(0.0245)
lnTariff_forward	-0.0037	-0.0153	-0.0008
	(0.0078)	(0.0118)	(0.0071)
Constant	1.715***	1.997***	2.046***
	(0.0638)	(0.0703)	(0.0440)
Observations	1,545,626	348,029	1,197,597
R-squared	0.180	0.205	0.167
F-stat (HHK=HFR)	3.01	0.80	5.42
Prob>F	0.088	0.374	0.023
F-stat (BHK=BFR)	0.11	0.61	0
Prob>F	0.736	0.438	0.944
F-stat (FHK=FFR)	3.61	10.63	1.02
Prob>F	0.062	0.002	0.32
F-stat (three conditions jointly)	4.64	6.99	4.16
Prob>F	0.006	0.004	0.009

Notes: Robust clustered standard errors are presented in parentheses. The dependent variable for each regression is lnTFP. Each regression includes firm-fixed effects and year dummies. HHK = Horizontal (by HK-Taiwan-Macau investors), HFR = Horizontal (by other countries). BHK = Backward (by HK-Taiwan-Macau investors), BFR = Backward (by other countries). FHK = Forward (by HK-Taiwan-Macau investors), FFR = Forward (by other countries).

Table 6 Olley and Pakes Regressions with Contemporaneous Spillover Variables and Tariff controls: non-SOEs vs. SOEs (with the sample of all firms, foreign-invested, and domestic firms with zero foreign share)

	All firms		Foreign-invested firms		Domestic firms (zero foreign share)	
	Non-SOEs	SOEs	Non-SOEs	SOEs	Non-SOEs	SOEs
Foreign share (by HK-Taiwan-Macau)	-0.0037	0.0348	0.0033	-0.0734		
	(0.003)	(0.0545)	(0.0048)	(0.0663)		
Foreign share (by other countries)	0.0052	0.098**	0.013***	0.082		
	(0.0031)	(0.0393)	(0.0049)	(0.0692)		
State share	-0.0016	-0.0256***	0.0037	0.0172	-0.0017	-0.0259***
	(0.0030)	(0.0041)	(0.0078)	(0.0305)	(0.0033)	(0.0041)
Horizontal	0.164*	0.109	0.117	-0.506	0.194**	0.111
	(0.088)	(0.100)	(0.099)	(0.444)	(0.089)	(0.100)
Backward	0.785***	1.027***	0.850***	2.893***	0.765***	1.005***
	(0.253)	(0.349)	(0.275)	(0.844)	(0.262)	(0.350)
Forward	0.162*	0.166	0.245***	0.483**	0.0867	0.169
	(0.0851)	(0.128)	(0.0875)	(0.219)	(0.0882)	(0.132)
lnTariff	-0.0349**	-0.0526**	-0.0237	-0.0676**	-0.0375**	-0.0519**
	(0.0154)	(0.0198)	(0.0183)	(0.0312)	(0.0171)	(0.0198)
lnTariff_backward	-0.0285	-0.0163	-0.0169	0.00579	-0.0354*	-0.0159
	(0.0185)	(0.0337)	(0.0176)	(0.0705)	(0.0207)	(0.0338)
lnTariff_forward	-0.0086	0.0065	-0.0205*	0.0705***	-0.0046	0.006
	(0.0082)	(0.0077)	(0.0115)	(0.0245)	(0.0074)	(0.0077)
Constant	1.721***	2.545***	1.913***	1.413***	1.663***	2.550***
	(0.0576)	(0.0690)	(0.0723)	(0.118)	(0.0598)	(0.0701)
Observations	1,418,632	126,994	345,631	2,398	1,073,001	124,596
R-squared	0.186	0.078	0.204	0.222	0.173	0.077
Horizontal*ownership	-0.184**		-0.030		-0.201**	
	(0.091)		(0.193)		(0.095)	
F-stat (Horizontal * ownership = 0)	4.06		0.02		4.4	

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Prob>*F*	0.048	0.879	0.04
Backward*ownership	-0.018	-0.236	-0.042
	(0.220)	(0.350)	(0.233)
F-stat (Backward * ownership = 0)	0.01	0.46	0.03
Prob>*F*	0.934	0.502	0.857
Forward*ownership	0.007	-0.100	0.043
	(0.064)	(0.109)	(0.065)
F-stat (Forward * ownership = 0)	0.01	0.85	0.44
Prob>*F*	0.915	0.36	0.51
F-stat (interaction terms jointly zero)	6.55	1.46	6.68
Prob>*F*	0.001	0.235	0.001

Notes: Robust clustered standard errors are presented in parentheses. The dependent variable for all regression is lnTFP. All regressions include firm fixed effects and year dummies. Ownership is a dummy variable, which equals one if a firm is a SOE and zero otherwise.

Table 7 Olley and Pakes Regressions: Allowing for Differential Spillovers with Differences in Trade Exposure

Dependent Variable	lnTFP	lnTFP	lnTFP	lnTFP
	(1)	(2)	(3)	(4)
	Domestic nonSOEs	Domestic nonSOEs	Non-exporting firms	Exporters
State share	-0.00174	-0.00240	-0.000923	-0.0108
	(0.00332)	(0.00318)	(0.00406)	(0.00822)
Horizontal	0.194**	0.550**	0.211**	0.121
	(0.0897)	(0.230)	(0.0992)	(0.0727)
Backward	0.765***	0.987	0.764***	0.752***
	(0.262)	(0.712)	(0.286)	(0.235)
Forward	0.0867	0.502	0.0687	0.130
	(0.0882)	(0.369)	(0.0912)	(0.0827)
lnTariff	-0.0375**	0.0124	-0.0364*	-0.0422***
	(0.0171)	(0.0309)	(0.0192)	(0.0141)
lnbwTariff	-0.0354*	-0.0285	-0.0392*	-0.0133
	(0.0207)	(0.0384)	(0.0218)	(0.0219)
lnfwTariff	-0.00458	0.000476	-0.00262	-0.0145
	(0.00742)	(0.00578)	(0.00764)	(0.00881)
Horizontal*lnTariff		-0.154*		
		(0.0809)		
Backward*lnbwTariff		-0.189		
		(0.332)		
Forward*lnfwTariff		-0.226		
		(0.140)		
Constant	1.663***	1.541***	1.855***	1.669***
	(0.0598)	(0.0777)	(0.0448)	(0.0616)
Observations	1,073,001	1,073,001	856,297	216,704
R-squared	0.173	0.174	0.163	0.204

Notes: In this table, we implement several extension based on the results shown in column 5 in Table 6. In column 1, we reproduce results from column 5 in Table 6. In column 2, we add three interaction terms. In column 3, we restrict the sample to non-exporting firms. We re-do the results with exporting firms in column 4. Firm fixed effect and year dummy variables in all regression. Robust clustered standard errors in parentheses.

Table 8 Exploration of FDI Productivity Effects Prior to and Following WTO Entry at the end of 2001

	All		Foreign-invested firms		Domestic firms	
	Non-SOEs	SOEs	Non-SOEs	SOEs	Non-SOEs	SOEs
Foreign share (by HK-Taiwan-Macau)	-0.00444	0.0389	0.00610	-0.0477		
	(0.00287)	(0.0564)	(0.00483)	(0.0671)		
Foreign share (by other countries)	0.00418	0.107***	0.0159***	0.0844		
	(0.00300)	(0.0376)	(0.00499)	(0.0713)		
State share	-0.00351	-0.0252***	0.00191	0.0155	-0.00320	-0.0255***
	(0.00289)	(0.00440)	(0.00827)	(0.0307)	(0.00331)	(0.00439)
Hor_1998	0.199**	0.0630	0.296***	-0.731	0.119	0.0676
	(0.0815)	(0.112)	(0.0787)	(0.528)	(0.0895)	(0.112)
Hor_1999	0.158**	0.0463	0.186**	-0.719	0.126	0.0479
	(0.0781)	(0.0948)	(0.0772)	(0.526)	(0.0832)	(0.0946)
Hor_2000	0.216***	0.123	0.170**	-0.561	0.217***	0.121
	(0.0699)	(0.0779)	(0.0656)	(0.550)	(0.0721)	(0.0767)
Hor_2001	0.158**	0.0866	0.0992	-0.820	0.157**	0.0889
	(0.0744)	(0.0708)	(0.0735)	(0.542)	(0.0750)	(0.0699)
Hor_2002	0.0835	0.0422	0.0217	-0.344	0.0862	0.0480
	(0.0782)	(0.0974)	(0.0730)	(0.480)	(0.0789)	(0.0955)
Hor_2003	0.0598	0.0217	-0.0145	-0.424	0.0884	0.0238
	(0.0801)	(0.0887)	(0.0753)	(0.496)	(0.0821)	(0.0890)
Hor_2004	0.188*	0.0596	0.142	0.386	0.200*	0.0476
	(0.104)	(0.134)	(0.0969)	(0.422)	(0.113)	(0.134)
Hor_2005	0.196	0.0872	0.171	0.148	0.216	0.0741
	(0.123)	(0.143)	(0.118)	(0.359)	(0.130)	(0.142)
Hor_2006	0.244*	0.118	0.263**	0.423	0.253*	0.106
	(0.129)	(0.164)	(0.131)	(0.456)	(0.133)	(0.163)
Hor_2007	0.289*	0.227	0.322**	0.176	0.309*	0.207
	(0.163)	(0.186)	(0.151)	(0.491)	(0.175)	(0.184)

Back_1998	-0.251	-0.162	-0.644***	1.473*	0.0298	-0.229
	(0.225)	(0.380)	(0.179)	(0.841)	(0.304)	(0.389)
Back_1999	-0.236	-0.278	-0.376**	1.411	-0.0847	-0.333
	(0.194)	(0.326)	(0.164)	(0.974)	(0.243)	(0.330)
Back_2000	-0.0749	-0.111	-0.104	1.526	0.0289	-0.168
	(0.153)	(0.229)	(0.134)	(0.970)	(0.174)	(0.230)
Back_2001	0.194	0.0457	0.155	2.234**	0.327*	-0.0218
	(0.165)	(0.220)	(0.152)	(1.043)	(0.188)	(0.219)
Back_2002	0.415**	0.262	0.509***	1.298	0.432**	0.205
	(0.167)	(0.287)	(0.155)	(0.885)	(0.185)	(0.282)
Back_2003	0.602***	0.602**	0.662***	1.928**	0.665***	0.555**
	(0.184)	(0.242)	(0.158)	(0.842)	(0.213)	(0.248)
Back_2004	0.769***	1.183***	0.721***	0.496	0.841***	1.228***
	(0.234)	(0.338)	(0.201)	(0.768)	(0.272)	(0.345)
Back_2005	0.836***	1.314***	0.798***	1.465**	0.902***	1.355***
	(0.269)	(0.407)	(0.232)	(0.642)	(0.314)	(0.414)
Back_2006	0.761**	1.460***	0.685**	1.543*	0.825**	1.462***
	(0.295)	(0.487)	(0.265)	(0.840)	(0.340)	(0.502)
Back_2007	0.820**	1.706***	0.769**	1.641**	0.879**	1.757***
	(0.371)	(0.487)	(0.319)	(0.810)	(0.430)	(0.497)
For_1998	-0.0176	-0.00245	-0.0459	-0.0493	0.0266	0.0126
	(0.0873)	(0.149)	(0.0801)	(0.269)	(0.105)	(0.159)
For_1999	0.0180	0.0423	0.0135	0.107	0.0458	0.0686
	(0.0723)	(0.109)	(0.0580)	(0.283)	(0.0877)	(0.110)
For_2000	0.00939	0.0250	0.0412	0.0764	0.00315	0.0423
	(0.0423)	(0.0737)	(0.0307)	(0.278)	(0.0541)	(0.0759)
For_2001	0.0672	0.109	0.0901**	0.260	0.0720	0.117*
	(0.0500)	(0.0659)	(0.0417)	(0.286)	(0.0571)	(0.0685)
For_2002	0.136***	0.140**	0.173***	0.0465	0.123**	0.152**
	(0.0494)	(0.0686)	(0.0437)	(0.271)	(0.0586)	(0.0705)
For_2003	0.167***	0.134**	0.211***	0.161	0.146**	0.143**

	(0.0467)	(0.0518)	(0.0402)	(0.260)	(0.0566)	(0.0546)
For_2004	0.143**	0.201**	0.200***	-0.00693	0.0887	0.216**
	(0.0629)	(0.0885)	(0.0514)	(0.221)	(0.0762)	(0.0912)
For_2005	0.133*	0.153	0.203***	0.0120	0.0632	0.170
	(0.0776)	(0.115)	(0.0601)	(0.178)	(0.0960)	(0.121)
For_2006	0.154*	0.169*	0.217***	0.00373	0.0841	0.180*
	(0.0781)	(0.0999)	(0.0638)	(0.218)	(0.0949)	(0.104)
For_2007	0.163*	0.163*	0.227***	0.178	0.0860	0.180*
	(0.0911)	(0.0922)	(0.0718)	(0.236)	(0.111)	(0.0957)
lnTariff	-0.0200	-0.0322*	-0.00861	-0.0332	-0.0241	-0.0321*
	(0.0172)	(0.0177)	(0.0148)	(0.0431)	(0.0190)	(0.0179)
lnbwTariff	-0.0267	-0.00377	-0.0126	0.00929	-0.0334*	-0.00161
	(0.0172)	(0.0283)	(0.0136)	(0.0711)	(0.0200)	(0.0284)
lnfwTariff	-0.00712	0.00314	-0.0150**	0.0910***	-0.00488	0.00220
	(0.00780)	(0.00735)	(0.00711)	(0.0160)	(0.00795)	(0.00727)
Constant	1.740***	2.393***	1.927***	1.221***	1.682***	2.394***
	(0.0561)	(0.0644)	(0.0511)	(0.144)	(0.0652)	(0.0656)
Observations	1,418,632	126,994	345,631	2,398	1,073,001	124,596
R-squared	0.190	0.083	0.212	0.274	0.175	0.082

Notes: We keep the same structure as in Table 6. In this table, we explore time effects of sector-level spillover variables on firms' productivity. We use year dummies to multiply *Horizontal*, *Backward*, and *Forward* separately; therefore, we have 30 interactions. Hor_interact1 = Horizontal * time dummy (when year = 1998).

Table 9 Olley and Pakes Regressions for Grouped Data with Contemporaneous Subsidized and non-Subsidized Spillover Variables (constructed based on income tax) and Tariff Controls: non-SOEs vs. SOEs (All firms, foreign-invested, and domestic firms with zero foreign investment

	All firms		Foreign-invested firms		Domestic firms (0 foreign investment)	
	non-SOEs	SOEs	non-SOEs	SOEs	non-SOEs	SOEs
Foreign share (by HK-Taiwan-Macau)	-0.00381	0.0363	0.00368	-0.0766		
	(0.00302)	(0.0543)	(0.00484)	(0.0675)		
Foreign share (by other countries)	0.00522	0.0986**	0.0137***	0.0807		
	(0.00313)	(0.0388)	(0.00498)	(0.0690)		
State share	-0.00174	-0.0254***	0.00420	0.0180	-0.00206	-0.0257***
	(0.00290)	(0.00420)	(0.00767)	(0.0307)	(0.00331)	(0.00421)
Hor_subsidized	0.117	0.103	0.0512	-0.595	0.163	0.103
	(0.107)	(0.133)	(0.109)	(0.511)	(0.111)	(0.134)
Bw_subsidized	2.189***	2.833***	2.065***	3.203***	2.286***	2.822***
	(0.644)	(0.611)	(0.475)	(0.986)	(0.799)	(0.628)
Fw_subsidized	0.165	0.203	0.238***	0.526**	0.0817	0.213
	(0.107)	(0.151)	(0.0859)	(0.259)	(0.141)	(0.158)
Hor_non_subsidized	0.189*	-0.0729	0.179*	-0.429	0.188	-0.0702
	(0.104)	(0.117)	(0.103)	(0.355)	(0.114)	(0.119)
Bw_non_subsidized	-0.934	-1.173**	-0.649	2.287*	-1.051	-1.175**
	(0.623)	(0.464)	(0.474)	(1.239)	(0.749)	(0.471)
Fw_non_subsidized	0.184**	0.222**	0.261***	0.403**	0.132	0.221**
	(0.0885)	(0.105)	(0.0683)	(0.163)	(0.122)	(0.110)
lnTariff	-0.0346**	-0.0458**	-0.0262*	-0.0712**	-0.0366**	-0.0451**
	(0.0144)	(0.0184)	(0.0155)	(0.0329)	(0.0163)	(0.0185)
lnTariff_backward	-0.0170	0.00734	-0.00343	0.0123	-0.0249	0.00716
	(0.0179)	(0.0305)	(0.0175)	(0.0727)	(0.0200)	(0.0306)
lnTariff_forward	-0.00981	0.00613	-0.0211*	0.0695***	-0.00610	0.00561
	(0.00782)	(0.00679)	(0.0110)	(0.0233)	(0.00716)	(0.00680)
Constant	1.728***	2.499***	1.920***	1.431***	1.673***	2.504***

	(0.0531)	(0.0632)	(0.0654)	(0.118)	(0.0577)	(0.0645)
Observations	1,418,632	126,994	345,631	2,398	1,073,001	124,596
R-squared	0.187	0.079	0.205	0.223	0.174	0.078
F-stat (HS=HNS)	0.28	0.96	0.98	0.42	0.03	0.88
Prob>F	0.596	0.332	0.327	0.518	0.862	0.351
F-stat (BS=BNS)	6.72	19.12	10.39	0.42	5.01	18.02
Prob>*F*	0.012	0.0001	0.002	0.52	0.029	0.0001
F-stat (FS=FNS)	0.02	0.02	0.14	0.74	0.06	0
Prob>*F*	0.882	0.889	0.705	0.394	0.813	0.955
F-stat (three conditions jointly)	2.61	7.46	3.92	0.32	1.99	6.85
Prob>*F*	0.06	0.0003	0.013	0.808	0.126	0.0005

Notes: Robust clustered standard errors are presented in parentheses. The dependent variable for all regressions is lnTFP. All regressions include firm fixed effect and year dummy variables. HS = subsidized horizontal, and HNS = non-subsidized horizontal; BS = subsidized backward, and BNS = non-subsidized backward; FS = subsidized forward, and FNS = non-subsidized forward.

Table 10 Olley and Pakes Regressions for Grouped Data with Contemporaneous Subsidized and non-Subsidized Spillover Variables (calculated based on value added tax) and Tariff Controls: non-SOEs vs. SOEs (all firms, foreign-invested, domestic firms)

	All firms		Foreign-invested firms		Domestic firms	
	non-SOEs	SOEs	non-SOEs	SOEs	non-SOEs	SOEs
Foreign share (by HK-Taiwan-Macau)	-0.0041	0.0371	0.003	-0.0765		
	(0.0031)	(0.0579)	(0.0044)	(0.0716)		
Foreign share (by other countries)	0.0050*	0.121***	0.0130***	0.0829		
	(0.0026)	(0.0357)	(0.0048)	(0.0698)		
State share	-0.001	-0.0250***	-0.0016	0.0312	0.0007	-0.0253***
	(0.0033)	(0.0045)	(0.0091)	(0.0318)	(0.0035)	(0.0046)
Hor_subsidized	0.0398	0.230*	0.0177	-0.683	0.0662	0.249*
	(0.0871)	(0.134)	(0.0865)	(0.416)	(0.0963)	(0.135)
Bw_subsidized	0.831	1.133**	1.138*	2.560***	0.636	1.086**
	(0.534)	(0.523)	(0.572)	(0.793)	(0.574)	(0.535)
Fw_subsidized	1.068***	0.685***	1.161***	0.785***	0.943***	0.659***
	(0.130)	(0.114)	(0.140)	(0.183)	(0.147)	(0.118)
Hor_non_subsidized	0.240**	0.116	0.214**	-0.518	0.255**	0.117
	(0.0928)	(0.111)	(0.0966)	(0.497)	(0.0978)	(0.112)
Bw_non_subsidized	0.765**	0.695	0.666**	2.763**	0.842*	0.663
	(0.376)	(0.527)	(0.314)	(1.109)	(0.456)	(0.537)
Fw_non_subsidized	-0.0597	0.00991	-0.00319	0.408	-0.105	0.0161
	(0.102)	(0.136)	(0.111)	(0.258)	(0.0990)	(0.144)
lnTariff	-0.0394**	-0.0515**	-0.0295*	-0.0408	-0.0424**	-0.0510**
	(0.0165)	(0.0209)	(0.0175)	(0.0355)	(0.0187)	(0.0209)
lnTariff_backward	-0.0324	-0.0135	-0.0263	0.0151	-0.0361	-0.0122
	(0.0198)	(0.0369)	(0.0185)	(0.0737)	(0.0223)	(0.0371)
lnTariff_forward	-0.00487	0.0129*	-0.0134	0.0568**	-0.0017	0.0123
	(0.0079)	(0.0076)	(0.0110)	(0.0242)	(0.0072)	(0.0076)

Constant	2.074***	2.472***	1.939***	1.390***	1.672***	2.553***
	(0.0401)	(0.0650)	(0.0723)	(0.127)	(0.0666)	(0.0721)
Observations	1,225,481	117,594	299,177	2,323	926,304	115,271
R-squared	0.205	0.084	0.233	0.213	0.185	0.083
F-stat (HS=HNS)	6.36	0.64	8.51	0.34	4.14	0.8
Prob>F	0.014	0.428	0.005	0.563	0.046	0.374
F-stat (BS=BNS)	0.01	0.26	0.42	0.04	0.05	0.23
Prob>*F*	0.932	0.61	0.521	0.848	0.823	0.632
F-stat (FS=FNS)	29.45	14.94	24.17	1.9	26.52	11.24
Prob>*F*	0	0.0003	0	0.173	0	0.001
F-stat (three conditions jointly)	13.49	8.08	11.09	1.14	10.22	6.34
Prob>*F*	0	0.0001	0	0.341	0	0.001

Notes: Robust clustered standard errors are presented in parentheses. The dependent variable for all regressions is lnTFP. All regressions include firm fixed effect and year dummy variables. Since the information on value added is missing for the year of 2004, we exclude the year of 2004 from regressions. HS = subsidized horizontal, and HNS = non-subsidized horizontal; BS = subsidized backward, and BNS = non-subsidized backward; FS = subsidized forward, and FNS = non-subsidized forward.

APPENDIX TABLES

Table A-1 Summary of Estimated Elasticities of Input Variables

Coefficients on Input Variables Estimated by OLS with firm Fes and time dummies

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Full	FIE	Domestic	Full_nonSOEs	Full_SOEs	FIE_nonSOEs	FIE_SOEs	Domestic_nonSOEs	Domestic_SOEs
logL	0.0918***	0.122***	0.0818***	0.0920***	0.0828***	0.122***	0.0798***	0.0809***	0.0820***
	(0.00413)	(0.00765)	(0.00336)	(0.00434)	(0.00575)	(0.00772)	(0.0207)	(0.00360)	(0.00593)
logK	0.0278***	0.0374***	0.0249***	0.0285***	0.0193***	0.0374***	0.0303*	0.0255***	0.0182***
	(0.00159)	(0.00266)	(0.00152)	(0.00157)	(0.00311)	(0.00267)	(0.0152)	(0.00156)	(0.00306)
logM	0.766***	0.732***	0.776***	0.768***	0.742***	0.732***	0.844***	0.781***	0.740***
	(0.00683)	(0.00709)	(0.00735)	(0.00732)	(0.0107)	(0.00713)	(0.0359)	(0.00811)	(0.0110)
Obs	1,545,626	348,029	1,197,597	1,418,632	126,994	345,694	2,403	1,073,001	124,596

Coefficients on Input Variables Estimated by Olley and Pakes Regression

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Full	FIE	Domestic	Full_nonSOEs	Full_SOEs	FIE_nonSOEs	FIE_SOEs	Domestic_nonSOEs	Domestic_SOEs
logL	0.0888***	0.153***	0.068***	0.0951***	0.012**	0.154***	0.0231	0.0743***	0.012**
	(0.0019)	(0.0035)	(0.0019)	(0.0022)	(0.005	(0.004)	(0.0245)	(0.0022)	(0.005)
logK	0.0436***	0.0427***	0.044***	0.0464***	0.0205***	0.0428***	0.0644*	0.0473***	0.0202***
	(0.0018)	(0.003)	(0.0016)	(0.0015)	(0.004)	(0.0024)	(0.027)	(0.0018)	(0.004)
logM	0.771***	0.725***	0.785***	0.770***	0.772***	0.725***	0.836***	0.786***	0.771***
	(0.004)	(0.006)	(0.005)	(0.0048)	(0.010)	(0.007)	(0.046)	(0.005)	(0.009)
Obs	779,148	192,146	587,002	724,371	54,777	191,006	1,140	533,365	53,637

Notes: In this table, we compare the input coefficients computed by two methods: OLS with firm fixed effects and Olley and Pakes regression. Since many firms report zero or negative investment, we construct our own investment measure by using capital accumulation equation (investment at current period equals the sum of the growth of capital and capital depreciation at the current period). However, we still lose many firms (note the changes in observations between two methods). When we calculate TFP using OP method, we actually apply those input coefficients to all firms in each sample. Therefore, there is no loss in efficiency in the second stage.

Table A-2 FDI Effect on Price Level

	Dependent variable: log of price index	
Horizontal	0.008	-0.008
	(0.017)	(0.014)
Backward	-0.097**	-0.097**
	(0.046)	(0.045)
Forward	-0.024	-0.024
	(0.016)	(0.015)
Robust Standard Error	No	Yes
Year Dummies	Yes	Yes
Industry fixed effect	Yes	Yes
Number of observations	610	610
R-squared	0.58	0.58

Year	(1) Mean of average wages from the data	(2) Average wages from the National Statistical Yearbook (for the manufacturing industry)	(3) Average wages from the National Statistical Yearbook (for SOEs manufacturing firms)	(4) Mean of average wages and non-wage cost from the data	(5) The ratio of total wages to output value	(6) The ratio of total cost on labor (wages and non-wage cost) to output value
1998	9,795	7,064	6,981	11,654	0.118	0.146
1999	8,072	7,794	7,611	9,653	0.122	0.151
2000	9,038	8,750	8,554	13,556	0.120	0.147
2001	10,329	9,774	9,590	11,858	0.130	0.150
2002	10,586	11,001	10,876	12,181	0.105	0.123
2003	11,002	12,496	12,601	12,602	0.101	0.116
2004	13,588			16,543	0.098	0.123
2005	14,087	15,757	16,963	17,472	0.087	0.108
2006	16,925	17,966	20,317	21,069	0.090	0.112
2007	19,957	20,884	23,913	24,720	0.083	0.100

Notes: Wages are measured in yuan/year for one person. To obtain means of average wages of the sample, we first calculate the average wage for each firm in each year by dividing total wages by the number of total employees then take the means of these averages. The official information on average wage is missing for the year of 2004, therefore we leave them with blank. In column (3) and (4), we calculate the total cost of wage and non-wage and get the mean of average cost for each year. For the year of 1998-2003, non-wage cost includes unemployment insurance and other welfare. Starting from the year of 2004, information on medical insurance and housing subsidies becomes available; therefore we include these two additional costs when we calculate the non-wage cost for the year of 2004-2007. In column (5), we calculate the ratio of total wages to output value (at current price, both wages and output value are in nominal term). To take non-wage cost into account, we re-calculate the ratio using the sum of wages and non-wage cost as the numerator, which are shown in column (6).

Table A-4 Robustness Tests for Table 6 (Instrumental Variable Estimation)

	All		Foreign-invested firms		Domestic firms	
	Non-SOEs	SOEs	Non-SOEs	SOEs	Non-SOEs	SOEs
Foreign share (by HK-Taiwan-Macau)	-0.0011	-0.205	-0.0011	-0.0351		
	(0.0035)	(0.772)	(0.0056)	(0.149)		
Foreign share (by other countries)	0.0060	0.103	0.0072	0.0344		
	(0.0039)	(0.221)	(0.0056)	(0.120)		
State share	-0.0063*	-0.0441	0.0032	0.0175	-0.0080*	-0.0312*
	(0.0037)	(0.0516)	(0.0090)	(0.0455)	(0.0042)	(0.0168)
Horizontal	-0.744**	9.953	0.420	4.683	-0.682**	5.830
	(0.296)	(19.16)	(0.594)	(11.85)	(0.318)	(6.988)
Backward	3.469***	-39.11	1.201	-2.416	3.042***	-19.10
	(0.755)	(100.4)	(1.466)	(16.56)	(0.715)	(41.75)
Forward	-0.479***	-18.06	0.101	-2.951	-1.156***	-11.18
	(0.0899)	(35.40)	(0.166)	(7.440)	(0.154)	(14.08)
lnTariff	-0.209***	-1.064	-0.0383	-0.491	-0.191***	-0.679
	(0.0246)	(1.802)	(0.0490)	(0.752)	(0.0207)	(0.670)
lnTariff_backward	-0.0507***	-0.304	-0.0579*	0.00305	-0.112***	-0.343*
	(0.0133)	(0.239)	(0.0296)	(0.304)	(0.0196)	(0.187)
lnTariff_forward	0.0791***	0.290	0.00983	0.257	0.109***	0.213
	(0.0135)	(0.422)	(0.0112)	(0.394)	(0.0173)	(0.175)
Observations	915,545	83,453	241,372	1,490	661,978	81,570
R-squared	0.098	-4.630	0.194	-0.597	0.046	-1.598

Notes: We keep the same structure as in Table 6. To address the potential endogeneity of sector-level FDI variables, we apply instrumental variables (IV) technique. We use future tariffs (tariffs at time t+1) as instruments. Since our tariff data is from 1998-2007, we will lose one year of observations when we apply future tariff as instruments. All identification tests show that the equations are exactly identified.

Table A-5 Summary Statistics on Tariffs (by sectors)

Industry names	Tariff Mean	Tariff Diff b/w 1998 and 2007	Tariff_backward Mean	Tariff_forward Mean
1.Grain mill products	41.002	-18.29 (means fall by 18 percentage)	11.410	19.799
2.Forage	13.501	-7.87	19.654	1.932
3.Vegetable oil refining	19.85	-21.77	2.752	8.796
4.Sugar manufacturing	37.101	10.710	5.837	14.656
5.Slaughtering and meat processing	18.949	-4.510	10.705	15.193
6.Fish and fish products	16.052	-12.419	12.196	10.698
7.All other food manufacturing	22.206	-13.238	17.262	12.642
8.Wines, spirits and liquors	27.569	-34.290	16.811	4.384
9.Soft drink and other beverages	28.916	-20.560	16.372	1.328
10.Tobacco products	49.584	-24.000	4.275	
11.Cotton textiles	14.96	-13.88	4.168	14.558
12.Woolen textiles	14.96	-13.88	7.638	11.505
13.Hemp textiles	14.96	-13.88	5.044	8.632
14.Textiles products	17.674	-15.005	12.643	12.958
15.Knitted and crocheted fabrics and articles	20.082	-17.936	12.841	13.452
16.Wearing apparel	21.997	-16.212	14.651	11.568
17.Leather, fur, down and related products	19.176	-8.271	7.629	3.691
18.Products of wood, bamboo, cane, palm, straw	8.849	-8.346	4.591	8.130
19.Furniture	11.7	-18.51	10.835	12.740
20.Paper and paper products	11.975	-12.734	4.862	13.265

21.Printing, reproduction of recording media	13.584	-14.950	10.897	15.092
22.Stationary and related products	18.112	-5.306	11.426	9.624
23.Toys, sporting and athletic and recreation products	12.120	-14.198	11.291	1.494
24.Petroleum and nuclear processing	6.499	-0.930	6.647	11.159
25.Coking	5.479	-0.080	9.099	7.447
26.Basic chemicals	6.848	-3.13	5.342	10.513
27.Chemical fertilizers	7.511	3.15	8.390	2.418
28.Chemical pesticides	8.974	-2.07	7.906	1.169
29.Paints, varnishes and similar coatings, printing ink	9.242	-3.71	6.644	10.096
30.Man-made chemical products	10.043	-6.108	6.844	11.981
31.Special chemical products	12.661	-5.804	6.906	10.784
32.Chemical products for daily use	16.088	-11.882	9.763	7.675
33.Medical and pharmaceutical products	6.535	-4.599	6.911	1.817
34.Chemical fibers	9.825	-12.423	6.639	11.829
35.Rubber products	16.167	-3.752	8.967	12.782
36.Plastic products	12.583	-8.299	7.137	12.860
37.Cement, lime and plaster	11.811	-2.741	10.929	9.913
38.Glass and glass products	15.457	-4.890	7.790	10.669
39.Pottery, china and earthenware	18.236	-12.03	9.899	6.928
40.Fireproof materials	9.777	-3.671	9.550	7.751
41.Other nonmetallic mineral products	10.030	-2.355	7.801	8.187
42.Iron-smelting	6.601	-3.76	6.809	7.720
43.Steel-smelting	6.601	-3.76	7.538	9.424
44.Steel pressing	6.601	-3.76	6.700	11.368
45.Alloy iron smelting	6.601	-3.76	6.318	6.282
46.Nonferrous metal smelting	6.189	-2.382	5.554	7.897
47.Nonferrous metal pressing	5.63	-2.33	6.356	11.921
48.Metal products	12.788	-4.814	6.043	12.599
49.Boiler, engines and turbine	10.081	-4.635	7.551	10.693

50.Metalworking machinery	10.978	-5.201	8.875	8.637
51.Other general industrial machinery	10.869	-6.203	7.562	11.131
52.Agriculture, forestry, animal husbandry and fishing machinery	8.253	-5.070	9.018	1.163
53.Other special industrial equipment	9.871	-5.426	8.575	9.798
54.Railroad transport equipment	4.082	-1.34	8.528	2.403
55.Motor vehicles	29.126	-26.921	11.348	7.771
56.Parts and accessories for motor vehicles and their engines	17.584	-18.57	6.907	13.769
57.Ship building	7.365	-1.151	9.258	2.488
58.Other transport equipment	25.944	-9.094	8.338	3.349
59.Generators	10.725	-6.465	9.211	9.195
60.Household electric appliances	18.441	-7.963	9.438	7.640
61.Other electric machinery and equipment	15.103	-5.202	8.425	12.144
62.Telecommunication equipment	10.992	-13.480	6.546	4.279
63.Electronic computer	8.422	-14.87	6.629	5.235
64.Other computer peripheral equipment	8.352	-14.828	6.780	7.261
65.Electronic element and device	4.912	-7.01	7.641	10.988
66.Radio, television and communication equipment and apparatus	21.374	-13.97	8.162	5.635
67.Other electronic and communication equipment	9.528	-5.450	8.450	5.169
68.Instruments, meters and other measuring equipment	10.097	-5.150	8.621	8.603
69.Cultural and office equipment	10.460	-9.548	8.647	4.231
70.Arts and crafts products	16.980	-7.374	10.600	6.483
71.Other manufacturing products	19.324	-5.036	10.777	9.855
Average (all sectors)	12.691	-8.862	8.191	9.185

Table A-6 Summary Statistics on foreign investment (by sectors)

Industry names	Mean of firm-level foreign share (range from 0 to 100)	Diff b/w 1998 and 2007	Mean of horizontal (range from 0 to 100)	Diff b/w 1998 and 2007
1.Grain mill products	1.5	0.2	4.0	-2.0
2.Forage	8.3	1.2	20.1	-10.7
3.Vegetable oil refining	4.8	1.3	28.1	13.4
4.Sugar manufacturing	3.4	2.9	7.7	5.3
5.Slaughtering and meat processing	5.7	1.3	16.9	4.9
6.Fish and fish products	19.7	7.6	19.7	3.4
7.All other food manufacturing	16.6	4.8	28.8	2.2
8.Wines, spirits and liquors	6.4	3.5	15.3	1.2
9.Soft drink and other beverage	15.0	1.6	41.2	8.2
10.Tobacco products	1.1	1.1	0.2	-0.1
11.Cotton textiles	10.0	0.7	14.4	1.7
12.Woolen textiles	15.6	-2.8	21.9	0.7
13.Hemp textiles	5.9	3.1	8.7	4.6
14.Textiles products	20.3	4.7	24.7	3.4
15.Knitted and crocheted fabrics and articles	26.0	-3.3	31.4	-2.2
16.Wearing apparel	32.1	-1.4	36.0	-2.6
17.Leather, fur, down and related products	30.9	0.3	42.3	-0.9
18.Products of wood, bamboo, cane, palm, straw	12.0	-2.9	17.2	-7.6
19.Furniture	24.5	4.1	39.6	8.4
20.Paper and paper products	11.8	3.8	24.6	8.0
21.Printing, reproduction of recording media	9.5	3.0	22.4	1.9
22.Stationary and related products	25.3	6.1	34.6	12.2

23.Toys, sporting and athletic and recreation products	42.0	-1.5	54.4	3.2
24.Petroleum and nuclear processing	7.2	2.8	7.5	4.2
25.Coking	2.2	1.0	5.1	5.1
26.Basic chemicals	6.2	2.4	9.7	9.7
27.Chemical fertilizers	3.1	3.3	3.1	3.1
28.Chemical pesticides	5.5	3.7	8.8	2.0
29.Paints, varnishes and similar coatings, printing ink	17.5	8.0	30.3	16.8
30.Man-made chemical products	18.6	6.5	25.3	12.8
31.Special chemical products	10.0	2.1	18.3	9.8
32.Chemical products for daily use	20.4	8.8	48.3	18.9
33.Medical and pharmaceutical products	10.4	3.1	16.8	4.4
34.Chemical fibers	14.9	0.9	18.5	0.7
35.Rubber products	17.0	6.8	27.9	8.1
36.Plastic products	21.7	0.5	33.0	1.0
37.Cement, lime and plaster	5.3	2.8	9.4	3.7
38.Glass and glass products	12.4	0.6	18.4	5.9
39.Pottery, china and earthenware	17.1	-0.1	23.5	-1.1
40.Fireproof materials	4.8	3.0	7.4	2.7
41.Other nonmetallic mineral products	7.9	2.7	13.5	0.5
42.Iron-smelting	3.2	-0.3	5.6	-4.5
43.Steel-smelting	4.7	1.6	6.7	6.8
44.Steel pressing	6.3	4.0	10.9	8.0
45.Alloy iron smelting	2.5	-0.2	4.8	-2.2
46.Nonferrous metal smelting	5.8	1.5	6.1	0.3
47.Nonferrous metal pressing	9.5	3.9	15.7	4.5
48.Metal products	15.2	2.6	25.9	2.2
49.Boiler, engines and turbine	5.6	3.6	11.1	0.9

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50.Metalworking machinery	10.8	5.4	12.6	5.0
51.Other general industrial machinery	10.1	4.4	20.9	5.7
52.Agriculture, forestry, animal husbandry and fishing machinery	3.3	6.3	3.8	6.2
53.Other special industrial equipment	14.2	10.6	18.6	14.7
54.Railroad transport equipment	3.7	4.9	2.9	4.3
55.Motor vehicles	6.7	3.1	24.0	3.9
56.Parts and accessories for motor vehicles and their engines	13.3	10.8	27.9	21.4
57.Ship building	12.6	0.9	12.0	4.9
58.Other transport equipment	13.4	3.0	19.0	2.3
59.Generators	15.3	6.0	25.5	10.5
60.Household electric appliances	22.9	4.6	31.5	7.5
61.Other electric machinery and equipment	23.0	4.2	36.2	3.6
62.Telecommunication equipment	27.6	10.4	55.5	16.3
63.Electronic computer	43.5	22.1	81.8	54.2
64.Other computer peripheral equipment	59.5	11.9	85.8	14.5
65.Electronic element and device	44.3	10.2	68.7	27.1
66.Radio, television and communication equipment and apparatus	46.1	10.8	54.4	19.4
67.Other electronic and communication equipment	35.7	5.2	59.6	10.3
68.Instruments, meters and other measuring equipment	23.7	3.0	36.5	7.7
69.Cultural and office equipment	45.8	8.9	85.7	9.0
70.Arts and crafts products	25.9	3.7	30.7	1.1
71.Other manufacturing products	25.6	4.0	36.1	-3.8
Overall (all sectors)	15.9	3.8	25.3	6.0

Figure 1 Tax Rate Distribution with Groups of firms (2004)
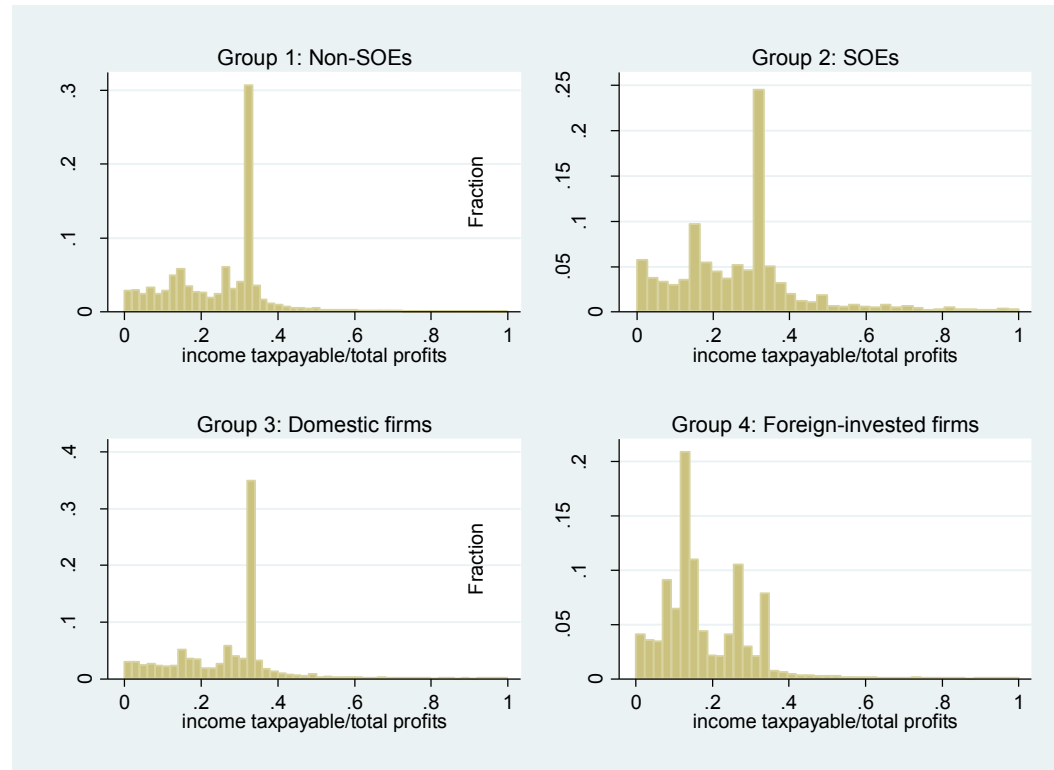
Figure 2 Tax Rate Distribution with Domestic Non-SOEs (2004)