Productivity Spillovers from Foreign Direct Investment: Evidence from Firm-Level Data in China

Xinpeng Xu* and Yu Sheng **

Abstract Using firm-level census data, this paper examines the spillover effects of foreign direct investment (FDI) on domestic firms in the Chinese manufacturing industry between 2000 and 2003. We find that FDI has a significant positive spillover on industry productivity that decreases as the share of FDI in the industry increases. These positive spillovers are more likely to occur through forward linkage (where domestic firms purchase high-quality intermediate goods or equipment from foreign suppliers) than through backward linkage (where firms produce goods for foreign multinationals). Entering and exiting firms receive greater benefits from both horizontal and vertical productivity spillovers than existing firms. Benefits are also highest in large, non-exporting and non-SOE firms. Our evidence suggests that domestic firms differ significantly in the extent to which they benefit from FDI according to firm structure as well as the source of FDI.

Keywords: Foreign Direct Investment, Spillover Effects, Chinese Manufacturing Industry

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* Xinpeng Xu (*Corresponding author*)
Faculty of Business
Hong Kong Polytechnic University
Kowloon, Hong Kong
afxxu@polyu.edu.hk

** Yu Sheng
Crawford School of Economics and Government
The Australian National University
Canberra, Australia
yu.sheng@anu.edu.au

I. Introduction

Over the past two decades, cross-border flows of foreign direct investment (FDI) have taken centre stage in the globalization process, with increasing numbers of firms (usually developed countries) investing in foreign countries (either developed or developing countries). According to UNCTAD (2007), the global flows of FDI increased from US$324 billion in 1995 to US$1.3 trillion in 2006. Inflows of FDI to developed countries amounted to US$857 billion in 2006 while rising to a record US$379 billion for developing countries. The global stock of FDI has thus more than quadrupled from US$2.76 trillion in 1995 to $12 trillion in 2006.

A commonly-held belief is that FDI benefits recipient countries through knowledge transfer from multinational firms, which helps improve the productivity of domestic firms. There are several channels through which FDI may affect domestic productivity. First, domestic firms may benefit by observing and imitating the multinationals (horizontal spillovers). Second, productivity spillovers may occur because of labor turnover, as former employees of multinationals, who have acquired managerial expertise, production or marketing skills, may resurface in domestic firms or set up their own firms to which they can transfer that knowledge (horizontal spillovers). Third, domestic firms may also benefit through backward linkage, by being a supplier of the multinationals and thereby obtaining some free technology transfer, or through forward linkage by having a foreign supplier (vertical spillovers).

Despite these perceived relationships, empirical evidence of the benefits of FDI spillovers is sobering (Rodrik 1999). Due to a lack of detailed firm-level data, researchers have focused mainly on developed countries such as the U.S. (Haskel *et al.*, 2007) and UK (Griffith *et al.*, 2006), which as technological leaders may have little to gain from FDI spillovers. Other studies focus on small developing countries where the amount of FDI is relatively small and domestic industries are not sufficiently diversified to reap significant benefits from FDI. For example, Aitken and Harrison (1999) estimate the productivity effects of FDI to a sample of Venezuelan manufacturing plants from 1976 to 1989, and find that plants in industries with a higher foreign presence actually had *lower* productivity than those in other industries. Javorick (2004) finds that domestic firms in Lithuania only benefit from FDI when they are the suppliers to foreign firms.

Recently, Blalock and Gertler (2007) found positive horizontal spillover effects of FDI in Indonesian manufacturing, but argue that lower input prices due to the presence of downstream FDI are a major source of the heightened domestic productivity.

What is lacking in the literature is firm-level evidence from a large FDI recipient country in the developing world where any spillover effects may be most important. This paper fills the gap by examining the case of China. Using annual manufacturing census data of firms (including all state-owned enterprises and non-stated firms with annual sales of more than RMB 5 million (about US$600,000)) for the years 2000 to 2003, we study the effects of FDI on domestic-firm productivity in the manufacturing sector. Such a study is of interest for several reasons. First, China is the largest recipient of FDI in the developing world, recording US$69 billion of inflows and a total FDI stock of US$292 billion in 2006. This level of FDI appears sufficiently large for China to reap horizontal benefits. Second, China's history under centralised planning led to unique industry development. As the economy has opened to foreign direct investment, this wide spectrum of industries has a high potential to benefit from backward and forward linkages with foreign firms. Third, as a developing economy, China's distance from the technology-and-management frontier may place it in an ideal position to exploit the potential benefits of FDI (Findlay 1978), relative to more advanced industrialized nations.

We contribute to the literature in several ways. By using census data we are able to undertake a full-scale examination of firm-level FDI spillover in China.[1] Further, our empirical analysis overcomes with a variety of problems typically associated with this type of analysis; including endogeneity of input choices, omitted variables and clustering effects in standard errors. In particular, we differ from other publications by controlling for clustering effects. As well as identifying the spillover effects on existing firms as commonly undertaken, we extend our analysis to identify the productivity effects of foreign investment on entering and exiting firms. Finally, we explore the role of heterogeneity in firms and in FDI sources and investigate whether certain firm characteristics (such as ownership structure and export orientation) have implications for FDI benefits.

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[1] There are some studies on the spillover effect of FDI in China using industry-level data (e.g.,Sun *et al*.,2002). Industry-level studies, however, suffer from problems such as aggregation bias and endogeneity, as discussed in Hale and Long (2007) and Haskel *et al*. (2007, Footnote 2). Hu and Jefferson (2002) study FDI spillovers in China's electronic and textile industries.

Our results indicate that there are significant positive horizontal spillovers from FDI. Chinese domestic firms in an industry with high FDI can produce a greater output (for a given level of inputs) than otherwise similar firms in industries with low FDI. The result is in stark contrast with most empirical studies on small developing countries that find negative or no spillovers (Aitken and Harrison 1999, among others). However, positive effects diminish as the share of FDI in an industry increases, and become negative when the share of FDI in that industry reaches a certain threshold. Our results capture both positive spillovers and negative "business stealing" effects: when FDI is below a certain level, domestic firms may benefit more from its presence just by observing and imitating the multinationals and perhaps through labor turnover; yet when FDI increases to a certain level, "business stealing" effects dominate.

Furthermore, the positive spillovers are more likely to operate through forward linkage when domestic firms purchase high-quality intermediate goods with lower input prices, or equipment from foreign suppliers, than through backward linkage when they produce for multinationals as commonly found in other (small) developing countries. This may be the result of a set of unique Chinese FDI policy that encourages firms to import raw materials and equipments from international market.

The magnitude of the horizontal and forward linkage effects is economically meaningful. A one percentage point increase in the share of foreign firms in an industry leads to a 0.015 percent productivity gain for domestic firms in the same industry and a 0.057 percent productivity gain for domestic firms in the downstream industry. Most important, we find that newly entering and exiting firms benefit more from foreign investment than incumbent firms. We find that estimated elasticities of both horizontal and forward linkage effects of FDI on all domestic firms are 0.029 and 0.070 respectively, which are much higher than the effects on continuing firms (domestic firms excluding new entry and exit) where the elasticities are 0.009 and 0.051 respectively. We also find that domestic firms differ significantly in the extent to which they benefit from FDI, with large, non-exporting and non-SOE firms accruing the greatest benefits from foreign firms in China.

Not only is there significant heterogeneity across firms in absorbing the benefits of FDI spillovers, but also sources of FDI matter for the spillovers, with FDI coming from Western firms produce more substantive spillovers than overseas Chinese firms. This is consistent with observations that the Hong Kong and Taiwan firms investing in China are usually less capital-intensive and technologically advanced than their Western counterparts. Also, these firms are often "round-trip" firms taking advantage of China's preferential tax treatment for foreign investors.

The rest of the paper is organized as follows. The next section describes in detail the background of FDI in China. Section III discusses the construction of our dataset and provides basic statistics, as well as the parameter-identification strategy implemented. Section IV discusses the results. Section V concludes.

II. Overview of Foreign Direct Investment in China

Although China's first experience with FDI came after the reforms of 1978, it was not until 1992 that high levels of FDI started to flow into the country. Figure 1 reports the utilized inflow during the period of 1992 to 2006. Between 1992 and 2006, FDI inflows increased from US$1.1 billion to $73 billion. In particular, after its entry into the WTO in 2001, China's commitment to broader and deeper liberalization in trade and investment further accelerated FDI inflows and increased the share of foreign ownership in Chinese assets. In 2006, the share of FDI inflow in total fixed-asset investment reached 5.28 percent, with the manufacturing sector the largest recipient of FDI in China, accounting for 63.6 percent of the total FDI.[2]

China's policy objectives in attracting FDI are to advance China's technology and to promote exports, articulated in Article 3 of the *Law of the People's Republic of China on Foreign-owned Enterprises*: "…[China] encourage the establishment of foreign-owned enterprises that are export-oriented or technologically advanced." To promote exports to China from foreign firms, China offers import tariff and value-added tax (VAT) exemption for imported raw materials and

[2] Source: http://www.fdi.gov.cn.

parts used in the export processing. This tax incentive encourages foreign firms to purchase inputs from, and to export their output to, the international market. In fact, imports by foreign firms accounted for almost 59 percent of China's total imports while exports by foreign firms accounted for 57 percent of China's total exports in 2007.[3] Consequently, most foreign firms in China are exported-oriented. An unintended consequence of the tax incentive has been a weakening vertical linkage between foreign firms and local Chinese firms, in particular, a lack of backward linkage with those Chinese firms in the upstream industry.[4]

China also offers various preferential treatments to foreign firms if their investment falls into the so-called 'high-tech' sector. Within the manufacturing sector, FDI has started to move from labor-intensive industries, where FDI was initially concentrated, to capital-intensive and technology-intensive industries. From 2001 to 2005, the growth in total assets of foreign firms was greatest in the most technology-intensive industries — increasing by 137 percent — followed closely by capital-intensive industries, which increased by 125 percent, though foreign firms' total assets in labor-intensive industries increasing by 81 percent.[5] The inflow of FDI with relatively advanced technology into Chinese manufacturing offered ample opportunities for domestic firms to improve their productivity.

FDI inflows into China contribute significantly to the process of marketization in the manufacturing sector. In 2006, the total output value of FDI firms add up to 6.09 trillion RMB, accounting for 47.5 percent of the total output value of private enterprises in Chinese manufacturing sector. With more foreign firms entering into Chinese manufacturing sector, state owned enterprises (SOEs) are less dominant. Due to the intensified market competition, more productive firms enter while less efficient firms exit freely. Between 2000 and 2003, the average Herfindahl concentration index, defined as the output share of top eight firms across 21 two-digit level manufacturing industries decreased from 8.7 per cent to 8.5 per cent as the average FDI output share increased from 29.0 per cent to 30.5 per cent.

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[3] See http://www.fdi.gov.cn.

[4] China also allows imported inputs sold to downstream firms to be exempt from import tariff and VAT tax as long as they are processed for export.

[5] The nine sectors with the most significant expansion of foreign firms are furniture (183 percent), chemical materials and products (128 percent), ferrous metal smelting (297 percent), non-ferrous metal smelting (193 percent), general machinery (145 percent), special machinery (206 percent), transport equipment (134 percent), electronics and telecommunications equipment (146 percent), and instruments (169 percent), most of which are capital-intensive and technology-intensive industries (reference?).

A distinct feature of FDI in China has been the sources of investment. The bulk of FDI in China is from newly-industrialized Asian economies with similar culture and traditions rather than from Westernized economies. In particular, FDI from Hong Kong and Taiwan (HKTW) accounts for around half of the total FDI inflow to mainland China while less than one third is from developed economies. There are mixed views in the literature as to how HKTW firms provide benefit to local firms. Although investors of Chinese ethnicity have the added advantage of cultural and language similarities, their technology is typically regarded as less advanced. The variability in productivity spillovers from FDI in China, based on the investment source, remains an empirical question.

III. Data and Estimation Strategy

A. Data Collection and Variable Definition

The data used in this study is derived from from the Annual Enterprise Census conducted by the National Bureau of Statistics (NBS) of China. The census covers all state-owned firms and non-state-owned enterprises with annual sales above RMB ¥5 million in mining, manufacturing and public-utility sectors, across all provinces. These sectors account for more than 95 percent of the total value of Chinese industrial output. The sample used is an unbalanced dataset at the firm level for the manufacturing sector (China Industry Classification Code: 13-42), which spans the four year period from 2000 to 2003. The number of firms sampled varies from 134,130 in 2000 to 169, 810 in 2003.

Table 1 provides summary data for the period including the number of firms, the value of their average output, their average use of labor and capital, and the intermediate inputs of domestic firms and FDI firms. The real output of firms, Y, is defined as the total value of the sample firms' outputs, deflated by the producer price index at the firm level, with 1990 as the base year.[6] Labor input, L, is defined as total employment. As employment data are not available for 2003, we use registered labor ("Zai Gang") as a substitute. Although there are large numbers of non-

[6] Some studies have used industry-specific price index to deflate firm output, which may not be appropriate as it imposes a strong assumption that all firms faced the same prices (see Klette and Griliches (1996) for a discussion).

productive workers in Chinese firms, there is strong correlation (about 95 percent) between total employment and "Zai Gang" labor at the firm level in 2000. Therefore, we use "Zai Gang" workers as a proxy for total employment in 2003 given data availability. Capital, *K*, is defined as the value of fixed assets at the end of the year, deflated by the price index for investment goods, with 1990 as the base year. As defined by the Chinese National Bureau of Statistics, intermediate goods, *M*, is the value of total output less value added, plus the net value-added tax, deflated by the intermediate-input deflator.

Following Javorick (2004), we measure FDI in an industry by calculating the weighted sum of foreign capital, with the weight being each firm's share of industry output ($FDIShare_{jt}$):

$$FDIShare_{jt} = (\sum_{i \in j} ForeignShare_{it} * Y_{it}) / (\sum_{i \in j} Y_{it}), \qquad (1)$$

where i denotes firm, j denotes industry and t year. The index is calculated at the two-digit level.[7]

Table 1 also shows the average share of foreign equity during the period 2000-2003, measured as capital share of FDI by output. There is a significant increase over time in the shares of foreign equity. Table 2 shows the distribution of FDI firms and their shares (output-weighted) across industries at the two-digit level within the manufacturing sector during the sample period. The industry that had the largest shares of foreign investment is "Instruments, Meters, Cultural and Clerical Machinery" (57.9%), followed by "Communication Equipment, Computers and Other Electronic Equipment" (55.2%), "Cultural, Educational and Sports Goods" (49.4%) and "Leather, Fur, Feather and Related Products" (40.6%).

Finally, we use $HKTWRatio_{jt}$ as an index to distinguish the spillover effects of foreign capital from Hong Kong and Taiwan from other sources, where:

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[7] See Aitken and Harrison (1999) and Javorcik (2004) for the output-penetration index. To test for robustness, we also provide an alternative measure of FDI in a sector by calculating the weighted sum of foreign capital, with the weight being each firm's share of capital in the sector ($KFDI_{it}$).

$$HKTWRatio_{jt} = (\sum_{i \in j} ForeignShare\_HKTW_{it} * Y_{it}) / (\sum_{i \in j} ForeignShare\_Other_{it} * Y_{it}) \quad (2)$$

where $ForeignShare\_HKTW_{it}$ and $ForeignShare\_Other_{it}$ are the weighted sum of capital from Hong Kong SAR and Taiwan and other foreign countries respectively.

The backward and forward linkages of FDI, $FDI\_Backward_{jt}$ and $FDI\_Forward_{jt}$, are defined, following Javorick (2004), as follows:

$$FDI\_Backward_{jt} = \sum_{k \neq j} \alpha_{jk} FDIShare_{kt} \quad (1A)$$

and

$$FDI\_Forward_{jt} = \sum_{m \neq j} \varphi_{jm} [[\sum_{i \in m} ForeignShare_{it} * (Y_{it} - X_{it})] / [\sum_{i \in m} (Y_{it} - X_{it})]], \quad (1B)$$

where α_{jk} is the proportion of industry *j*'s output supplied to industry *k*, derived from the 1997 input-output table at the two-digit International Standard Industrial Classification (ISIC) level, and φ_{jm} is the share of inputs purchased by industry *j* from industry *m* in total inputs sourced by industry *j*. Y_{it} is the total output and X_{it} is the export of firm i at time t

B. Specification and Identification

To examine whether FDI generates intra-industry or inter-industry productivity spillovers to domestic firms, we start with a specification that has been used extensively in the literature; e.g., Aitken and Harrison (1999) and Javorcik (2004):

$$\begin{aligned} \ln Y_{ijrt} &= \beta_0 + \beta_1 \ln L_{ijrt} + \beta_2 K_{ijrt} + \beta_3 \ln M_{ijrt} + \gamma fdi_{ijrt} \\ &+ \beta_4 FDIShare_{jt} + \beta_5 FDIShare_{jt}^2 + \beta_6 HKTWRatio_{jt} \\ &+ \beta_7 FDI\_Backward_{jt} + \beta_8 FDI\_Forward_{jt} \\ &+ \alpha_j + \alpha_r + \alpha_t + \varepsilon_{ijrt} \end{aligned} \quad (3)$$

where Y_{ijrt} denotes the real output of domestic firm *i* operating in industry *j* and region *r* at time t, L_{ijrt}, K_{ijrt} and M_{ijrt} are labor, capital and intermediate production inputs, respectively, fdi_{ijrt} is the capital share of foreign investment in domestic firms at the firm level. $FDIShare_{jt}$

and its square term measure the share of foreign equity in industry j at time t,[8] which takes the form of $YFDI_{jt}$ and its square term. $FDI\_Backward_{jt}$ and $FDI\_Forward_{jt}$ are defined as the backward and forward linkages of FDI, $HKTWRatio_{jt}$ represents the relative share of foreign equity owned by investors from Hong Kong and Taiwan. Three sets of dummy variables are used to control for the industry-, region- and time-specific effects, respectively. They include $\alpha_j = \sum_j \varpi_j d_j$ for the industry-specific effect, $\alpha_r = \sum_r \chi_r d_r$ for the region-specific effect, and $\alpha_t = \sum_t \delta_t d_t$ for the time-specific effect.

To correctly identify the effects of FDI on domestic productivity, we need to address several econometric issues such as endogeneity of input choices, cluster effects and omitted variables

Endogeneity of Input Choices — Ordinary least squares (OLS) is inappropriate for estimating the impacts of labor and capital on productivity, since factors of production should be treated as endogenous. Olley and Pakes (1996) (OP), followed by Levinsohn and Petrin (2003) (LP), point out that inputs like capital should be considered endogenous since producers chooses the level or usage rate based on cost and productivity considerations. These considerations are observed by the producer but not by the econometrician. Thus, productivity estimates may be biased if the endogeneity of input choice is not taken into account.

To address this concern, we employ a semi-parametric estimation procedure suggested by Levinsohn and Petrin (2003). Compared with the approach of Olley and Pakes (1996), this approach allows for firm-specific productivity differences that exhibit idiosyncratic changes over time, and use intermediate inputs rather than long-term capital investment as a proxy for unobserved productivity. We follow the LP method for two reasons. Firstly, investment behavior in Chinese firms is highly influenced by government policy (such as policy loans to SOEs) so investment may not be monotonic with respect to productivity. Secondly, the four year data sample available is not sufficiently long for firms to make capital adjustments, especially in regard to long-term investments such as buildings and machinery. More specifically, we assume

[8] An alternative measure would use each firm’s share in the aggregate industrial capital.

a Cobb-Douglas production function, written as a natural-logarithm after taking the first order differentiation:

$$y_{it} = \beta_c + \beta_l l_{it} + \beta_k k_{it} + \beta_m m_{it} + \varpi_{it} + u_{it} \tag{4}$$

where β_c measures the mean efficiency level across firms and over time, ϖ_{it} represents firm-level productivity, and u_{it} is an *i.i.d.* component, representing unexpected deviations from the mean due to measurement error, unexpected delays or other external circumstances. The three components combine to determine the time-specific and producer-specific outputs.

In order to estimate Equation (4), we further assume that capital is a state variable only affected by current and past levels of unobserved productivity (ϖ_{it}) and monotonic with respect to the intermediate inputs. We define

$$m_{it} = g_t(k_{it}, \varpi_{it}) \quad (t = 1,...,T) \tag{5}$$

where m_{it} is a vector of proxy variables (i.e. intermediate inputs) and $g(\cdot,\cdot)$ is monotonic with respect to ϖ_{it}. The choice of intermediate inputs hence depends on capital and productivity. Provided that the choice of intermediate inputs is strictly increasing, conditional on capital, the relationship between m_{it} and ϖ_{it} can be inverted. Thus, we have $\varpi_{it} = h_t(k_{it}, m_{it})$ where $h_t(.,.) = g_t^{-1}(.,.)$. Substituting this information into Equation (4), we have

$$y_{it} = \beta_0 + \beta_l l_{it} + \beta_k k_{it} + \beta_m m_{it} + h_t(k_{it}, m_{it}) + u_{it} \tag{6}$$

Estimation of Equation (6) is carried out in two stages. In the first stage, we define $\phi(m_{it}, k_{it}) = \beta_0 + \beta_k k_{it} + \beta_m m_{it} + h_t(m_{it}, k_{it})$ (in LP). Thus, OLS method can be used to estimate

$$y_{it} = \beta_l l_{it} + \phi(m_{it}, k_{it}) + u_{it} \tag{7}$$

where $\phi(.,.)$ is approximated by a higher-order polynomial in m_{it} and k_{it} (including a constant term). Estimation of Equation (7) results in a consistent estimate of the coefficients for labor. In the second stage, assume that productivity follows a first-order Markov process, i.e. $\varpi_{it+1} = E(\varpi_{it+1} | \varpi_{it}) + \xi_{it+1}$, where ξ_{it+1}, representing the news component, is assumed to be uncorrelated with productivity and capital in period $t+1$. Thus, the estimation algorithm can be written as:

$$E[y_{it+1} - \beta_l l_{it+1}] = \beta_0 + \beta_k k_{it+1} + E(\varpi_{it+1} | \varpi_{it}) + \xi_{it+1} + u_{it+1} \tag{8}$$

where $E(\varpi_{it+1} | \varpi_{it}) = q(\phi_{it} - \beta_k k_{it} - \beta_m m_{it})$ follows from the law of motion for the productivity shock. As the first stage of the estimation procedure has used a higher-order polynomial expansion in $\hat{\phi}_{it} - \hat{\beta}_k k_{it}$ or $\hat{\phi}_{it} - \hat{\beta}_k k_{it} - \hat{\beta}_m m_{it}$ to approximate $g(\cdot,\cdot)$, the capital coefficients can then be obtained by applying Non-Linear Least Squares (NLS) to Equation (9):

$$y_{it+1} - \beta_l l_{it+1} = \beta_0 + \beta_k k_{it+1} + \beta_m m_{it+1} + q(\phi_{it} - \beta_k k_{it} - \beta_m m_{it}) + \xi_{it+1} + u_{it+1} \quad . \tag{9}$$

By using this method, we can obtain accurate production-function estimates that can in turn be used to estimate domestic productivity; or $\ln TFP_{ijrt} = y_{ijrt} - \beta_l \ln l_{ijrt} - \beta_k \ln k_{ijrt} - \beta_m \ln m_{ijrt}$.

Both the OLS and our estimates are shown in Table 3. Using the productivity estimate as the dependent variable, we obtain from equation (3):

$$\begin{aligned} \ln TFP_{ijrt} &= \beta_0 + \gamma fdi_{ijrt} + \beta_4 FDIShare_{jt} + \beta_5 FDIShare_{jt}^2 \\ &+ \beta_6 HKTWRatio_{jt} + \beta_7 FDI\_Backward_{jt} + \beta_8 FDI\_Forward_{jt} \; . \\ &+ \alpha_j + \alpha_r + \alpha_t + \varepsilon_{ijrt} \end{aligned} \tag{10}$$

Cluster Effect — The OLS estimates may overestimate the spillover effects of FDI on domestic firm productivity without a correction for clustering. Moulton (1990; p.334), followed by Bertrand *et al*. (2004), argues that "when one tends to use the aggregate market or public policy variables to explain the economic behavior of micro units, it is possible that the standard errors of estimated coefficients of those aggregate variables from OLS might be underestimated, which would lead to the overstated significance of coefficients." The presence of group-level variables in such a 'structural' model can be viewed as putting additional restrictions on the intercepts in separate-group models, which can cause the residual to deviate from the *i.i.d* assumption. Failure to address this type of cluster error problem may cause a serious downward bias in the estimated errors, resulting in spurious findings of statistical significance for the aggregate variable of interest (industry FDI in this case).

Javorcik (2004) uses a simple cluster-robust option to correct for any intra-group correlation in standard errors between observations belonging to the same industry in a given year. Although this represents an improvement over previous studies that do not correct for cluster effects, the method of allowing for differences in the variance/standard errors due to arbitrary intra-group correlation has limitations (Wooldridge, 2006). To illustrate the potential risk that the simple cluster-robust correction can bring about, we suppose there is a cluster effect in equation (10). Then, the residual part can be decomposed into two components: $\varepsilon_{ijrt} = u^g_{jt} + v_{ir}$. Thus, the variance of the residual in the regression could be written as:

$$\varepsilon_{ijrt} : \sigma_{\varepsilon} = \sigma^2_u + \sigma^2_v / M_g \qquad (11)$$

where ε_{ijrt} is the residual of Equation (10), σ_{ε} is the variance of ε_{ijrt}. σ^2_u is the variance of the inter-group residual (u^g_{jt}), σ^2_v is the variance of the intra-group residual (v_{ir}), and M_g is the number of observations in each group. In such a situation, the cluster-robust option will work only when u^g_{jt} is normally distributed with constant variance and when it dominates ε_{ijrt} so that either σ^2_v is small relative to σ^2_u, M_g is large, or both. In many FDI studies, however, the number of groups (say, two-digit industries in a single time period) is small (M<<50) (i.e., σ^2_v is small relative to σ^2_u) and there are very unbalanced cluster sizes in the sample (some M_g may be small) so that σ_ε may not be constant and dominated by σ_u^2.[9] Therefore, the cure provided by the cluster-robust correction can be even worse than the disease, since using the wrong weights may bias the standard errors of the estimated coefficients in an unclear direction.[10]

To properly correct for cluster effects in standard errors of the estimated coefficients, we follow a new two-stage estimation procedure proposed by Wooldridge (2006). In the first stage, we treat each industry-year as a group and run regressions for firm productivity on some firm-level variables within each group, separately controlling for regional disparity.[11] The equation used for the first-stage estimation can be written as:

$$\ln TFP_{ir} = \overline{\delta}_{jt} + \gamma fdi_{ir} + \alpha_r + v_{ir} \qquad , \qquad (12)$$

where $\ln TFP_{ir}$ is firm i's total factor productivity in region r (given industry j at time t), fdi_{ir} is the foreign investment in the firm, which is used to control for the firm level impact. The α_r are regional dummies used to specify the regional disparity of domestic firms. The constant term ($\overline{\delta}_{jt}$) and its standard error ($se(\overline{\delta}_{jt})$) are then extracted from each of these regressions, capturing firm characteristics at the industry-year group level, or firm industry characteristics. In the second-stage, we estimate regressions of firm industry characteristics on FDI, controlling for other factors, using weighted least squares, where group g is weighted by $1/[se(\overline{\delta}_{jt})]^2$. Hence, groups for which there are more data and a smaller variance receive greater weight, which is similar to M_g / σ_v^2 (See Wooldridge (2006; p.21)).[12] In doing so, our estimation equation for the

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[9] See Blalock and Gertler (2007) for the argument on the over-correction of the cluster effect for FDI studies.
[10] Moreover, in Javorcik (2004), the introduction of industry dummies into the regression between firms' productivity and the FDI variables at the industry level tends to reduce the freedom of estimation leading to over-identification in the regression.
[11] We treat each industry in each year as a group rather than each industry over time as a group because our observations on FDI at the industry level are changing over time for each sector.
[12] If we assume that Z_g is the group-specific effect and u_g is the residual from the second-stage estimation, we have

$$A\hat{\operatorname{var}}(\hat{\beta}_{FE}) = E(\sum Z'_g Z_g)^{-1}(\sum Z'_g \hat{u}_g \hat{u}'_g Z_g)(\sum Z'_g Z_g)^{-1}$$ or

$$A\hat{\operatorname{var}}(\hat{\beta}_{FE}) = E(\sum Z'_g Z_g)^{-1}(\sum Z'_g \Omega_g Z_g)(\sum Z'_g Z_g)^{-1}$$ when G is large. If a cluster effect arises due to correlation among intra-group firms, we have $A\hat{\operatorname{var}}(\hat{u}_g) = E(\hat{u}_g \hat{u}'_g) = E(\Omega_g) = \sigma_g^2 + \sigma_u^2 / M_g$. Given that the

second stage becomes

$$\begin{aligned}\bar{\delta}_{jt} &= \beta_0 + \beta_4 FDIShare_{jt} + \beta_5 FDIShare^2_{jt} + \beta_6 HKTWRatio_{jt} \\ &+ \beta_7 FDI\_Backward_{jt} + \beta_8 FDI\_Forward_{jt} + \alpha_j + \alpha_t + u_{jt}\end{aligned} \quad . \qquad (13)$$

Compared with the simple cluster-robust correction, Wooldridge's (2006) two-stage method has three advantages. First, it has some explicit assumptions for the intra-group and inter-group components in the random-error term, so that the cluster effect can be better controlled. Second, it helps to avoid the potential multi-collinearity and identification problems between regional dummies and industry dummies (where interaction terms between regional dummies and industry dummies should have been, but are not, incorporated in previous studies) through the two-stage estimation,. Third, it is compatible with all other methods (such as instrumental variable approach and first differencing methods) used for dealing with omitted variables.

Omitted Variables — Another threat to identification is that there may be certain unobserved factors at the industry level, such as changes in business-cycle conditions or industry-wide implementation of new technologies that may affect domestic firms' yet may be closely correlated with FDI in the industry. For example, FDI may flow into industries that are *a priori* more productive for reasons that are unclear.[13] Failure to account for omitted variables would lead to biased results.

We address the omitted-variables problem with two strategies. First, we use the standard instrumental variable (IV) approach. We choose the number of foreign visitors in each industry ($ForeignVistor_{jt}$) as the instrument for FDI in that industry. It is calculated as the inbound foreign visitors in each region multiplied by regional industrial share.[14] The inflow of foreign

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first-stage estimation yields σ_u^2 / M_g, the OLS with the analytical weight correction adjusts Ω_g by dividing it by σ_u^2 / M_g. The adjusted $\hat{A}\text{var}(\hat{u}_g) = \sigma_g^2 / \sigma_u^2 * M_g + 1$, which may be biased when M_g / σ_u^2 is small. Thus, we use frequency weights in applying weighted least squares. The correlation between the weights and group size is high (0.74).

[13] Sometimes this problem is also referred to as the endogeneity of FDI. See, e.g., Galina and Long (2007).

[14] As we do not have data for foreign visitors by sector, we allocate foreign visitors to each sector according to its relative importance. This allocation is reasonable since their visits are mainly for business purposes. Other instruments, including FDI to the same industry of the ASEAN countries and the real-profit tax-burden estimated from firm-level data were also tested, but did

visitors may be positively related to FDI, while it is less likely to be related to changes in productivity at the firm level. Approximately one-third of its foreign visitors come to China for business, a large proportion of which are there for FDI-related activities. Many of the remaining two-thirds, although not specifically concerned with FDI, will take a lot of information back to their home countries, which in turn may increase future FDI inflows.

Second, we estimate the equation in first differences which removes any unobserved firm-specific, industry-specific and region-specific effects and is commonly used to deal with omitted variables.[15] We also include the industry and time dummy variables in the first-difference specification to control for unobserved factors that may be driving changes in the attractiveness of a given industry or year. From Equations (13) we arrive at:

$$\begin{aligned}\Delta\bar{\delta}_{jt} &= \beta_0 + \beta_4 \Delta FDIShare_{jt} + \beta_5 \Delta FDIShare^2_{jt} + \beta_6 \Delta HKTWRatio_{jt} \\ &+ \beta_7 \Delta FDI\_Backward_{jt} + \beta_8 \Delta FDI\_Forward_{jt} + \alpha_j + \alpha_t + u_{jt}\end{aligned} \quad (14)$$

C. Three Scenarios to Address Firm Dynamic

In most studies, the sample used for examining the relationship between FDI and domestic productivity is restricted to continuing firms or surviving firms.[16] Thus, the estimated coefficients of FDI in these regressions should be interpreted as the impact of FDI on the productivity of continuing or surviving domestic firms. It has been widely documented that there are significant differences in productivity between entering, exiting and incumbent firms.[17] If FDI increases the probability of a firm's survival and encourages new entrants through positive spillover effects, it may lead to fewer exits and perhaps more entrants. In this case, there will be an underestimation of the true relationship between FDI and productivity (Haskel *et al.*, 2007). Alternatively, FDI may lower the probability of firm survival through tougher competition and

not survive the testing process.

[15] Although time differencing removes unobservable factors that are not changing over time while inclusion of the industry and time dummy variables in the first-difference specification controls for unobserved factors that may be driving changes in the attractiveness of a given industry or year, it may not remove those factors at the firm level that may change over time. Our LP method in *Identification Issue (1)* deals with unobservable factors changing over time at the firm level, such as quality of management, which may not be fixed over time within firms.

[16] Continuing firms refer to firms that exist during the entire sample period while surviving firms refer to firms that exit at least in one of the sample years.

[17] Aw *et al.* (2001), for example, show that the productivity differential between entering and exiting firms is an important source of industry-level productivity growth in Taiwanese manufacturing that accounts for as much as half of the growth in some industries and time periods.

encourage firms with lower productivity to exit. The spillover effect is thus oversated when only a sample of surviving firms is used.[18]

There was substantial entry and exit in our sample period. As is shown in Table 4, the average entry rate and exit rate of domestic firms in China are 29.9 percent and 24.6 percent, respectively, between 2000 and 2004. Although it is difficult to address the issue of selection bias, as pointed out by (Haskel *et al*., 2007), we believe it is interesting to consider the exit and entry of domestic firms in estimating the relationship between FDI and productivity.

To control for the productivity differences between entering and exiting firms, we apply the neighborhood-matching technique to match entering and exiting firms with similar productivity levels in the two-digit industries and in three regions (including Eastern China, Middle China and Western China) for each of the two consecutive years over the whole period of 2000-2003. Details of implementing the neighborhood-matching technique are in the Appendix A. Throug this process, three separate data sets are generated: firms that exist throughout the sample period (continuing firms); firms that have observations in any sample year, thus allowing for free entry and exit (surviving firms, including continuing firms plus entering and exiting firms); and surviving firms controlling for the productivity difference of entering and exiting firms. Some descriptive statistics on the average output, labor, capital, and intermediate inputs, and the number of observations of the three data sets are summarized in Table 5.

VI. Estimation Results

A. Baseline Specification: output measure

To be consistent with the literature, Table 6 provides the estimates for our baseline-model specification (Equation (3)) where the dependent variable is the logarithm of output. This specification is close to that of Aitken and Harrison (1999), Javorick (2004) and Hasket *et al*. (2008). The OLS estimates of column (1) affirm the results of Aitken and Harrison (1999), suggesting that FDI negatively affects the productivity of domestic firms in the same industry. Moreover, the coefficient of the forward-linkage variable is negative and that of the backward-

[18] Less-productive domestic firms usually choose to exit, while the more productive may choose to enter (Helpman, 2006).

linkage variable is positive, and both are statistically significant (α = 0.01). This result is consistent with Javorick (2004), in that positive spillovers from FDI take place through backward linkage rather than forward linkage.

Using OLS, however, risks encountering two potential problems: (1) the simultaneous-bias problem wherein FDI may occur in more (or less) productive industries; and (2) the omitted-variable problem wherein unobserved factors are present in the industry that are closely correlated with FDI and that affect domestic productivity. The rest of Table 6 contains the results of regressions that address these identification problems. First, we run OLS but use the number of foreign visitors as an instrument for FDI (OLS with IV). Second, we repeat OLS but with first differences (FD). Third, we estimate first-difference regressions with the foreign-visitor instrument (FD with IV). Columns 2, 3 and 4 in Table 6 report the results from these three regressions. Removing these identification problems overturns the OLS results of column (1). In particular, the results from FD and FD with IV consistently indicate that while foreign investment *positively* affects same-industry productivity, the effects decrease as the level of FDI increases, which suggests that the spillover effects of FDI are not monotonic. Rather, the spillover effects would appear to follow an inverted-U shape. Moreover, vertical spillovers occur when foreign affiliates supply inputs and equipment to local firms (i.e., through forward linkage rather than backward linkage), a result that differs from that of Javorick (2004). We also find that relative to Western firms in China, firms from Hong Kong and Taiwan have a bigger impact on domestic firms, with the only exception being for the OLS estimates with first differencing. All effects are statistically significant (α = 0.10).

B. Accounting for Endogeneity of Input Choices: TFP Measure

Although Aitken and Harrison (1999) argue that a regression of output on FDI that controls for inputs allows for an estimate of productivity, the endogeneity of input choices may be a threat to identification. Table 7 reports a set of results from regressions using TFP as the dependent variable, where TFP is derived using the method described in section II. With productivity as the dependent variable, OLS (Column 1) yields positive and statistically-significant coefficients (α =0.01) for FDI, suggesting that removing the problem of endogeneity of input choices is important. Again, the effects decline as the level of FDI increases.

Vertical spillovers occur through forward linkage rather than backward linkage and firms from Hong Kong and Taiwan have bigger spillovers than do Western firms. Accounting further for problems of simultaneous bias and omitted variables using first differencing together with an instrumental variable provides even stronger results than those obtained using OLS. This is shown in columns (2), (3) and (4) of Table 7. The coefficient for FDI is higher and statistically more significant, as is the case for the square terms of FDI and other vertical variables (forward and backward linkages). The only exception is the coefficient for the Hong Kong and Taiwan share, which now turns negative and statistically significant (α = 0.01), suggesting that Western firms produce more substantive spillovers than do overseas Chinese firms. This is consistent with observations that the Hong Kong and Taiwan firms that invest in the mainland are usually less capital intensive and technology advanced than are their Western counterparts, and some of them are even "round-trip" domestic firms taking advantage of China's preferential tax treatment for foreign investors.

C. Firms' Entry, Exit and FDI Spillovers

Domestic firms' entry and exit affects the estimation of FDI spillovers in China. Table 3 describes the outputs and inputs of both exiting and entering firms. Note that on average newly-entering domestic firms have higher outputs and inputs than those exiting, which is again confirmed in Figure 3 when comparing the productivity distribution between exiting and entering sample firms.

Tables 7 and Panels A and B of 7A provide regression estimates based on the three datasets.[19] As suggested by column (4) of Panel A in Table 7A, excluding entering and exiting firms, a one percentage point increase in the share of foreign firms in an industry raises the productivity of continuing firms in the same industry by 0.009 percent and a gain of 0.05 percent for firms in the downstream industry. Interestingly, when including entering and exiting firms in the sample and further controlling for productivity differences between entering and exiting firms, the spillover effects is higher (column (4) of Panel B in Table 7A), suggesting that the productivity spillovers

[19] Tables 6 and Panels A and B of 6A provide regression estimates based on the three datasets using output as the dependent variable.

(both horizontal and forward spillovers) to entering and exit firms with the similar quality are on average higher (0.014 and 0.057 percentage points respectively) than spillovers to continuing firms. Since the coefficient estimate (0.014) implies average spillovers to both continuing firms and new entrant and exit firms with the similar quality, it indicates that spillovers to new entrant and exit firms with the similar quality are much higher than 0.014. This is an interesting finding since the spillovers of foreign firms fall disproportionally on domestic firms, with spillovers to new entrant and exit firms more than double that to incumbent firms. This result survives even if there is no control for quality differences among exiting and entering firms. Without controlling for productivity differences between entering and exiting firms, productivity spillovers to entering and exiting firms would be even higher that to incumbent firms, as shown in column (4) of Table 7.

Controlling for firm turnover due to FDI presence re-confirms our results that foreign investment positively affects the productivity of domestic firms in the same industry. A one percentage point increase in the share of foreign firms in an industry leads to a 0.015 percent productivity gain for domestic firms in the same industry and a 0.057 percent productivity gain for domestic firms in downstream industries.

Figure 2 illustrates the simulated relationship between FDI share in an industry and domestic-firm productivity using the estimated coefficients as a proxy for FDI share and its square. The dotted, solid, and dash lines show the result for three scenarios: continuing firms, all firms (with control for the quality of entering and exiting firms), and surviving firms. For all three scenarios, the positive spillovers of FDI will reach their maxima when the FDI share in an industry is approximately 50 percent. This threshold level of FDI is well below the average of our dataset, suggesting that for most industries in China an increase in FDI will still yield positive spillovers for domestic firms. Yet, the marginal impacts of FDI on domestic productivity are substantially different in magnitude across different scenarios. The maximum marginal impact of FDI to the continuing firms' productivity is estimated at 0.25 percent, while when considering all firms and controlling for the quality of entering and exiting firms it becomes 0.36 percent, and for surviving firms it is 0.78 percent.

In terms of the backward-linkage and forward-linkage channels, the pattern of FDI's impact on domestic firms' productivity remains unchanged. The coefficients for the forward-linkage variable under the four different specifications (OLS, IV, FD, FD with IV) in panel B of Table 7A remain positive and statistically significant (α = 0.01), while the coefficients for the backward-linkage variable under the four different specifications remain negative and statistically significant (α = 0.01). But the coefficient for the relative impact of overseas Chinese firms turns negative for the cases of IV and FD with IV, while remaining positive for the regression using OLS and FD.

D. Robustness

We provide several robustness checks. It is sometimes argued that the increase in measured productivity may reflect the degree of concentration in the industry (changes in mark-ups). To determine whether our estimated coefficients on spillovers to productivity pickup any of the effects of the industry's mark-ups, we include a Herfindahl concentration index, defined as the output share of the top eight firms in each industry. The inclusion of a Herfindahl concentration index does not affect any of the coefficients.[20]

We also experiment with an alternative measure of FDI that uses each firm's share of capital in the industry as the weight (*KFDI*). The results are qualitatively the same as using an output-share measure of FDI.

We test for potential specification problems by estimating regressions with and without the square FDI term. The results indicate that the hypothesis that only the FDI share enters the regression but not its square can be rejected (α = 0.01) in most regressions, which implies that the inverted "U" shape of FDI spillovers fits better than a linear curve.

Taken together, our results suggest that FDI has a significant positive impact on domestic firms' productivity within the same industry, which declines as the level of FDI increases. We find that positive spillovers are more likely to occur through forward linkage where domestic firms

[20] The results from the robust checks are not reported here due to space, but are available on request.

purchase high-quality intermediate inputs or equipment from foreign suppliers than through backward linkage where they produce for multinationals.

E. Export-orientation, ownership and FDI spillovers

The above results suggest that on average domestic firms do benefit from FDI. Yet one may be interested in whether this observation masks heterogeneity across different types of firms. In this section we consider the relationship between three attributes of domestic firms and their benefits from the presence of foreign firms: namely, export-oriented vs. domestic-market-oriented firms, large firms vs. small firms and state-owned enterprises (SOEs) vs. non-SOE firms.

Table 8 reports regression results for two set of firms: exporting and non-exporting domestic firms. The results indicate that whether a firm is exporting or not has significant implications for their benefits from FDI. For non-exporting domestic firms, the coefficient estimates for both FDI and forward-linkage variables are positive and significant, and are robust across the four sets of specifications, suggesting that non-exporting domestic firms benefit from FDI in the same industry as well as in their upstream industry (forward linkage). In contrast, for exporting firms, the coefficient estimates for FDI, and the forward and backward linkage variables are all negative and significant, suggesting that exporting firms are adversely affected by FDI firms.

Whether a firm is state-owned also affects the spillover effects of FDI. For non-SOE firms, the coefficient estimates for both FDI and forward-linkage variables are positive and significant and robust across different sets of specifications, suggesting that non-SOE firms accrue greater benefit from FDI than do SOEs (Table 9).

As shown in Table 10, the coefficients for the FDI and forward-linkage variables are positive and significant for firms with different sizes, but large and medium firms enjoyed greater benefits from FDI than did small firms, in particular through forward linkage. Taken together, domestic firms differ significantly in the extent to which they benefit from FDI, with large, non-exporting and non-SOE firms accruing the greatest benefits from foreign firms in China.

V. Conclusion

China has emerged as the largest recipient of foreign direct investment (FDI) in the developing world, yet little is known about the benefits for domestic firms. Using firm-level census data from China for the period of 2000-2003, this paper examines the various channels of FDI spillovers. We find that FDI have had a significant positive impact on domestic productivity within the same industry, but the benefits decline as the level of FDI increases. More importantly, we are able to identify sizable gains in productivity spillovers arising from firms' turnover (entry and exit). We find that the spillovers of foreign firms fall disproportionally on firms, with spillovers to new entrant and exit firms more than double that to existing firms.

We also find substantial vertical spillovers, which are more likely to happen through forward linkage than through backward linkage. Moreover, firms in China do not benefit uniformly from foreign investment, with large, non-exporting and non-SOE firms accruing the greatest benefits from foreing presence in China.

The positive spillovers to domestic firms from FDI suggest that Chinese governments preferential treatments for forieng firms in past decades may be justifiable. However, the negative backward linkage effect we identified in this paper requires more policy attention. For a long time the Chinese government provides tax incentives to attract foreign investmnet (such as exemption of import duty to those firms that import equipment and inputs, provided that those firms exported their goods to international market), for fear of a shortage of foreign exchange,. This export incentive, although successful in encouraging exports, comes with an implicit cost by reducing the incentive for domestic firms to supply parts, intermediate inputs and equipment to forieng firms. Now that China's foreign exchange reserves have reached to about US$2 trillion, concerns about shortage of foreign exchange are remote and a rethinking of tax incentive may be warranted. Further, our result that entering and exiting firms benefit more from FDI than existing firms suggests that moving towards a market environment could benefit society by stimulating further entry and exit.

However, notwithstanding the government policy, the benefits from FDI are not automatic, but require some support from domestic firms also. Perhaps, more R&D is needed to increase the quality of domestic products to attract foreign firms to source products from the domestic market. Furthermore, as non-SOE firms accrue greater benefits from foreign firms in China than SOE firms, there is an incentive to continue reform of SOEs.

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Appendix A. Neighborhood matching between entering and exiting firms with similar productivity

To control for differences in productivity between entering and exiting domestic firms, we adopt a neighborhood-matching technique based on propensity score estimation (Imbens and Angrist, 1994 and Hahn, Todd and Klaauw, 2001 and Leuven and Sianesi, 2008). Although entering and exiting firms have productivity, firms from both groups can be treated as similarif their inputs and outputs are controlled for. As long as we can separate the similar firms from non-similar firms based on the neighborhood-matching technique, selection bias due to firms' entry and exit can be controlled.

To do so, we define two groups (the entering and exiting firms) in different industries (at 2-digit ISIC level) and regions (including the East, Middle and West region) for each of two consecutive years, and assume switching between the two groups as a type of treatment. Thus, we have one of the two groups (i.e. entering firms) as the treated group (or $T=1$), while the other as the non-treated one (or $T=0$). Based on the literature on "treatment effects", we further assume that (1) all relevant difference in productivity between the two group firms are captured by the observed firms' output and inputs since we are interested in their productivity differences across groups (which is determined by the input and output relationship); (2) the distribution of observed output and inputs in the controlled group selected from the non-treated pool, is as similar as the distribution in the treated group (since each firm is randomly selected).[21] The conditional probability of treatment (say, a firm switching from exiting to entering status) given the background variables for each individual firm can be defined as (Rosenbaum and Rubin, 1983):

$$p(x) \overset{def}{=} \Pr\{T=1 \mid X=x\} \qquad \text{(A1)}$$

where $p(x)$ is the conditional probability or the so-called propensity score, T is the binary treatment and $X=(output, labour, capital, \text{int}ermediateinputs)$ are firms' output and inputs (or the background variables). As is proved in Rosenbaum and Rubin (1983), $T \perp\!\!\!\perp TFP(0), TFP(1) \mid X$ is equal to $T \perp\!\!\!\perp TFP(0), TFP(1) \mid p(x)$ if un-confoundedness holds. This

[21] These assumptions guarantee that the neighbourhood matching is performed over the common support region.

suggests that the treatment is statistically independent of the productivity difference determined by the background variables.

Given the estimated propensity score in Equation (A1), we have treated firm i as matched to the non-treated firm j such that

$$|p_i - p_j| = \min_{k \in \{T=0\}} \{|p_i - p_k|\} \tag{A2}$$

If none of the non-treated firms j satisfies Equation (A2), firm i is left unmatched. Repeat the above calculation process for all firms in the entering group, all matched firms in the exiting group (which have at least one corresponding firm in the entering group) can be sorted out. Reverse the position of the treated and untreated groups (say, exiting and entering firms), we can also sort out all matched firms in the entering group with those in the exiting group by using the similar method. The combination of the results from the above two exercises can be used to merge and specify the firms with similar output and inputs in the entering and exiting groups and the method can be extended to all industries, regions throughout the whole period of 2000-2003. Table A1 shows the total sample of exiting and entering firms for each two consecutive years respectively as well as the matching results by industry. Among the exiting and entering firms, there are about 60 percent of firms surviving from the matching process.

Table 1, Summary Statistics for Domestic and FDI firms in China: 2000-2003

	2000			2001			2002			2003		
	Total	Domestic	FDI	Total	Domestic	FDI	Total	Domestic	FDI	Total	Domestic	FDI
Output (million US$)	106.2	86.2	191.3	112.5	89.4	208.5	126.6	101.0	231.8	148.5	115.3	279.1
	(150.4)	(120.9)	(237.1)	(187.5)	(128.47)	(334.8)	(214.4)	(148.5)	(379.3)	(288.3)	(189.4)	(519.9)
Employment (person)	315	313	324	336	332	354	365	362	382	276	259	345
	(1182)	(1248)	(859)	(1249)	(1335)	(886)	(2461)	(2766)	(962)	(921)	(957)	(756)
Capital (million US$)	46.2	40.4	70.4	46.7	40.3	72.7	47.9	41.4	74.4	47.3	40.5	73.9
	(73.4)	(70.5)	(82.1)	(89.9)	(83.1)	(109.5)	(94.6)	(91.4)	(105.9)	(84.8)	(78.8)	(102.3)
Intermediate Inputs (million US$)	82.5	66.4	150.6	87.6	69.2	163.7	97.9	77.7	180.8	114.5	88.1	218.4
	(121.5)	(93.7)	(199.6)	(149.7)	(102.2)	(267.2)	(172.9)	(117.5)	(309.3)	(238.2)	(148.6)	(440.6)
Horizontal FDI Share (%)	21.7	-	-	22.8	-	-	23.2	-	-	24.1	-	-
	(10.7)			(11.2)			(11.2)			(11.7)		
HKTW Share in FDI (%)	44.2	-	-	44.6	-	-	43.2	-	-	43.5	-	-
	(11.9)			(14.1)			(13.2)			(15.4)		
Upstream FDI Share (%)	8.5	-	-	8.8	-	-	9.0	-	-	9.5	-	-
	(6.2)			(6.3)			(6.5)			(6.8)		
Downstream FDI Share (%)	6.7	-	-	7.0	-	-	7.1	-	-	7.5	-	-
	(4.8)			(4.9)			(4.9)			(5.2)		
Number of Firms	134130	108714	25416	147690	119113	28577	154317	123816	30501	169810	135355	34455

Note: Output is defined as the total output value, employment is defined as the total number of employees, and capital is defined as the net fixed asset value. All financial variables are measured with US dollars at the 1990 constant price, and the exchange rate used for the conversion is 4.7832 (China Statistical Yearbook, 2000, 2001, 2002, 2003). Numbers in parenthesis are standard errors.

Table 2, FDI Share (Output weighted) by Industry in China: 2000-2003 (Unit: Percent)

Sector ID	Sector Name	2000		2001		2002		2003		Total	
		FDI Share	Num. of FDI Firms	FDI Share	Num. of FDI Firms	FDI Share	Num. of FDI Firms	FDI Share	Num. of FDI Firms	FDI Share	Num. of FDI Firms
13	Food Processing	16.8	[1017]	17.9	[1154]	17.5	[1225]	17.3	[1377]	17.4	[1193]
14	Food Production	29.3	[765]	33.2	[823]	30.5	[876]	30.7	[951]	30.9	[854]
15	Beverage Production	24.2	[380]	26	[404]	27.9	[406]	30.2	[460]	27.1	[413]
16	Tobacco Processing	0.1	[4]	0.3	[4]	0.2	[4]	0.2	[6]	0.2	[5]
17	Textile industry	14.1	[2003]	15.1	[2274]	15.5	[2450]	17	[2812]	15.5	[2385]
18	Clothing and Footware	33.7	[2705]	33.7	[2984]	33.2	[3203]	34.7	[3670]	33.8	[3141]
19	Leather, Fur, Feather and Related Products	43	[1153]	40.6	[1305]	39.5	[1423]	39.9	[1658]	40.6	[1385]
20	Timber Processing, Wood, Bamboo, Rattan, Palm and Straw Products	18.5	[453]	20.1	[531]	19.1	[529]	20.7	[610]	19.7	[531]
21	Furniture Manufacturing	34.5	[399]	35.4	[436]	36.5	[479]	40.9	[548]	37.1	[466]
22	Paper and Paper Products	23.6	[631]	23.8	[684]	25	[688]	23.7	[741]	24	[686]
23	Printing and Medium Reproduction	20.5	[442]	23.2	[488]	22.8	[504]	23.8	[556]	22.6	[498]
24	Cultural, Educational and Sports Goods	48.3	[770]	48.3	[820]	49.3	[917]	51	[1131]	49.4	[910]
25	Petroleum refining, Coking, and Gas Production and Supply	4.8	[112]	4.5	[89]	7.6	[121]	7.1	[92]	6.2	[104]
26	Raw Chemical Materials and Chemical Products	15.4	[1274]	16.5	[1502]	17.4	[1596]	19.6	[1850]	17.4	[1556]
27	Medical and Pharmaceutical Products	13.5	[464]	12.3	[554]	13.3	[545]	13	[597]	13	[540]
28	Chemical Fibers	21.5	[164]	16	[154]	17	[162]	13.8	[181]	16.8	[165]
29	Rubber Products	25.6	[319]	25.8	[348]	28.4	[342]	27.2	[393]	26.8	[351]
30	Plastics Products	33.2	[1730]	32.3	[1914]	31.2	[2010]	33	[2194]	32.4	[1962]
31	Nonferrous Mineral Products	12.3	[1245]	13.1	[1402]	12.9	[1445]	11.9	[1553]	12.6	[1411]
32	Smelting and Pressing of Ferrous Metals	5.1	[198]	5.6	[223]	6.3	[223]	7	[245]	6	[222]
33	Smelting and Pressing of Non-ferrous Metals	7.7	[213]	8.3	[188]	8.2	[222]	9.5	[309]	8.5	[233]
34	Metal Products	27.8	[1336]	26.2	[1525]	26.3	[1616]	26	[1756]	26.5	[1558]
35	General Purpose Machinery	15.9	[961]	15.2	[1093]	16.3	[1235]	18.8	[1592]	16.7	[1220]
36	Special Purpose Machinery	10.6	[651]	13.7	[810]	12.8	[823]	14.9	[929]	13.1	[803]
37	Transportion Equipment	20	[865]	20.9	[998]	20.4	[1103]	22.5	[1224]	21	[1048]
39	Electrical Machinery and Equipment	25.1	[1578]	26.4	[1819]	27.1	[1963]	28	[2163]	26.7	[1881]
40	Communication Equipment, Computers and Other Electronic Equipment	47.7	[1927]	55.1	[2167]	56.3	[2352]	59.9	[2712]	55.2	[2290]
41	Instruments, Meters, Cultural and Clerical Machinery	53.6	[542]	58.9	[608]	57.9	[628]	60.1	[781]	57.9	[640]
42	Other Manufacturing	32.6	[1115]	32.1	[1276]	35.1	[1411]	31.1	[1364]	32.8	[1292]
Total	All Manufacture	21.7	[25416]	22.8	[28577]	23.2	[30501]	24.1	[34455]	23	[29737]

Note: Numbers in the rectangle parenthesis are number of foreign firms.

Table 3, Comparison of Productivity Estimates between OLS and LP Methods

Sector ID	Number of Obs.	Panel A Coefficients from OLS Regression[a]			Panel B Coefficients from LP Regression[b]			Panel C Sign Change between A and B[c]		
		lnL	lnK	lnM	lnL	lnK	lnM	ΔlnL	ΔlnK	ΔlnM
13	33645	0.064***	0.001	0.905***	0.043***	0.021***	0.700***	-	+	-
14	11875	0.017***	0.003**	0.971***	0.014***	0.025***	0.794***	-	+	-
15	9256	0.036***	0.008***	0.963***	0.03***	0.029*	0.700***	-	+	-
16	973	0.055***	0.068***	0.965***	0.028*	Nil	Nil	-	Nil	Nil
17	36238	0.032***	0.009***	0.947***	0.032***	0.003	0.872***	-	-	-
18	17276	0.047***	0.015***	0.935***	0.044***	0.009	0.904***	-	-	-
19	8152	0.032***	0.013***	0.943***	0.029***	0.013*	0.968***	-	-	+
20	8622	0.037***	0.005***	0.95***	0.039***	0.001	0.856***	+	-	-
21	4280	0.031***	0.012***	0.953***	0.032***	0.000	1.000***	+	-	+
22	15062	0.03***	0.008***	0.952***	0.031***	0.004	0.870***	+	-	-
23	11364	0.045***	0.023***	0.933***	0.038***	Nil	Nil	-	Nil	Nil
24	3881	0.034***	0.015***	0.943***	0.035***	0.010	0.820***	+	-	-
25	3889	0.021***	0.014***	0.949***	0.024***	0.018	0.966***	+	+	+
26	35311	0.025***	0.01***	0.952***	0.024***	0.000	0.973***	-	-	+
27	10746	0.042***	0.019***	0.942***	0.035***	0.03***	0.858***	-	+	-
28	2031	0.028***	0.005*	0.955***	0.029***	0.014*	0.856***	+	+	-
29	5146	0.033***	0.012***	0.945***	0.031***	0.003	0.972***	-	-	+
30	18391	0.037***	0.013***	0.944***	0.033***	0.015***	0.951***	-	+	+
31	47133	0.033***	0.004***	0.951***	0.031***	0.003	0.87***	-	-	-
32	11434	0.029***	0.004***	0.959***	0.03***	0.009	0.958***	+	+	-
33	8246	0.04***	0.006***	0.948***	0.041***	0.013	0.953***	+	+	+
34	24019	0.035***	0.015***	0.94***	0.032***	0.013*	0.844***	-	-	-
35	33076	0.037***	0.01***	0.944***	0.036***	0.000	1.000***	-	-	+
36	19825	0.022***	0.006***	0.957***	0.024***	0.016***	0.978***	+	+	+
37	21729	0.042***	0.01***	0.939***	0.037***	0.015**	0.915***	-	+	-
39	25830	0.031***	0.012***	0.952***	0.029***	Nil	Nil	-	Nil	Nil
40	9082	0.049***	0.013***	0.944***	0.04***	0.018	0.830***	-	+	-
41	5038	0.052***	0.005***	0.94***	0.053***	0.007	0.938***	+	+	-
42	9864	0.045***	0.013***	0.935***	0.044***	0.000	1.000***	-	-	+

Note: [a] The regression is based on the OLS method with random effects. [b] The regression is based on the LP method, which is a semi-parametric GMM estimate (See Olley and Pakes, 1996; Levinsohn and Petrin, 2003). [c] The sign comes from the estimates from the LP method minus the estimates from the OLS method. [d] * represents significant at 10 percent level, ** represents significant at 5 percent level and *** represents significant at 1 percent level.

Table 4, Characteristics of Exit and Entry of Domestic Firms in China: 2000-2003

	2000-2001	2001-2002	2002-2003	Total
Number of Exit Firms	32575	25569	27905	28683
Exit Rate (%) [a]	30.0	21.5	22.5	24.7
Output (Million US$)	65.9	61.5	63.6	63.9
	(103.6)	(129.0)	(79.4)	(105.1)
Employment (person)	256	237	257	252
	(848)	(754)	(1019)	(868)
Capital (Million US$)	29.7	31.3	26.2	29.0
	(40.0)	(66.7)	(36.6)	(48.6)
Intermediate Inputs (Million US$)	51.0	47.5	48.9	49.3
	(79.7)	(103.1)	(60.8)	(82.2)
Number of Entry Firms	43438	30605	39170	37738
Entry Rate (%) [b]	36.5	24.7	28.6	29.9
Output (Million US$)	66.3	69.3	71.2	68.8
	(111.2)	(141.9)	(157.7)	(137.1)
Employment (person)	330	656	171	214
	(733)	(10568)	(652)	(3031)
Capital (Million US$)	25.9	27.1	23.3	25.3
	(55.8)	(45.0)	(46.8)	(50.0)
Intermediate Inputs (Million US$)	51.4	53.8	54.5	53.1
	(87.8)	(113.8)	(127.1)	(109.8)

Notes: [a] Exit rate is defined as the number of exit firms in year (t) divided by the total number of domestic firms in year (t-1). [b] The entry rate is defined as the number of entry firms in year (t) divided by the total number of domestic firms in year (t). Numbers in parenthesis are standard errors.

Table 5 Entry, Exit and Continuing Firms

	Number of Domestic Firms				Output (Million US$)	Employment (person)	Capital (Million US$)	Intermediate Inputs (Million US$)
	2000	2001	2001	2002				
All Domestic Firms [a]	108714	119113	123816	135355	98.8	284	22.0	76.1
					(151.2)	(1074)	(52.8)	(119.1)
Domestic Firms with Matched Exit and Entry [b]	80236	76603	78061	89039	110.1	319	25.7	84.6
					(152.4)	(1198)	(62.2)	(120.0)
Domestic Firms Excluding Exit and Entry [c]	49658	49658	49658	49658	135.1	379	32.2	103.7
					(186.2)	(1453)	(76.2)	(146.1)

Notes: [a] All domestic firms includes continuing firms and newly entering and exiting firms; [b] Domestic firms with matched exit and entry are defined as the firms surviving through any consecutive two years plus those matched firms between the exit and entry firms; [c] Domestic firms excluding exit and entry are continuing firms that survived through the whole sample years. Numbers in parenthesis are standard errors.

Table 6, Productivity Spillover from FDI: Results from Baseline Regressions (Dependent Variable: lnY)

	OLS (1)	IV (2)	FD (3)	FD with IV (4)
	All domestic firms			
FDIShare	-0.331***	-0.501***	1.223***	1.056***
	(0.007)	(0.037)	(0.024)	(0.063)
FDIShare^2	0.557***	0.644***	-0.585***	-0.999***
	(0.012)	(0.039)	(0.029)	(0.054)
HKTWRatio	0.002***	0.013***	0.068***	0.006**
	(0.000)	(0.001)	(0.001)	(0.003)
FDI_Forward	-2.399***	-2.803***	2.865***	4.638***
	(0.030)	(0.059)	(0.970)	(0.122)
FDI_Backward	3.030***	3.360***	-5.167***	-7.693***
	(0.039)	(0.062)	(0.109)	(0.122)
Constant	0.557***	0.593***	-0.018***	-0.012***
	(0.001)	(0.006)	(0.006)	(0.000)
Adjusted R-square	0.185	0.159	0.412	0.352
Number of obs.	86081	86081	66737	66737

Notes: *, **, *** denote significance at 10%, 5% and 1% levels respectively. Numbers in parenthesis are standard errors. All regressions include dummy variables to control for industry, region and year effects. Cluster effects have been adjusted based on the discussion in the main text. The IV variable used for YFDI in the OLS regression is the number of foreign tourists entering China by industry. FDIShare, FDIShare^2 are defined as "FDI share" and the square of "FDI share", weighted by output value, and HKTWRatio is defined as the ratio of FDI from Hong Kong and Taiwan over those from other countries. FDI_Forward and FDI_Backward are defined as FDI share in downstream and upstream industries, measured with output value.

Table 7, Productivity Spillover from FDI: Results from LP Productivity Regressions (Dependent Variable: lnTFP)

	OLS (1)	IV (2)	FD (3)	FD with IV (4)
	All domestic firms			
FDIShare	0.746***	15.148***	0.565***	2.924***
	(0.046)	(0.118)	(0.016)	(0.037)
FDIShare^2	-1.171***	-14.150***	-0.222***	-2.731***
	(0.074)	(0.132)	(0.022)	(0.032)
HKTWRatio	0.096***	-0.456***	0.039***	-0.109***
	(0.003)	(0.005)	(0.001)	(0.002)
FDI_Forward	4.104***	23.912***	3.849***	7.029***
	(0.188)	(0.237)	(0.059)	(0.065)
FDI_Backward	-6.869***	-24.562***	-3.367***	-6.828***
	(0.254)	(0.284)	(0.066)	(0.066)
Constant	0.790***	-1.913***	0.000	-0.004***
	(0.007)	(0.019)	(0.000)	(0.000)
Adjusted R-square	0.027	0.084	0.330	0.376
Number of obs.	140201	140201	108553	108553

Notes: *, **, *** denote significance at 10%, 5% and 1% levels respectively. Numbers in parenthesis are standard errors. All regressions include dummy variables to control for industry, region and year effects. Cluster effects have been adjusted based on the discussion in the main text. The IV used for FDI is the number of foreign tourists in each year. Dependent variable lnTFP is calculated using $lnTFP=lnY-\beta_L lnL-\beta_K lnK-\beta_M lnM$ where the coefficients of β_L, β_K and β_M are from the LP regression. FDIShare, FDIShare^2 are defined as "FDI share" and the square of "FDI share", weighted by output value, and HKTWRatio is defined as the ratio of FDI from Hong Kong and Taiwan over those from other countries. FDI_Forward and FDI_Backward are defined as FDI share in downstream and upstream industries, measured with output value.

Table 6A, Productivity Spillover from FDI: Additional Results from Baseline Regressions (Dependent Variable: lnY)

	OLS (1)	IV (2)	FD (3)	FD with IV (4)
Panel A - Domestic firms excluding new entry and exit				
FDIShare	-0.410***	0.445***	2.260***	1.231***
	(0.017)	(0.067)	(0.072)	(0.062)
FDIShare^2	0.844***	-0.330***	-3.042***	-1.422***
	(0.027)	(0.072)	(0.098)	(0.054)
HKTWRatio	0.000	-0.019***	0.055***	-0.019***
	(0.001)	(0.003)	(0.001)	(0.004)
FDI_Forward	-0.295***	0.329***	2.643***	3.925***
	(0.047)	(0.091)	(0.196)	(0.217)
FDI_Backward	0.179***	-0.404***	-2.811***	-4.892***
	(0.063)	(0.093)	(0.265)	(0.267)
Constant	0.596***	0.453***	-0.047***	-0.042***
	(0.002)	(0.011)	(0.001)	(0.001)
Adjusted R_square	0.291	0.239	0.332	0.286
Number of Obs.	38562	38562	30013	30013
Panel B - Domestic firms controlling for quality of exit and entry				
FDIShare	-0.397***	-0.206***	0.738***	1.425***
	(0.010)	(0.060)	(0.035)	(0.083)
FDIShare^2	0.724***	0.307***	-0.870***	-1.520***
	(0.017)	(0.065)	(0.057)	(0.072)
HKTWRatio	-0.006***	-0.002	0.064***	-0.005
	(0.001)	(0.002)	(0.002)	(0.004)
FDI_Forward	-1.723***	-1.849***	1.890***	3.615***
	(0.044)	(0.099)	(0.160)	(0.204)
FDI_Backward	2.024***	2.106***	-4.569***	-6.265***
	(0.058)	(0.103)	(0.174)	(0.193)
Constant	0.577***	0.556***	-0.019***	-0.020***
	(0.001)	(0.011)	(0.001)	(0.001)
Adjusted R_square	0.191	0.157	0.284	0.290
Number of Obs.	58417	58417	44129	44129

Notes: *, **, *** denote significance at 10%, 5% and 1% levels respectively. Numbers in parenthesis are standard errors. All regressions include dummy variables to control for industry, region and year effects. Cluster effects have been adjusted based on the discussion in the main text. The IV variable used for YFDI in the OLS regression is the number of foreign tourists entering China by industry. FDIShare, FDIShare^2 are defined as "FDI share" and the square of "FDI share", weighted by output value, and HKTWRatio is defined as the ratio of FDI from Hong Kong and Taiwan over those from other countries. FDI_Forward and FDI_Backward are defined as FDI share in downstream and upstream industries, measured with output value.

Table 7A, Productivity Spillover from FDI: Additional Results from LP Productivity Regressions (Dependent Variable: lnTFP)

	OLS (1)	IV (2)	FD (3)	FD with IV (4)
Panel A - Domestic firms excluding new entry and exit				
FDIShare	-0.348***	14.291***	0.633***	0.920***
	(0.072)	(0.168)	(0.027)	(0.046)
FDIShare^2	0.304***	-13.060***	-1.105***	-0.863***
	(0.112)	(0.188)	(0.033)	(0.041)
HKTWRatio	0.192***	-0.380***	0.080***	0.037***
	(0.005)	(0.008)	(0.001)	(0.002)
FDI_Forward	8.344***	26.565***	4.226***	5.087***
	(0.296)	(0.343)	(0.132)	(0.140)
FDI_Backward	-13.236***	-29.184***	-2.115***	-2.771***
	(0.400)	(0.418)	(0.116)	(0.121)
Constant	0.940***	-1.720***	-0.005***	-0.010***
	(0.010)	(0.028)	(0.000)	(0.000)
Adjusted R_square	0.080	0.137	0.383	0.369
Number of Obs.	63905	63905	48835	48835
Panel B - Domestic firms controlling for quality of exit and entry				
FDIShare	0.540***	14.516***	0.511***	1.406***
	(0.057)	(0.179)	(0.021)	(0.057)
FDIShare^2	-1.169***	-13.349***	-0.644***	-1.351***
	(0.091)	(0.200)	(0.032)	(0.048)
HKTWRatio	0.134***	-0.429***	0.045***	-0.025***
	(0.004)	(0.008)	(0.001)	(0.003)
FDI_Forward	7.102***	26.137***	4.214***	5.727***
	(0.219)	(0.316)	(0.081)	(0.102)
FDI_Backward	-10.974***	-27.785***	-4.620***	-6.055***
	(0.299)	(0.366)	(0.107)	(0.110)
Constant	0.838***	-1.797***	0.004***	0.000
	(0.008)	(0.029)	(0.000)	(0.000)
Adjusted R_square	0.046	0.088	0.352	0.358
Number of Obs.	93739	93739	69549	69549

Notes: *, **, *** denote significance at 10%, 5% and 1% levels respectively. Numbers in parenthesis are standard errors. All regressions include dummy variables to control for industry, region and year effects. Cluster effects have been adjusted based on the discussion in the main text. The IV used for FDI is the number of foreign tourists in each year. Dependent variable lnTFP is calculated using $lnTFP=lnY-\beta_L lnL-\beta_K lnK-\beta_M lnM$ where the coefficients of β_L, β_K and β_M are from the LP regression. FDIShare, FDIShare^2 are defined as "FDI share" and the square of "FDI share", weighted by output value, and HKTWRatio is defined as the ratio of FDI from Hong Kong and Taiwan over those from other countries. FDI_Forward and FDI_Backward are defined as FDI share in downstream and upstream industries, measured with output value.

Table 8, FDI Productivity Spillovers and Exporting Status in China: 2000-2003

	OLS (1)	IV (2)	FD (3)	FD with IV (4)
	Panel A - Non-exporting Firms			
FDIShare	0.622***	0.580***	15.035***	2.557***
	(0.071)	(0.032)	(0.254)	(0.111)
FDIShare^2	-1.849***	-0.720***	-14.439***	-2.133***
	(0.118)	(0.061)	(0.282)	(0.095)
HKTWRatio	0.100***	0.032***	-0.497***	-0.098***
	(0.005)	(0.001)	(0.011)	(0.005)
FDI_Forward	6.536***	2.859***	26.407***	6.016***
	(0.244)	(0.123)	(0.420)	(0.180)
FDI_Backward	-10.435***	-3.832***	-28.080***	-6.350***
	(0.335)	(0.148)	(0.465)	(0.167)
Constant	0.944***	0.004***	-1.764***	-0.003***
	(0.010)	(0.001)	(0.042)	(0.001)
Adjusted R_square	0.04	0.262	0.063	0.280
Number of Obs.	74846	55628	74846	55628
	Panel B -Exporting Firms			
FDIShare	1.817***	-1.224***	13.546***	-4.541***
	(0.094)	(0.063)	(0.327)	(0.167)
FDIShare^2	-1.828***	1.104***	-11.303***	3.706***
	(0.148)	(0.062)	(0.364)	(0.152)
HKTWRatio	-0.085***	-0.027***	-0.086***	0.038***
	(0.008)	(0.004)	(0.005)	(0.004)
FDI_Forward	-5.719***	11.804***	47.226***	-3.694***
	(0.877)	(0.315)	(1.269)	(0.595)
FDI_Backward	6.100***	-23.442***	-57.775***	-6.272***
	(1.119)	(0.374)	(1.529)	(0.625)
Constant	0.601***	0.037***	-1.835***	0.132***
	(0.012)	(0.002)	(0.061)	(0.004)
Adjusted R_square	0.225	0.285	0.349	0.328
Number of Obs.	44424	11722	44424	11722

Notes: *, **, *** denote significance at 10%, 5% and 1% levels respectively. Numbers in parenthesis are standard errors. All regressions include dummy variables to control for industry, region and year effects. Cluster effects have been adjusted based on the discussion in the main text. The IV used for FDI is the number of foreign tourists in each year. Dependent variable lnTFP is calculated using $lnTFP = lnY - \beta_L lnL - \beta_K lnK - \beta_M lnM$ where the coefficients of β_L, β_K and β_M are from the LP regression. The above regressions are based on data controlling for quality of entering and exiting firms (see discussions in the text). FDIShare, FDIShare^2 are defined as "FDI share" and the square of "FDI share", weighted by output value, and HKTWRatio is defined as the ratio of FDI from Hong Kong and Taiwan over those from other countries. FDI_Forward and FDI_Backward are defined as FDI share in downstream and upstream industries, measured with output value.

Table 9, FDI Productivity Spillovers and Firm Ownership in China: 2000-2003

	OLS (1)	IV (2)	FD (3)	FD with IV (4)
Panel A - SOEs Firms				
FDIShare	1.323***	0.048	12.774***	0.590***
	(0.072)	(0.034)	(0.306)	(0.088)
FDIShare^2	-2.795***	0.121**	-11.715***	-0.690***
	(0.115)	(0.042)	(0.337)	(0.078)
HKTWRatio	0.164***	-0.022***	-0.344***	-0.050***
	(0.005)	(0.001)	(0.012)	(0.005)
FDI_Forward	7.404***	-0.739***	23.239***	-0.146
	(0.246)	(0.111)	(0.492)	(0.155)
FDI_Backward	-11.299***	-1.798***	-24.817***	-2.446***
	(0.343)	(0.177)	(0.537)	(0.171)
Constant	0.705***	0.014***	-1.511***	0.006***
	(0.011)	(0.014)	(0.051)	(0.001)
Adjusted R_square	0.080	0.256	0.091	0.260
Number of Obs.	48130	36027	48130	36027
Panel B - Non-SOEs Firms				
FDIShare	1.327***	0.203***	13.114***	0.426***
	(0.068)	(0.036)	(0.242)	(0.097)
FDIShare^2	-1.792***	-0.515***	-11.711***	-0.377***
	(0.111)	(0.050)	(0.272)	(0.086)
HKTWRatio	0.092***	0.065***	-0.401***	0.046***
	(0.005)	(0.002)	(0.011)	(0.005)
FDI_Forward	9.023***	6.063***	25.098***	6.669***
	(0.275)	(0.146)	(0.400)	(0.182)
FDI_Backward	-13.696***	-3.462***	-27.556***	-3.770***
	(0.376)	(0.221)	(0.459)	(0.237)
Constant	0.806***	-0.004***	-1.517***	-0.007***
	(0.010)	(0.001)	(0.040)	(0.001)
Adjusted R_square	0.059	0.166	0.094	0.163
Number of Obs.	60980	46005	60980	46005

Notes: *, **, *** denote significance at 10%, 5% and 1% levels respectively. Numbers in parenthesis are standard errors. All regressions include dummy variables to control for industry, region and year effects. Cluster effects have been adjusted based on the discussion in the main text. The IV used for FDI is the number of foreign tourists in each year. Dependent variable lnTFP is calculated using $\ln TFP = \ln Y - \beta_L \ln L - \beta_K \ln K - \beta_M \ln M$ where the coefficients of β_L, β_K and β_M are from the LP regression. The above regressions are based on data controlling for quality of entering and exiting firms (see discussions in the text). FDIShare, FDIShare^2 are defined as "FDI share" and the square of "FDI share", weighted by output value, and HKTWRatio is defined as the ratio of FDI from Hong Kong and Taiwan over those from other countries. FDI_Forward and FDI_Backward are defined as FDI share in downstream and upstream industries, measured with output value.

Table 10, FDI Productivity Spillovers and Firm Size in China

	OLS (1)	IV (2)	FD (3)	FD with IV (4)
	Panel A - Small Firms: with restricted exit and entry			
FDIShare	1.057***	0.528***	13.984***	0.621***
	(0.061)	(0.028)	(0.241)	(0.062)
FDIShare^2	-2.018***	-1.191***	-12.847***	-0.565***
	(0.099)	(0.042)	(0.264)	(0.054)
HKTWRatio	0.089***	0.041***	-0.447***	0.011***
	(0.004)	(0.001)	(0.010)	(0.003)
FDI_Forward	5.892***	4.017***	24.516***	4.819***
	(0.237)	(0.097)	(0.402)	(0.132)
FDI_Backward	9.097***	-4.838***	-25.629***	-5.164***
	(0.323)	(0.131)	(0.447)	(0.133)
Constant	0.792***	-0.004***	-1.690***	-0.008***
	(0.009)	(0.001)	(0.040)	(0.001)
Adjusted R_square	0.033	0.339	0.061	0.322
Number of Obs.	81141	59694	81141	59694
	Panel B - Large and Medium Firms: with restricted exit and entry			
FDIShare	-1.752***	0.782***	36.052***	6.482***
	(0.107)	(0.148)	(0.636)	(0.161)
FDIShare^2	1.116***	1.079***	-38.687***	-6.260***
	(0.169)	(0.156)	(0.839)	(0.161)
HKTWRatio	-0.056***	-0.379***	-0.835***	-0.577***
	(0.009)	(0.006)	(0.013)	(0.007)
FDI_Forward	15.452***	11.045***	54.968***	17.330***
	(0.612)	(0.462)	(0.787)	(0.403)
FDI_Backward	-22.950***	-5.984***	-61.294***	-12.547***
	(0.806)	(0.814)	(0.915)	(0.711)
Constant	1.412***	-0.017***	-5.464***	-0.031***
	(0.017)	(0.002)	(0.108)	(0.002)
Adjusted R_square	0.183	0.585	0.255	0.582
Number of Obs.	33285	25770	33285	25770

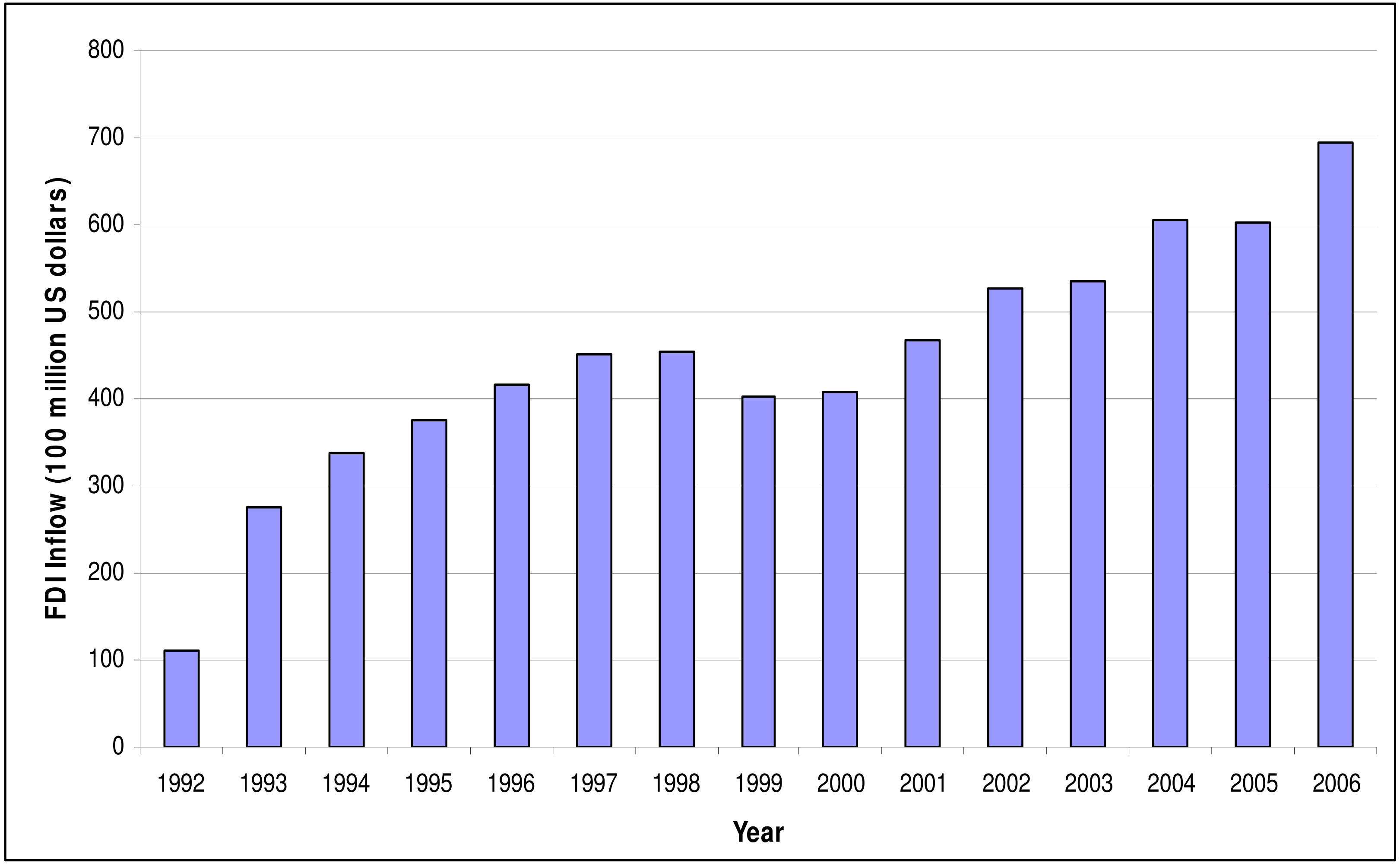
Notes: *, **, *** denote significance at 10%, 5% and 1% levels respectively. Numbers in parenthesis are standard errors. All regressions include dummy variables to control for industry, region and year effects. Cluster effects have been adjusted based on the discussion in the main text. The IV used for FDI is the number of foreign tourists in each year. Dependent variable lnTFP is calculated using $lnTFP=lnY-\beta_L lnL-\beta_K lnK-\beta_M lnM$ where the coefficients of β_L, β_K and β_M are from the LP regression. The above regressions are based on data controlling for quality of entering and exiting firms (see discussions in the text). Firm size is defined according to their registration with China Statistical Bureau, which contains three categories including small, medium and large. FDIShare, FDIShare^2 are defined as "FDI share" and the square of "FDI share", weighted by output value, and HKTWRatio is defined as the ratio of FDI from Hong Kong and Taiwan over those from other countries. FDI_Forward and FDI_Backward are defined as FDI share in downstream and upstream industries, measured with output value.

Table A1, Matched Exit and Entry Domestic Firms in China based on Propensity Score and Neighborhood Matching: 2000-2003

Sector ID	2000-2001				2001-2002				2002-2003				Total			
	Exits with Entry		Entry with Exit		Exits with Entry		Entry with Exit		Exits with Entry		Entry with Exit		Exits with Entry		Entry with Exit	
	(unit)	(%)	(unit)	(%)	(unit)	(%)	(unit)	(%)	(unit)	(%)	(unit)	(%)	(unit)	(%)	(unit)	(%)
13	1588	55.5	1574	51.1	1065	46.8	1076	52.9	2042	94.8	2408	89.3	4695	64.4	5058	64.8
14	551	55.0	553	47.2	385	43.9	397	51.8	799	95.3	890	89.1	1735	63.9	1840	62.6
15	484	57.2	472	49.3	307	44.8	306	58.3	560	91.8	626	92.3	1351	63.1	1404	65.0
16	22	45.8	20	50.0	14	25.0	17	81.0	47	87.0	23	92.0	83	52.5	60	69.8
17	1605	64.1	1570	41.3	1206	61.2	1169	43.9	2543	96.3	2859	87.5	5354	75.2	5598	57.5
18	813	67.5	798	39.3	677	68.1	647	40.5	1161	95.9	1460	84.3	2651	77.8	2905	54.2
19	389	66.8	381	39.8	278	62.9	274	40.8	618	97.9	841	87.6	1285	77.6	1496	57.8
20	499	68.0	476	42.0	332	56.1	319	47.5	676	95.5	1011	91.7	1507	74.1	1806	62.1
21	228	66.9	220	46.7	153	59.3	138	45.8	309	96.6	413	88.4	690	75.1	771	62.2
22	598	62.6	586	40.6	454	56.6	428	45.8	837	94.9	1072	90.2	1889	71.6	2086	58.5
23	423	56.6	416	45.8	278	43.2	281	43.2	587	92.7	675	88.1	1288	63.6	1372	59.0
24	175	68.1	167	39.0	134	60.4	131	40.3	277	96.5	341	84.6	586	76.5	639	55.3
25	201	50.1	205	62.5	147	73.5	134	28.2	232	95.9	308	81.1	580	68.8	647	54.6
26	1493	59.1	1468	47.4	1129	57.8	1114	47.9	1899	94.8	2789	91.1	4521	69.7	5371	63.3
27	424	68.6	416	41.2	335	51.7	334	53.2	509	87.2	798	92.6	1268	68.5	1548	61.9
28	72	68.6	73	40.3	61	50.0	56	43.8	135	96.4	148	90.8	268	73.0	277	58.7
29	244	61.3	239	50.1	141	52.0	132	45.7	264	93.3	367	90.2	649	68.2	738	62.9
30	814	66.7	784	40.4	674	63.6	657	44.0	1119	95.3	1555	88.3	2607	75.5	2996	57.7
31	2094	59.5	2086	50.4	1301	53.6	1311	50.3	2466	93.9	3333	91.7	5861	68.4	6730	64.9
32	547	66.2	533	44.4	405	56.8	392	53.0	723	94.6	1116	93.6	1675	72.7	2041	65.2
33	341	41.0	347	57.9	248	81.0	235	26.9	534	98.3	697	78.5	1123	66.8	1279	54.2
34	1092	64.5	1040	40.7	814	58.8	793	44.9	1535	95.3	2021	88.4	3441	73.4	3854	58.3
35	1279	62.4	1265	43.5	904	55.9	881	44.9	1600	95.0	2499	91.1	3783	70.7	4645	61.0
36	801	54.8	790	48.1	549	50.4	545	44.4	1011	94.0	1331	89.4	2361	65.1	2666	61.2
37	962	60.2	938	45.9	645	51.8	643	49.0	1073	90.3	1783	93.2	2680	66.5	3364	63.8
39	1012	66.2	974	40.7	731	56.2	693	42.7	1305	95.3	1862	90.5	3048	72.6	3529	58.1
40	374	62.2	366	43.2	346	67.4	324	40.0	552	96.7	696	84.4	1272	75.5	1386	55.7
41	190	63.5	187	41.3	158	56.0	153	45.4	266	93.3	341	87.9	614	70.9	681	57.8
42	524	64.0	496	41.4	404	65.5	381	45.2	773	97.6	690	82.7	1701	76.3	1567	54.5
Total	19839	60.9	19440	44.	14275	55.8	13961	45.6	26452	94.8	34953	89.2	60566	70.4	68354	60.4

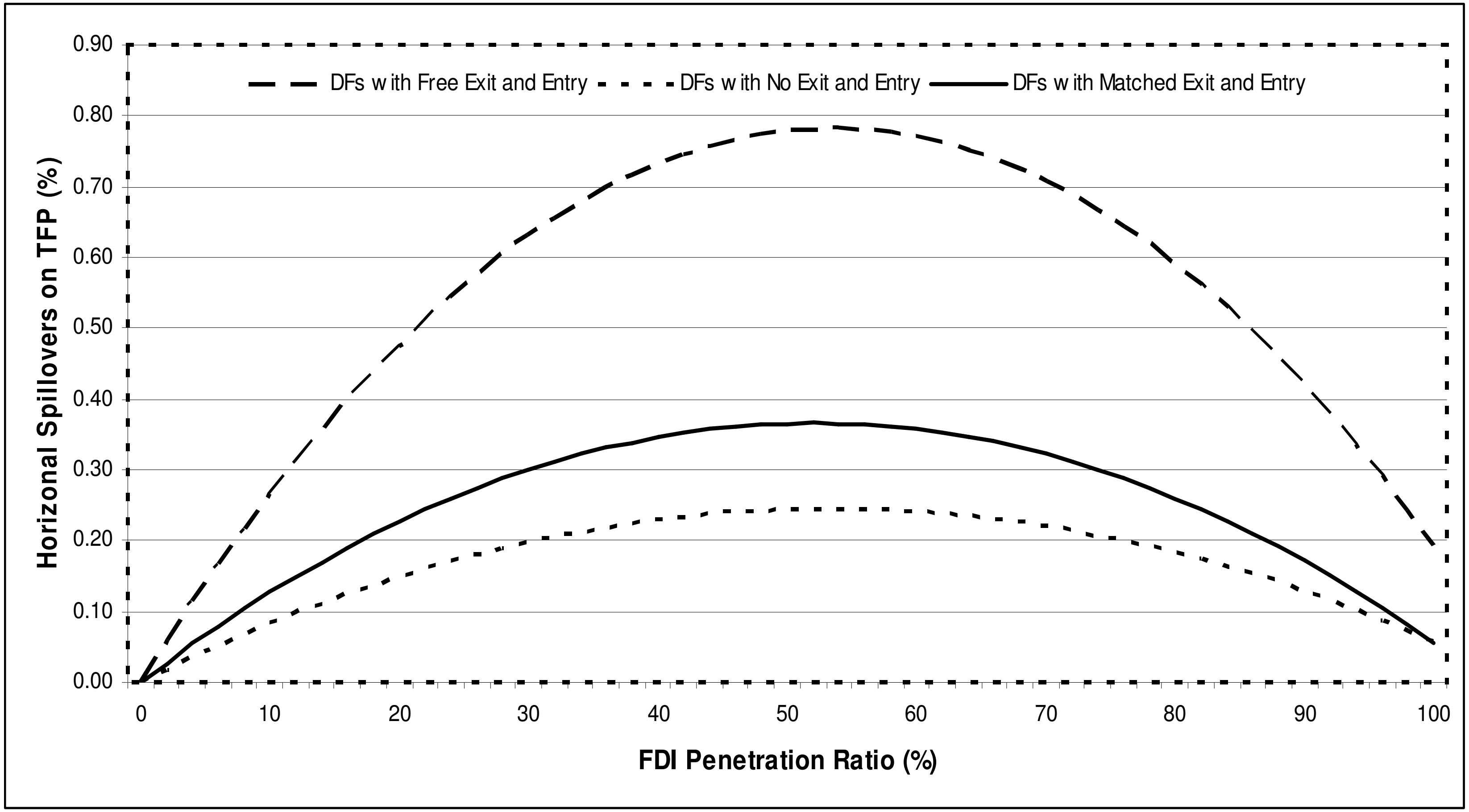
Notes: The propensity score method and the neighbor matching technique are applied to 29 industries and 3 regions (East, Middle and West) independently. The controlled and uncontrolled groups are defined as the exit and entry firms (and also the entry and exit firms), while the independent variables are specified as lnY, lnL, lnK and lnM. The reported results in all cells have passed the balanced test at 5 percent level.

Figure 1, Actually Utilized FDI Inflows in China: 1992-2006 (unit: billion US$)



Source: China Statistical Yearbook, 2007.

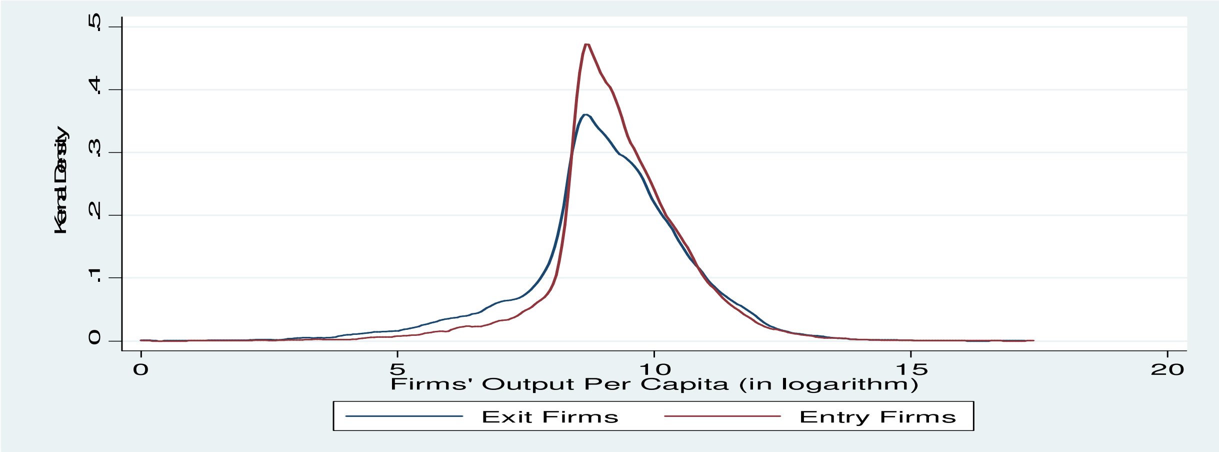
Figure 2 Impact of Horizontal FDI Presence on Domestic Firms' Productivity



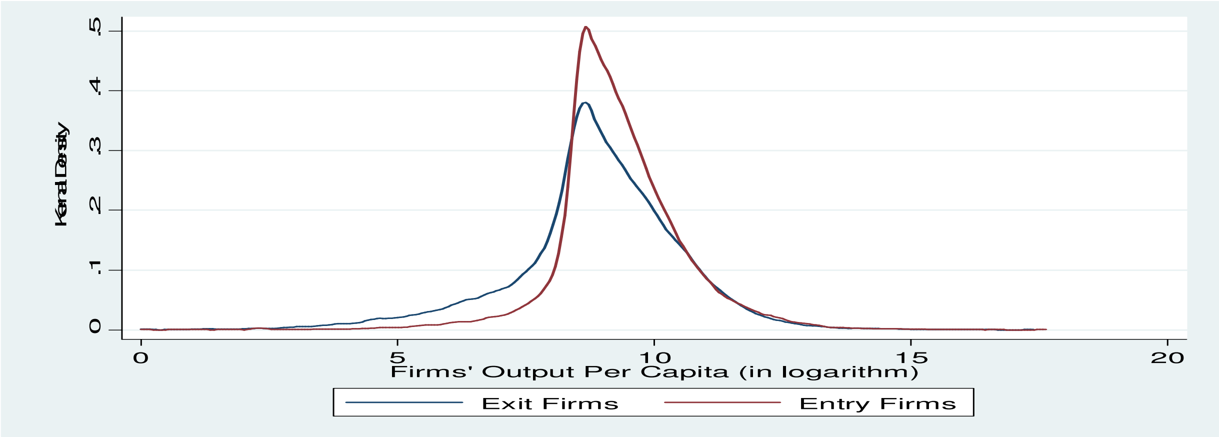
Source: Authors' own estimation.

Figure 3 Comparison of Output Per Capita between Exit and Entry Enterprises: 2000-2003

(a) Exit and Entry of Firms in 2000-2001



(b) Exit and Entry of Firms in 2001-2002



(c) Exit and Entry of Firms in 2002-2003