Impact of FDI on Domestic Firms' Exports in China

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Using firm-level census data of manufacturing industry during the period of 2000-2003, this paper examines the impact of foreign direct investment on domestic firms' exports in China. After dealing with some econometric problems of endogeneity and sample selection problems, we find that foreign direct investment in China has generated positive impact on domestic firms' export value through backward industrial linkages and positive impacts on domestic firms' export propensies in the same industry through demonstration effects. In particular, non-exporting FDI firms and FDI firms producing homogeneous products are more likely to generate the positive export spillovers to domestic firms through industrial linkages while exporting FDI firms and FDI firms producing heterogeneous products are more likely to generate positive export spillovers to domestic firms through demonstration effects in the same industry.

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1   Introduction

China's international trade has experienced a dramatic expansion in the last three decades. During the period of 1978 to 2008, China's total international trade increased from US$20.6 billion to US$2563.3 billion with an annual growth rate of 17.4 percent. China's exports increased even more rapidly than its total trade, rising from US$9.8 billion in 1978 to US$1430.7 billion in 2008 with an annual growth rate of 18.1 percent. Consequently, China has become the largest exporting nation in the world. The dramatic increase in international trade, particularly in exports, has contributed significantly to China's economic growth. According to the International Monetary Fund (IMF, 2009), China's exports were estimated to contribute around 30-45 per cent of the growth rate of China between 2001 and 2008 — a striking figure for an economy of her size — up from 15 per cent in the 1990s.

Foreign direct investment (FDI) in Chin has also increased dramatically in the last three decades. Foreign firms have been attracted by the huge domestic market and pool of relatively well-educated, low-cost labour, which have made China one of the most attractive destinations for FDI in the world. By the end of 2009, China has attracted a total of US$760 billion FDI inflows (at constant 1990 US dollar prices), making it the largest FDI recipient among the developing countries in the world.

FDI has contributed greatly to China's international trade. Exports and imports by FDI firms have accounted for nearly 60 percent of China's total international trade. What, however, are the impacts of FDI on China's domestic firms' exports? This question is important because it is expected that export spillovers is one of the main benefits generated by FDI to host economies, which not only can help domestic firms improve productivity, promote specialisation and increase exports, but also can help host countries improve resource allocation and play their comparative advantages in international trade (Dunning, 1993).

Chinese domestic firms' exports have experienced a significant increase in terms of both the total export value and the average export propensity. Between 1980 and 2008, the value of exports from domestic firms have increased from US$18.11 billion to US$640.20 billion at an annul growth rate of 13.58 percent. In 1998 the total number of domestic exporting firms was 20,537 and their average export value was RMB209 million yuan with the average export propensity of 8.80 percent. However, ten years later by 2007, the total number of domestic exporting firms reached 41,872 and their average export value reached RMB576 million yuan (both were more than two times of those in 1998) with the average export propensity increased to 9.58 percent. In particular in some industries, such as plastic products, metal products and electrical machinery, domestic firms' average export value has increased by around three times. The interest in this paper is the contribution of FDI to this performance.

FDI can reduce domestic firms' export costs through knowledge spillovers such as learning by doing (demonstration effects), research and development, human resource movement, training courses, technical assistance, and technology transfer (Dunning, 1993; Caves, 1996; Aitken, et al., 1997; Barrios, et al., 2003; Gorg and Greenaway, 2004; Greenaway, et al., 2004; Javorcik, 2004; Kneller and Pisu, 2007). These various effects can be combined into three main channels by which FDI may promote domestic firms' export activities. First, FDI can generate positive spillovers to domestic firms in productivity, which may improve domestic firms' competitiveness in the international market. Second, FDI can strengthen domestic industrial linkages through buying and supplying parts and components, which will encourage domestic firms in the upstream and downstream industries to be involved into international production specialization, thus enhancing domestic firms' ability to export. Third, FDI can pass information between international markets and domestic firms, facilitating domestic firms' exports. This effect will depend on whether the FDI firm is oriented to the domestic market of the host economy or the international market, and it will also depend on the types of products or services sold by the FDI firm, such as the extent of differentiation of those items.

Empirical studies on the impact of FDI on domestic firms have mainly focused on productivity spillovers or technology transfer from FDI while there are few empirical studies of other forms of export spillovers from FDI (Gorg and Greenaway, 2004). Moreover, most studies of export spillovers only investigate the intra-industry or horizontal impact of FDI on the export activities of domestic firms. Theoretically, as we mentioned above, FDI could also affect export activities of domestic firms in the upstream and downstream industries through vertical linkages and information flows. Therefore, it is important to do further empirical analysis to understand how FDI can affect domestic firms' exports. China, with huge FDI inflows and fast growth in international trade in the last three decades, provides a valuable case for such empirical studies.

Using the firm-level census data[2] of Chinese manufacturing industries during the period of 2000-2003, this paper carries out a series of regressions to investigate the impacts of FDI on China's domestic firms' export performance both in terms of the export value and the export propensity.[3] In searching for the export spillovers from FDI firms to domestic firms, we not only examine the horizontal impact but also investigate the impact through vertical industrial linkages between FDI firms and domestic firms. In addition, to identify the impact of information flows, we also examine the impact of different FDI firms, in terms of the market orientation and product differentiation, on domestic firms' exports.

After controlling firm characteristics, like productivity, capital to labour ratio, R&D activities, scale, age, and indirect foreign investment of domestic firms, and dealing with some econometric problems of endogeneity and sample selection, our empirical regressions reveal the following three main findings.

First, FDI has a positive impact on domestic firms' export value through the backward and forward industrial linkages, and this positive impact is mainly generated by non-exporting FDI firms and FDI firms producing homogeneous products.

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[2] It is more appropriate to use firm level data to do the analysis because firms are the basic unit of economic activity.

[3] Export propensity is defined as the share of export to total sales.

Second, FDI, in particular high-exporting FDI firms and FDI firms producing heterogeneous products, will tend to increase domestic firms' export propensity in the same industry through demonstration effects.

Third, the positive export spillovers from FDI firms are mainly to domestic non-state-owned enterprises both in terms of export value and export propensity.

This paper is an attempt to use the firm-level data to examine the relationship between FDI and domestic firms' exports throughout the whole manufacturing industry in China. Two contributions are made to the previous literature. First, in addition to intra-industry impacts of FDI on domestic firms' exports through demonstration effects, our analysis also points out that industrial linkages can be another important channels through which FDI can promote domestic firms' exports activities. Second, we distinguish FDI firms by their different characteristics such as market orientation and product differentiation in order to reveal how different types of FDI firms may have different impacts on domestic firms' exports, which can help to provide some useful policy implications.

The paper is arranged as follows. Sector 2 presents the literature review. Section 3 specifies the empirical model specifications for investigation the impact of FDI variables (i.e. horizontal, backward and forward FDI) on domestic firms' export value and export propensity. In particular, a Heckman two-step procedure regression has been combined with the first differencing regression technique to deal with the endogeneity problem associated with firms' fixed effects and the sample selection problem due to domestic firms' non random selection between exporting and non-exporting behaviours. Section 4 documents the data sources and variable definitions. Section 5 discusses the estimation results. Finally, Section 6 makes the conclusion.

2   Evidence of export spillovers from FDI: a literature review

The literature on export spillovers from FDI is relatively limited compared to that on productivity spillovers (Gorg and Greenaway, 2004; Kneller and Pisu, 2007). Aitken et al. (1997) pioneered in exploring the particular strand of externalities associated with FDI. Using plant-level cross-section data for Mexican manufacturing industries for 1986 and 1989, they investigate the role of geographic and multinational spillovers on the export decision of local firms. They estimate a probit model using export activity by multinationals in the industry and region as a proxy for export information externalities. They argue that proximity to multinational activity reduces the cost of access to foreign markets and find evidence that export activities by multinational firms in a sector positively affect the probability of a firm in the same sector and region being an exporter.

Kokko et al. (2001) investigate the decision to export by domestic firms in Uruguay using cross-sectoral firm level data for 1998. They distinguish between the presence of multinational firms in import-substituting and export-oriented industries and find evidence only for spillovers from export-oriented multinational firms.

Greenaway et al. (2004), using firm-level panel data for the United Kingdom for 1992-96, investigate whether spillovers affect a domestic firm's export probability of exporting and extend the analysis to examine what affects a domestic firm's export ratio. By estimating a two-step Heckman selection model, they first estimate the probability of exporting and then estimate the factors that affect a firm's export ratio. Their results suggest that multinational firms' exports have a positive effect on domestic firms' probability of exporting but do not affect their export ratio. They also find that the presence of multinational firms in the sector positively affect the decision to export and the export ratio.

Barrios at al. (2003) focus on export information externalities and on demonstration effects through R&D spillovers. Using firm-level panel data for Spanish manufacturing

for 1990-98, they estimated a probit model to explain why firms export and a tobit model to estimate what determines the firm's export ratio. They find no evidence that either R&D activity or export activity by multinational firms in a sector affects the probability that domestic firms export. The tobit estimations, however, find evidence for positive effects of multinational firms' R&D activities on export activities on domestic firms' export ratios, but no spillovers from multinational firms' export activities on domestic firms.

Ruane and Sutherland (2005) concentrate on searching for evidence of export spillovers from foreign enterprises on the export decision and intensity of domestic enterprises in countries that promote themselves as export platforms for FDI. By using firm-level data for manufacturing sector in Ireland for the period 1991-98, they find that the decision by host-country enterprises to enter the export market is positively associated with the presence of foreign enterprises in their sector. However, they find that the export intensity of foreign enterprises is negatively associated with the export decision and export intensity of domestic enterprises in Irish manufacturing.

Empirical studies on export spillovers from FDI firms to domestic firms in China are even more limited. For example, Zhang et al. (2004), using a panel data at the regional level for the period of 1985-99, examine the impact of FDI on the export performance of domestic Chinese firms. They find that FDI has some positive effects on domestic firms' export performance, but the influence is less than that on all firms (foreign and domestic). Similarly, Ma (2006), using a panel data at the provincial level for the period of 1993-2000, examine whether exports by multinational firms increase the probability of exporting by Chinese domestic firms. Ma finds that FDI firms funded by the overseas-Chinese investors do not increase the probability of exporting by local firms, while FDI firms from the OECD countries positively influence the export decision of local firms, particularly under processing trade.

Buck et al. (2007), using a firm-level panel data for the period 1998-2001, investigate export spillovers from FDI firms to Chinese domestic firms. By using a two-step

modelling strategy, their estimations show that multinational firms in China positively affect local Chinese firms' exports. Sun (2009), uses the pooled firm-level data to assess the impact of FDI on China's domestic firms' exports in the cultural, educational and sporting product manufacturing industry between 2000 and 2003. After dealing with the sample-selection bias, he finds that there are some positive effects of FDI on domestic firms' exports in this industry though the impacts are asymmetric across regions and differ among types of firms.

Kneller and Pisu (2007) is one of the few examples of a study of spillovers from foreign firms to domestic firms through horizontal, backward and forward linkages. Using a firm-level dataset of the United Kingdom manufacturing industries from 1992 to 1999, they use the Heckman selection process and model the two decisions of whether to export or not, and how much to export, separately. They find that the export decision of domestic firms does not seem to be affected by contacts they may have with multinational enterprises. Except for backward spillovers (which are positive and significant) they did not find any evidence of forward and horizontal spillovers. On the contrary, the decision concerning how much to export appears to be influenced by the presence of foreign multinational enterprises in the same, upstream and downstream industries. In addition, the horizontal spillovers seem to depend on the export orientation of foreign firms. Both export-oriented and domestic market-oriented multinational enterprises appear to generate positive and significant export spillovers, but the export-oriented foreign firms seem to be the source of stronger export spillovers. With regard to vertical spillovers, they find significant negative forward export externalities and significant positive backward externalities.

This review finds mixed results and little study of the impact of FDI in China on domestic firms' exports. This paper proceeds by examining four questions. First, do FDI inflows affect domestic firms' export value and export propensity through horizontal or vertical, channels? Second and third, do different types of FDI, in terms of a) market orientation and b) product differentiation, have different impact on domestic firms'

exports? And fourth, do FDI inflows have different impact on the export of different ownership types of domestic firms?

3 Data collection and variable definition

We use the firm level data from the annual enterprise census conducted by the National Bureau of Statistics (NBS) of China. The census covers the population of all state-owned enterprises (SOEs) and non-state-owned enterprises with annual sales value above RMB5 million yuan in the manufacturing industries across all provinces (except for Taiwan). The sample is an unbalanced dataset at the firm level for the manufacturing industries (China Industry Classification Code: 13-42), which spans a period of four years from 2000 to 2003. The total number of firms covered varies from 134,130 in 2000 to 169,810 in 2003. To control for firms' entry and exit and their possible impact on the relationship between FDI and domestic firms' exports, we restrict the sample used for regressions to those domestic firms which at least appeared in two consecutive years (for the sample period) and use the neighbourhood matching technique to sort out unmatched domestic firms with the same exporting behaviour between each consecutive two years.[4] Finally, the sample used contains 250,868 observations.

To distinguish between domestic firms and FDI firms, we use both firms' ownership type information from the China Enterprise Registration Code (CERC) and their capital composition: domestic firms are defined as the currently operating firms with foreign capital share less than 25 percent of the total registered capital (or CERC 100-190) and FDI firms are defined as the current operating firms with foreign capital share more than or equal to 25 percent of the total registered capital (or CERC 200-340).[5] Based on these definitions, we choose both domestic firms' export value (at constant price) and average export propensity as the dependent variables. Domestic firms' export value (at constant

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[4] For the details of neighbourhood matching technique please see Imbens and Angrist (1994) and Hahn, et al, (2001). The related results are available from authors upon request.

[5] According to China's regulation, FDI is defined as foreign capital share at least 25 percent of the total registered capital.

price) is defined as domestic firms' export revenue divided by firm-level output price index (calculated by using the constant price output value and the current price output value), while domestic firms' average export propensity is defined as domestic firms' export revenue divided by their total sales revenue.

For the variables of FDI spillovers at the industry level, we follow Javorcik (2004) to account for both the relative importance of FDI in firms' capital stock and FDI firms' scale in the sector. Specifically, the variable for horizontal spillovers is defined as the weighted sum of foreign capital share, with the weight being each firm's share in the sector's output ($Horizontal_{jt}$):

$$Horizontal_{jt} = (\sum_{i \in j} ForeignShare_{it} * Y_{it}) / (\sum_{i \in j} Y_{it}) \tag{1}$$

where $ForeignShare_{it}$ denotes the share of foreign capital in FDI firms at time t and Y_{it} the total output of the same FDI firm at the same time. The value of the variable increases with the output of FDI firms and the share of foreign capital in these firms.

The variable of backward spillovers is defined as:

$$Backward_{jt} = \sum_{k \neq j} \alpha_{jk} Horizontal_{kt} \tag{2}$$

where α_{jk} is the proportion of sector j's output supplied to sector k, taken from China's 2002 input-output table at the two-digit level basing on the International Standard Industrial Classification (ISIC) Code. The greater the foreign presence in sectors supplied by industry j and the larger the share of intermediates supplied to industries with FDI presence, the higher the value of the variable.

The variable of forward spillovers is defined as:

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$$Forward_{jt} = \sum_{m \neq j} \varphi_{jm} [[\sum_{i \in m} ForeignShare_{it} * (Y_{it} - EX_{it})]/[\sum_{i \in m} (Y_{it} - EX_{it})]] \quad (3)$$

where φ_{jm} is the share of inputs purchased by sector j from sector m in total inputs sourced by sector j. EX_{it} denotes the export value of FDI firm i at time t estimated with the output constant price.

In addition to FDI variables, we also control some firm characteristics affecting domestic firms' export behaviour, including productivity, capital-labour ration, R&D activities, operational scale, age and indirect foreign investment. For domestic firms' productivity, we choose domestic firms' total factor productivity as an approximation, which is estimated by using the semi-parametric regression method following Levinsohn and Petrin (2003). All value variables used for the productivity estimation are calculated at the 2000 constant prices. Domestic firms' exports are controlled in the estimation in order to deal with the possible reverse causality problem. Based on the estimate, domestic firms' average productivity has increased by 1.63 percent for the period of 2000-2003 with exporting domestic firms' average productivity increased more quickly by 3.14 percent. Productivity is expected to have positive impact on domestic firms' exports.

Firms' capital-labour ratio is defined as the log of net value of fixed assets at the 2000 constant prices divided by total number of employed workers. Similar as firms' productivity, domestic firms' average capital-labour ratio has also increased during the period from 2000 to 2003, with the growth rate being 4.63 percent. However, domestic exporting firms' capital-labour ratio has only increased by 2.0 percent, which implies that domestic firms' exports are still primarily based on the comparative advantage in labour. Given China's comparative advantage in labour-intensive activities, the capital-labour ratio is expected to have negative impact on domestic firms' exports.

Firms' R&D index is defined as the total revenue from new products divided by the total revenue. R&D activities can increase firms' competitiveness and therefore are expected to have positive impact on domestic firms' exports.

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Firms' age is based on their establishment year. In our sample, domestic firms' average age is 12.4 years. Firms' operational scale is a dummy variable, which takes one if the domestic firm is classified as the large and medium sized firm whereas zero if not. We have no pre-judgement of the impact of these two variables on domestic firms' exports.

Finally, indirect foreign investment is the foreign equity share in total registered capital of domestic firms ranging from zero to less than 25 percent. This variable controls the direct impact of foreign capital on domestic firms' exports and is expected to be positive.

Tables 1-3 show the descriptive statistics of domestic firms' basic information and export behaviour, and FDI in the same, upstream and downstream industries.

4   Methodology and model specification

To examine whether FDI may affect domestic firms' exports through either intra-sector or inter-sector channels, we start with a basic specification that regresses domestic firms' export value with respect to the horizontal, upstream and downstream FDI presence at the industry level.

$$
\begin{aligned}
\ln \exp ort_{ijrt} = \beta_0 &+ \beta_1 Horizontal_{jt} + \beta_2 Backward_{jt} + \beta_3 Forward_{jt} \\
&+ \sum \alpha_r D_r + \sum \alpha_j D_j + \sum \alpha_t D_t + u_{ijrt}
\end{aligned}
\tag{4}
$$

where $\ln \exp ort_{ijrt}$ denotes the logarithm of export value of domestic firm i operating in sector j and region r at time t. $Horizontal_{jt}$ measures the export spillovers generated by FDI presence in the same sector j at time t, and $Backward_{jt}$ and $Forward_{jt}$ measure the export spillovers generated by FDI presence in the downstream and upstream sectors respectively. Since all the three variables are estimated with the data on firm-level capital stock (registered capital), no lags of those variables are required to be included in

Equation (4). Finally, there are three groups of dummy variables, $\sum \alpha_r D_r$, $\sum \alpha_j D_j$ and $\sum \alpha_t D_t$, used to control the regional, sectoral and time specific effects, and u_{ijrt} is used to capture the random errors.

Although Equation (4) can be used to examine the impact of FDI on domestic firms' exports, the estimated results would be biased. This is because that there are many firm level factors affecting domestic firms' export behaviour and at the same time correlating with the industry level FDI variables. For example, domestic firms with relatively higher productivity or lower capital-labour ratio are more likely to export their products to the international market due to trade theorem (Melitz, 2003) while FDI is more likely to enter domestic firms with high productivity or lower capital-labour ratio through joint venture, merger and acquisition — the cherry picking effect (Brambilla, et al., 2009) — thus raising the industry-level FDI stock. Without considering the impact of those factors may lead to overestimation of the impact of FDI on domestic firms' exports. To deal with this problem, we introduce some control variables, thus Equation (4) can be written as:

$$
\begin{aligned}
\ln \text{export}_{ijrt} = {} & \beta_0 + \beta_1 Horizontal_{jt} + \beta_2 Backward_{jt} + \beta_3 Forward_{jt} \\
& + \beta_4 \Pr od_{ijrt} + \beta_5 \ln(K/L)_{ijrt} + \beta_6 \text{OpenYear}_{ijrt} + \beta_7 \text{D\_Scale}_{ijrt} + \beta_8 RnD_{ijrt} \quad (5) \\
& + \beta_9 IFI_{ijrt} + \sum \alpha_r D_r + \sum \alpha_j D_j + \sum \alpha_t D_t + u_{ijrt}
\end{aligned}
$$

where $\Pr od_{ijrt}$ denotes domestic firms' total factor productivity (estimated by using the LP method as explained in Section 3), which is used to control the possible impact of productivity disparity across firms on their exporting behaviour (Melitz, 2003). $\ln(K/L)_{ijrt}$ denotes the log of capital-labour ratio at the firm level, which is used to control the impact of comparative advantage disparity across firms on their exporting behaviour (H-O model). OpenYear_{ijrt}, D_Scale_{ijrt}, RnD_{ijrt} and IFI_{ijrt} are firms' open year, a dummy variable for firms' scale, R&D index representing domestic firms' innovation ability, and indirect foreign investment respectively.

The pooled OLS regression method can be applied to estimate Equation (5), but the estimated results could be biased due to two econometric problems.

The first econometric problem is the endogeneity. It is widely believed that there are many unobserved time-invariant firm-specific factors affecting domestic firms' export behaviour as well as affecting FDI inflows into the same, upstream and downstream sectors, even after controlling firms' characteristics, such as productivity, capital-labour ratio, R&D and so on. For example, domestic firms with good connections to international clients not only help them to export but also defer FDI inflows into the same industry targeting the international market while promote FDI inflows into the upstream and downstream industries seeking profits from inter-industry linkages. Without considering these factors, the pooled OLS regression may under-estimate FDI's intra-industry and over-estimate FDI's inter-industry impacts on domestic firms' export behaviour. To deal with this problem, we adopt the first-differencing regression technique (FD) to eliminate the time-invariant firm-specific factors from the OLS regression and re-examine the impact of FDI on domestic firms' export behaviour. Thus, Equation (5) can be re-arranged as:

$$
\begin{aligned}
d\ln export_{ijrt} = {} & \beta_0 + \beta_1 dHorizontd_{jt} + \beta_2 dBackward_{jt} + \beta_3 dForward_{jt} \\
& + \beta_4 d\Pr od_{jrit} + \beta_5 d\ln(K/L)_{ijrt} + \beta_6 dD\_Scale_{ijrt} + \beta_7 dOpenYear + \beta_8 dRnD_{ijrt} \quad (6) \\
& + \beta_9 dIFI_{ijrt} + \sum \alpha_r D_r + \sum \alpha_j D_j + \sum \alpha_t D_t + u_{ijrt}
\end{aligned}
$$

where $d(.)$ denotes the change of each variable over time and other variables are defined the same as those in Equation (5).

The second econometric problem is the sample selection due to the truncated dependent variable. According to Melitz (2003), domestic firms choosing to export may usually incur additional sunk costs, which are related to marketing exploration. Thus, domestic firms with exporting ability will not enter the international market if the profits from exporting behaviour can not compensate for their loss. In China's manufacturing

industries between 2000 and 2003, there are on average two thirds of domestic firms are not exporting though others are doing so. Since those non-exporting domestic firms (i.e. their exports are all equal to zero) with different abilities of exporting are not included in our regression (or select out), the change in their ability due to FDI inflows can not be captured. Thus, both the OLS and FD regressions may tend to underestimate the impact of FDI inflows on domestic firms' export behaviour. To deal with this sample selection problem, we adopt the Heckman two-step procedure (Wooldridge, 2002) to include the non-exporting domestic firms into our regression. The method is first to assume that domestic firms with similar characteristics may have similar exporting probability (though they may not do so due to many other constraints), and then to estimate the inversed Mills ratio to capture the probability of both exporting and non-exporting firms choosing to export. Thus, FDI's impact on domestic firms' export behaviour can be estimated by regressing domestic exporting firms' exports with regards to the variables of FDI presence with the control of the Mills ratios. To fulfil this two-step procedure, a dummy variable representing whether domestic firms export or not in the base year (say, year 2000)—highly related to domestic firms' exporting choice but not related to their export amount—has been used in the first step to identify the two regressions. The above model can also be summarised in Equation (7).

$$
\begin{aligned}
d \ln \exp ort_{ijrt} = {} & \beta_0 + \beta_1 dHorizonta\, l_{jt} + \beta_2 dBackward_{jt} + \beta_3 dForward_{jt} \\
& + \beta_4 d \ln(\Pr od_{ijrt}) + \beta_5 d \ln(KL\_ratio)_{ijrt} + \beta_7 \mathrm{dD\_Scale}_{ijrt} + \beta_8 dRnD_{ijrt} + \beta_9 dIFI_{ijrt} \\
& + \gamma dMills_{ijrt} + \sum \alpha_t D_t + v_{ijrt}
\end{aligned}
\tag{7}
$$

where $Mills_{ijrt}$ is the Mills ratio, which has been estimated from the first-step probit model

$$
\begin{aligned}
P(y \exp ort_{ijrt} = 1 \mid \exp ort_{ijrt} > 0) = {} & \theta_0 + \theta_1 dHorizonta\, l_{jt} + \theta_2 dBackward_{jt} + \theta_3 dForward_{jt} + \\
& \lambda D\_Export_{ijr-t} + \theta_4 d \ln(\Pr od_{ijrt}) + \theta_5 d \ln(KL\_ratio)_{ijrt} + \theta_7 \mathrm{dD\_Scale}_{ijrt} + \theta_8 dRnD_{ijrt} \\
& + \theta_9 dIFI_{ijrt} + \sum \phi_t D_t + v_{ijrt}
\end{aligned}
\tag{8,}
$$

and D_Export_{ijr-t} is domestic firms' export status before year t used to identify the first-stage probit model for domestic firms' exports ($yexport_{ijrt}=0,1$) (Heckman, 1979; Wooldridge, 1995 and 2002; Christofides et al., 2003).

Equations (7) and (8) can provide consistent estimates on the impact of intra-sector and inter-sector FDI on domestic firms' export value, with the control of time-invariant firm-specific factors and the truncated dependent variable problems.

In order to investigate the impact of FDI on domestic firms' export propensity, we re-write Equations (5), (7) and (8) as:

$$
\begin{aligned}
\ln\exp ratio_{ijrt} = {} & \beta_0 + \beta_1 Horizontal_{jt} + \beta_2 Backward_{jt} + \beta_3 Forward_{jt} \\
& + \beta_4 \Pr od_{ijrt} + \beta_5 \ln(K/L)_{ijrt} + \beta_6 \mathrm{OpenYear}_{ijrt} + \beta_7 \mathrm{D\_Scale}_{ijrt} + \beta_8 RnD_{ijrt} \quad (9) \\
& + \beta_9 IFI_{ijrt} + \sum \alpha_r D_r + \sum \alpha_j D_j + \sum \alpha_t D_t + u_{ijrt}
\end{aligned}
$$

$$
\begin{aligned}
d\exp ratio_{ijrt} = {} & \beta_0 + \beta_1 dHorizontal_{jt} + \beta_2 dBackward_{jt} + \beta_3 dForward_{jt} \\
& + \beta_4 d\ln(\Pr od_{ijrt}) + \beta_5 d\ln(KL\_ratio)_{ijrt} + \beta_7 \mathrm{dD\_Scale}_{ijrt} + \beta_8 dRnD_{ijrt} \quad (10) \\
& + \beta_9 dIFI_{ijrt} + \gamma dMills_{ijrt} + \sum \alpha_t D_t + v_{ijrt}
\end{aligned}
$$

where $Mills_{ijrt}$ is the Mills ratio, which has been estimated from the first-step probit model

$$
\begin{aligned}
P(yexport_{ijrt}=1\mid export_{ijrt}>0) = {} & \theta_0 + \theta_1 dHorizontal_{jt} + \theta_2 dBackward_{jt} + \theta_3 dForward_{jt} \\
& \lambda D\_Export_{ijr-t} + \theta_4 d\ln(\Pr od_{ijrt}) + \theta_5 d\ln(KL\_ratio)_{ijrt} + \theta_7 \mathrm{dD\_Scale} + \theta_8 dRnD_{ijrt} \quad (11), \\
& + \theta_9 dIFI_{ijrt} + \sum \phi_t D_t + v_{ijrt}
\end{aligned}
$$

and $\exp ratio_{ijrt}$ is domestic firm i's export propensity at time t and other variables are defined as the same as those in Equations (7) and (8) .

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5 Empirical results: FDI and domestic firms' exports

To examine the impact of FDI inflows on China's domestic firms' exports, we regress export value and export propensity with horizontal, backward and forward spillovers variables and other control variables with the 4-year longitudinal data following the model specifications presented in Section 4. The two-step Heckman procedure has been applied to OLS and FD regressions. The estimation results are reported in Tables 4 to 10.

The impact of FDI on domestic firms' export value and export propensity: all firms

Based on Equations (5) and (9), we use the OLS method with the adjustment for heteroscedasticity and the cluster effects. As shown in Columns (1) and (3) of Table 4, the estimated results show that FDI has a significant positive impact only on domestic firms' export value in the same sector. The estimated elasticities to the horizontal, backward and forward spillovers variables are all positive but only the elasticity to the horizontal spillovers variable is significant at 1 per cent level. In terms of export propensity, none of the elasticities to the spillovers variables are significant even at 10 per cent level. Most of the estimated coefficients of the control variables are consistent with our prediction.

Table 4. Estimation results for domestic firms' export value and export propensity: all firms

	Export value		Export propensity	
	OLS	FD	OLS	FD
	(1)	**(2)**	**(3)**	**(4)**
Prod (TFP Index)	0.664***	0.117***	-0.016***	0.004***
	(0.137)	(0.031)	(0.003)	(0.001)
ln(K/L)	0.004	-0.035***	-0.010***	-0.003***
	(0.011)	(0.013)	(0.002)	(0.001)
Open Year	-0.870***	-	0.103***	-
	(0.065)	-	(0.005)	-
D_Scale	0.197***	-0.157***	0.126***	-0.023***
	(0.071)	(0.020)	(0.009)	(0.003)
RnD	0.012***	0.145**	-0.000	0.057***
	(0.001)	(0.065)	(0.000)	(0.007)

Inversed Mills Ratio	-0.600***	-0.249***	-0.229***	0.069***
	(0.022)	(0.030)	(0.011)	(0.007)
Within-firm FDI share	1.723***	1.218***	0.111***	0.102***
	(0.148)	(0.298)	(0.035)	(0.031)
Horizontal	2.074***	0.072	0.009	0.042***
	(0.610)	(0.247)	(0.083)	(0.013)
Backward	7.894*	0.927***	0.055	0.011
	(4.689)	(0.275)	(0.634)	(0.028)
Forward	0.930	0.196	0.188	-0.019
	(4.727)	(0.857)	(0.487)	(0.076)
Constant	-16.823***	0.053***	0.588***	0.004***
	(2.503)	(0.012)	(0.212)	(0.001)
Number of Observations	52,713	23,562	52,713	23,562
R^2	0.188	0.020	0.489	0.017

Note: For the reason of concision, regional, sectoral and time dummies are not reported, but they are controlled and jointly significant in each regression.

*** $p<0.01$, ** $p<0.05$, * $p<0.1$ and numbers in parentheses are standard error.

Source: Authors' own calculation.

OLS estimates are biased due to endogeneity. As we discussed in previous section, there are many unobserved time-invariant firm-specific factors, such as firms' entrepreneurship, local transportation and communication facilities, government policies and so on, which may positively related to firms' export value, export propensity, and the horizontal, upstream and downstream FDI shares. To deal with this problem, we adopt the first differencing (FD) regression to eliminate the time-invariant firms-specific characteristics from our estimation. As shown in Columns (2) and (4) of Table 4, the estimated coefficients of FDI spillovers variables become smaller but most of them become more significant, which implies that the endogeneity problem does exist in our regression and tends to generate overestimation. The negative significant coefficient of Mills ratio in the FD regression of domestic firms' export value and the positive significant coefficient of Mills ratio in the FD regression of domestic firms' export propensity also suggest that the sample selection problem does matter for the regression. So the adjustment with the Heckman selection is appropriate.

After dealing with the endogeneity and the sample selection problems, our estimation results (Columns (2) and (4) of Table 4) show that FDI may tend to raise domestic firms' export value in the upstream sector (backward linkage). The estimated elasticity is 0.927

and significant at 1 percent level. A possible explanation on this phenomenon is that the entry of FDI firms may generate demand from the upstream industry, which may in turn help domestic firms improve and adjust production suitable to international markets, thus increasing export. Also, to secure high quality inputs, downstream FDI firms may transfer technology to upstream domestic firms, thus improving the competitiveness of domestic firms and increasing export. However, FDI has no significant impact on domestic firms' export value in the same industry or in the downstream sector.

The impact of FDI on domestic firms' export propensity may only take place in the same sector but the magnitude of the impact is very small. The elasticity of domestic firms' export propensity to the horizontal spillovers variable is 0.042 and significant at 1 percent level. The estimation results show that FDI has no significant impact on domestic firms' export propensity through backward and forward industrial linkages.

As for the control variables, domestic firms' export value and export propensity are negatively related to their capital-labour ratio and firms' operational scale. Domestic firms' export value and export propensity are positively related to firms' productivity and R&D activities, implying that FDI can also promote domestic firms' exports through their positive productivity spillovers. Finally, indirect foreign investment is a positive and statistically significant factor to both domestic firms' export value and export propensity.

The impact of FDI firms' market orientation on domestic firms' exports

One notable feature of FDI firms in China is the high propensity to export. During the period of 2000 to 2003, the average export propensity of FDI firms was 42 percent and in ten industries out of the twenty-nine manufacturing industries FDI firms' export propensity exceeded 50 percent. Therefore, it is important to investigate whether FDI firms' own export behaviour may affect domestic firms' exports.

We group FDI firms into non-exporting FDI firms (the current export revenue is equal to zero), exporting FDI firms (the current export revenue is more than zero), and high-exporting FDI firms (the export propensity is more than or equal to 50 percent). Equations (1) to (3) are used to calculate the corresponding horizontal, backward and forward FDI spillovers variables for each group of these FDI firms. The estimation results are shown in Tables 5-6.

The estimated results show that non-exporting FDI is more likely to generate the positive impact on domestic firms' export value through the backward linkage than the exporting FDI and the high-exporting FDI. As shown in Table 5, the estimated elasticity of domestic firms' export value to the backward FDI spillovers variable for the non-exporting FDI is 6.085 and significant at 1 percent level, which is higher and more significant than those for the exporting FDI (1.653 and significant at 10 percent level) and the high-exporting FDI (2.579 and not significant at 10 percent level). This result suggests that the non-exporting FDI may play more important role than the exporting FDI, particularly than high-exporting FDI, in generating positive export spillovers to domestic firms through industrial linkages.

FDI firms in China are highly engaged in processing trade. In 2006, FDI firms accounted for 84 percent and 85 percent of China's total processing export and import, and processing export and import accounted for 80 percent and 58 percent of FDI firms' total export and import respectively. The high exporting FDI firms (the export propensity at least 50 percent) are mainly engaged in processing export. They import almost all the materials and intermediate inputs from overseas and export almost all the final products after processing and assembling in the special export-processing zones or duty-free zones specifically designed and created for export-oriented FDI firms. As a result, they not only have no backward or forward industrial linkages with domestic firms but also compete with domestic firms for the same products in the international markets.

However, in terms of the ordinary exporting FDI firms, as more and more of them flow in, they will increasingly source materials and intermediate inputs from domestic firms,

which would improve productivity and adaptability of domestic firms in the upstream industry, thus improving their ability to export to the international markets.

Table 5. Estimation results for non-export, export and high-export FDI on domestic firms' export value

	Non-exporting FDI		Exporting FDI		High exporting FDI	
	OLS	FD	OLS	FD	OLS	FD
Prod (TFP Index)	0.664***	0.121***	0.664***	0.114***	0.664***	0.115***
	(0.137)	(0.031)	(0.137)	(0.030)	(0.137)	(0.030)
ln(K/L)	0.004	-0.035***	0.004	-0.035***	0.004	-0.035***
	(0.011)	(0.013)	(0.011)	(0.013)	(0.011)	(0.013)
Open Year	-0.869***	-	-0.870***	-	-0.870***	-
	(0.065)	-	(0.066)	-	(0.066)	-
D_Scale	0.197***	-0.158***	0.199***	-0.157***	0.198***	-0.158***
	(0.071)	(0.020)	(0.071)	(0.020)	(0.071)	(0.020)
RnD	0.012***	0.146**	0.012***	0.145**	0.012***	0.145**
	(0.001)	(0.065)	(0.001)	(0.065)	(0.001)	(0.065)
Inversed Mills Ratio	-0.601***	-0.249***	-0.600***	-0.249***	-0.600***	-0.248***
	(0.022)	(0.029)	(0.022)	(0.030)	(0.022)	(0.029)
Within-firm FDI share	1.720***	1.219***	1.724***	1.215***	1.723***	1.219***
	(0.148)	(0.299)	(0.148)	(0.299)	(0.147)	(0.298)
Horizontal	-1.776	-0.558	1.072***	0.059	-1.363	0.021
	(1.306)	(0.795)	(0.312)	(0.272)	(2.459)	(1.303)
Backward	1.465	6.085***	3.049	1.653*	-4.204	2.579
	(10.530)	(2.173)	(3.746)	(0.869)	(10.486)	(5.451)
Forward	-6.374	1.329	35.946***	3.309	51.657***	10.688
	(6.435)	(1.970)	(6.446)	(4.107)	(6.749)	(8.209)
Constant	-15.961***	0.049***	-16.210***	0.053***	-16.083***	0.052***
	(2.590)	(0.014)	(2.524)	(0.012)	(2.524)	(0.013)
Number of Observations	52,713	23,562	52,713	23,562	52,713	23,562
R^2	0.187	0.020	0.188	0.020	0.188	0.020

Note: For the reason of concision, regional, sectoral and time dummies are not reported, but they are controlled and jointly significant in each regression.

*** $p<0.01$, ** $p<0.05$, * $p<0.1$ and numbers in parentheses are standard error.

Source: Authors' own calculation.

Exporting FDI and high-exporting FDI are more likely to generate positive impact on domestic firms' export propensity in the same industry than non-exporting FDI. As shown in Table 6, the estimated elasticity of domestic firms' export propensity to the horizontal FDI spillovers variable for the high-exporting FDI is 0.248 and significant at 5

per cent level, which are higher than those for the exporting FDI (0.062 and significant at 1 percent level) and for the non-exporting FDI (-0.110 and not significant at 10 percent level). There is some evidence of a positive impact on domestic firms' export propensity from high-exporting FDI and non-exporting FDI through forward industrial linkages. The estimated elasticity of domestic firms' exports propensity to the forward FDI spillovers variable for the high-exporting FDI is 1.874 and significant at 5 percent level and for the non-exporting FDI is 0.559 and significant at 10 percent level. The results suggest that the positive impact of FDI on domestic firms' export propensity is mainly in the same industry through the demonstration effects, though there are some evidence of positive impact of FDI on domestic firms' export propensity through forward industrial linkages.

Table 6. Estimation results for non-export, export and high-export FDI on domestic firms' export propensity

	Non-exporting FDI		Exporting FDI		High-exporting FDI	
	OLS	FD	OLS	FD	OLS	FD
Prod (TFP Index)	-0.016***	0.005***	-0.016***	0.004***	-0.016***	0.004***
	(0.003)	(0.001)	(0.003)	(0.001)	(0.003)	(0.001)
ln(K/L)	-0.010***	-0.003***	-0.010***	-0.003***	-0.010***	-0.003***
	(0.002)	(0.001)	(0.002)	(0.001)	(0.002)	(0.001)
Open Year	0.103***	-	0.103***	-	0.103***	-
	(0.005)	-	(0.005)	-	(0.005)	-
D_Scale	-0.126***	-0.023***	-0.127***	-0.023***	-0.126***	-0.023***
	(0.009)	(0.003)	(0.009)	(0.003)	(0.009)	(0.003)
RnD	-0.000	0.057***	-0.000	0.057***	-0.000	0.057***
	(0.000)	(0.007)	(0.000)	(0.007)	(0.000)	(0.007)
Inversed Mills Ratio	-0.229***	0.069***	-0.229***	0.069***	-0.229***	0.069***
	(0.011)	(0.007)	(0.011)	(0.007)	(0.011)	(0.007)
Within-firm FDI share	0.111***	0.101***	0.111***	0.102***	0.110***	0.101***
	(0.035)	(0.031)	(0.034)	(0.031)	(0.034)	(0.031)
Horizontal	0.452***	-0.110	-0.117***	0.062***	0.027	0.248**
	(0.141)	(0.068)	(0.039)	(0.018)	(0.257)	(0.122)
Backward	-0.620	0.308	-0.332	0.017	-3.244***	0.797
	(1.045)	(0.198)	(0.508)	(0.059)	(1.154)	(0.655)
Forward	0.735	0.559*	0.789	-0.057	1.115	1.874**
	(0.703)	(0.290)	(0.721)	(0.492)	(0.844)	(0.755)
Constant	0.566***	0.003***	0.605***	0.004***	0.599***	0.002**
	(0.212)	(0.001)	(0.214)	(0.001)	(0.214)	(0.001)
Number of Observations	52,713	23,562	52,713	23,562	52,713	23,562
R^2	0.489	0.018	0.489	0.018	0.489	0.018

The impact of FDI firms' product differentiation on domestic firms' exports

To investigate the impact of FDI firms' product differentiation on domestic firms' exports, based on Rauch (1999), we classify FDI firms into two categories: FDI firms producing homogenous (organised exchange) products and FDI firms producing heterogeneous (differentiated) products. We dropped the category of reference priced products in Rauch's classification from our regression exercise. Again Equations (1) to (3) are used to calculate the corresponding horizontal, backward and forward FDI spillovers variables for the two groups of FDI firms. In doing so, we matched between Chinese Industrial Classification Code (CICC) (for FDI firms) and the SITC Revision 2 (for Rauch's classification) by using Rauch's conservative classification in the concordance table (obtained from Jon Haveman's International trade database http://www.macalester.edu/research/economics/page/haveman/trade.resources/tradedata.html#Rauch). According to this concordance table, each product at the 4-digit level SITC Revision 2 is linked to one of the two categories, including the products traded on an organized exchange (homogeneous products) and the differentiated products (heterogeneous products).

Generally, FDI firms producing heterogeneous products are more likely to generate positive spillovers to upstream and downstream industries. However, since most FDI firms in China producing heterogeneous products are engaged in processing trade. The empirical results can be ambiguous.

As shown in Table 7, FDI producing heterogeneous products generally have no significant impact on domestic firms' export value in either the same industry or the upstream and downstream industries (though they are positive), while FDI producing

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homogeneous products may have positive and significant impact on domestic firms' export value in the downstream industry (forward linkage). This is because most FDI producing heterogeneous products are concentrated in the processing industries and are engaged in processing trade, which purchase materials and intermediate inputs from overseas and sell their products to the international markets, thus having little industrial linkages with domestic firms.

Table 7. Impacts of FDI producing homogenous and heterogeneous products on domestic firms' export value

	Homogenous products		Heterogeneous products	
	OLS	FD	OLS	FD
Prod (TFP Index)	0.664***	0.113***	0.664***	0.115***
	(0.137)	(0.031)	(0.137)	(0.031)
ln(K/L)	0.004	-0.035***	0.004	-0.035***
	(0.011)	(0.013)	(0.011)	(0.013)
Open Year	-0.869***	-	-0.870***	-
	(0.065)	-	(0.066)	-
D_Scale	0.196***	-0.156***	0.198***	-0.158***
	(0.071)	(0.020)	(0.071)	(0.020)
RnD	0.012***	0.144**	0.012***	0.145**
	(0.001)	(0.065)	(0.001)	(0.065)
Inversed Mills Ratio	-0.601***	-0.250***	-0.600***	-0.247***
	(0.022)	(0.029)	(0.022)	(0.029)
Within-firm FDI share	1.721***	1.215***	1.723***	1.220***
	(0.148)	(0.299)	(0.148)	(0.298)
Horizontal	-0.370	0.697	0.164	0.020
	(0.539)	(0.480)	(0.108)	(0.065)
Backward	-9.201	-1.285	0.379	0.517
	(8.599)	(4.328)	(0.996)	(0.726)
Forward	7.429	3.961*	3.716***	0.659
	(4.530)	(2.157)	(0.759)	(0.661)
Constant	-16.063***	0.055***	-16.091***	0.049***
	(2.525)	(0.012)	(2.524)	(0.015)
Number of Observations	52,713	23,562	52,713	23,562
R^2	0.187	0.020	0.188	0.020

Note: For the reason of concision, regional, sectoral and time dummies are not reported, but they are controlled and jointly significant in each regression.
   *** p<0.01, ** p<0.05, * p<0.1 and numbers in parentheses are standard error.
Source: Authors' own calculation.

As for the impact of FDI producing different products on domestic firms export propensity, as shown in Table 8, FDI producing heterogeneous products are more likely to generate positive impact on domestic firms' export propensity in the same industry through demonstration effects while FDI producing homogeneous products are more likely to generate positive impact on domestic firms' export propensity through the backward linkage.

Table 8. Impacts of FDI producing homogenous and heterogeneous products on domestic firms' export propensity

| | Homogenous products | | Heterogeneous products | |
	OLS	FD	OLS	FD
Dependent variable: lnexport				
Prod (TFP Index)	-0.016***	0.005***	-0.016***	0.005***
	(0.003)	(0.001)	(0.003)	(0.001)
ln(K/L)	-0.010***	-0.003***	-0.010***	-0.003***
	(0.002)	(0.001)	(0.002)	(0.001)
Open Year	0.103***	-	0.103***	-
	(0.005)	-	(0.005)	-
D_Scale	-0.126***	-0.023***	-0.126***	-0.023***
	(0.009)	(0.003)	(0.009)	(0.003)
RnD	-0.000	0.057***	-0.000	0.057***
	(0.000)	(0.007)	(0.000)	(0.007)
Inversed Mills Ratio	-0.229***	0.069***	-0.229***	0.069***
	(0.011)	(0.007)	(0.011)	(0.007)
Within-firm FDI share	0.111***	0.101***	0.111***	0.101***
	(0.035)	(0.031)	(0.034)	(0.031)
Horizontal	0.042	0.008	-0.007	0.028***
	(0.088)	(0.032)	(0.016)	(0.005)
Backward	4.045***	1.549**	-0.179	0.083
	(1.389)	(0.604)	(0.125)	(0.056)
Forward	-0.028	-0.206	0.181*	0.002
	(0.503)	(0.261)	(0.108)	(0.043)
Constant	0.589***	0.004***	0.597***	0.002*
	(0.212)	(0.001)	(0.214)	(0.001)
Number of Observations	52,713	23,562	52,713	23,562
R^2	0.489	0.017	0.489	0.018

Note: For the reason of concision, regional, sectoral and time dummies are not reported, but they are controlled and jointly significant in each regression..
   *** p<0.01, ** p<0.05, * p<0.1 and numbers in parentheses are standard error.
Source: Authors' own calculation.

The impact of firm ownership on export spillovers from FDI

A last question is what ownership type of domestic firms is more likely to receive export spillovers from FDI firms. To answer this question, we divide our sample of domestic firms into two categories based on their ownership: one is the state-owned enterprises (SOEs) (defined as the share of capital owned by state and collective groups more than 50 percent) and the other is the non-state-owned enterprises (non-SOEs). The estimated results are shown in Tables 9 and 10.

Comparing the estimation results from the two datasets, we find that the impact of FDI on domestic non-SOEs are much stronger than that on domestic SOEs. The estimated backward impact of FDI to domestic firms' export value and the horizontal impact of FDI to domestic firms' export propensity for the two groups are 1.134 and 0.05 (significant at 5 percent level) for non-SOEs, which are larger than 0.348 (not significant at 10 percent level) and 0.03 (significant at 10 percent level) for the SOEs respectively. This result implies that FDI's impact on domestic firms' exports is mainly transferred through their impact on domestic private firms.

Table 9. Impact of FDI on domestic firms' export value: SOEs vs. non-SOE firms

	SOEs		Non-SOEs	
	OLS	FD	OLS	FD
Prod (TFP Index)	0.757***	0.099**	0.594***	0.125***
	(0.139)	(0.040)	(0.144)	(0.035)
ln(K/L)	0.005	-0.028	0.005	-0.039***
	(0.020)	(0.027)	(0.010)	(0.012)
Open Year	-0.838***	-	-0.900***	-
	(0.072)	-	(0.066)	-
D_Scale	0.690***	-0.087**	-0.004	-0.171***
	(0.123)	(0.034)	(0.065)	(0.025)
RnD	0.011***	0.038	0.011***	0.179***
	(0.002)	(0.146)	(0.001)	(0.068)
Inversed Mills Ratio	-0.590***	-0.224***	-0.609***	-0.250***
	(0.035)	(0.051)	(0.023)	(0.035)
Within-firm FDI share	1.481***	1.277**	1.839***	1.174***
	(0.284)	(0.516)	(0.178)	(0.376)
Horizontal	4.101***	0.309	1.074*	0.018

	(0.995)	(0.464)	(0.640)	(0.275)
Backward	9.453	0.348	3.755	1.134***
	(6.115)	(1.072)	(4.475)	(0.243)
Forward	5.077	-0.197	1.568	0.131
	(5.686)	(1.732)	(3.264)	(0.943)
Constant	-15.211***	-0.013	-13.555***	0.072***
	(3.431)	(0.018)	(2.306)	(0.014)
Number of Observations	14,317	6,495	38,395	17,067
R^2	0.224	0.011	0.179	0.023

Note: For the reason of concision, regional, sectoral and time dummies are not reported, but they are controlled and jointly significant in each regression..

*** $p<0.01$, ** $p<0.05$, * $p<0.1$ and numbers in parentheses are standard error.

Source: Authors' own calculation.

Table 10. Impact of FDI on domestic firms' export propensity: SOEs vs. non-SOE firms

	SOEs		Non-SOEs	
	OLS	FD	OLS	FD
Prod (TFP Index)	-0.008***	0.005***	-0.021***	0.003
	(0.002)	(0.001)	(0.004)	(0.002)
ln(K/L)	-0.003***	-0.002**	-0.013***	-0.003***
	(0.001)	(0.001)	(0.002)	(0.001)
Open Year	0.079***	-	0.111***	-
	(0.005)	-	(0.004)	-
D_Scale	-0.101***	-0.019***	-0.134***	-0.024***
	(0.011)	(0.003)	(0.009)	(0.003)
RnD	-0.000***	0.026**	0.000	0.070***
	(0.000)	(0.012)	(0.000)	(0.008)
Inversed Mills Ratio	-0.176***	0.057***	-0.257***	0.077***
	(0.010)	(0.007)	(0.012)	(0.008)
Within-firm FDI share	0.124***	0.132*	0.114***	0.088**
	(0.039)	(0.070)	(0.043)	(0.045)
Horizontal	0.029	0.030*	0.004	0.050**
	(0.068)	(0.016)	(0.087)	(0.020)
Backward	-0.175	0.029	-0.016	-0.006
	(0.514)	(0.033)	(0.678)	(0.036)
Forward	-0.306	-0.025	0.531	-0.037
	(0.502)	(0.066)	(0.530)	(0.106)
Constant	1.121***	-0.000	0.219	0.006***
	(0.188)	(0.001)	(0.250)	(0.001)
Number of Observations	14,317	6,495	38,395	17,067
R^2	0.444	0.018	0.508	0.019

Note: For the reason of concision, regional, sectoral and time dummies are not reported, but they are controlled and jointly significant in each regression..

*** $p<0.01$, ** $p<0.05$, * $p<0.1$ and numbers in parentheses are standard error.

Source: Authors' own calculation.

6   Conclusion

Using the firm-level census data of manufacturing industry during the period of 2000-2003, this paper examines the impact of FDI on domestic firms export in China. Spillovers to productivity from FDI has been studied in some depth in the literature but there is less work done on the effects of FDI on export performance.

We find that FDI firms have a positive impact on the export value of domestic firms in the upstream industries through the backward linkage and a positive impact on the export propensity of domestic firms in the same industry through the demonstration effects.

We further find that the positive impact on the export value of domestic firms through the backward linkage is mainly from the non-exporting FDI firms and is mainly to domestic non-state-owned enterprises.

Whereas, the positive impact on the export propensity of domestic firms in the same industry through demonstration effects is mainly from the exporting FDI firms and FDI firms producing heterogeneous products and is also mainly to domestic non-state-owned enterprises.

We also find that FDI firms producing homogeneous products generate positive export spillovers to domestic firms in the downstream industries through forward linkage, meaning that domestic firms can get intermediate inputs with good quality and cheap prices from upstream FDI firms producing homogeneous products. Thus, domestic firms can reduce the production cost, improve competitiveness and increase export.

However, our study does not find significant evidence that high exporting FDI firms and FDI firms producing heterogeneous products generate export spillovers to domestic firms through either backward or forward industrial linkages. An explanation is that FDI firms

with high export propensity and producing heterogeneous products are mainly engaged in processing trade. Because they are concentrated in the special processing zones and the import duty-free zones specifically designed for export-oriented FDI firms and import almost all the materials and intermediate inputs from overseas and export the processed and assembled products abroad, they have no or at most marginal backward and forward industrial linkages with domestic firms. We note that governments sometimes promote FDI flows in order to have spillover benefits to domestic firms. Our finding is that if the concern is export performance, then not all FDI has the same impact.

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Table 1. Major Economic Indicators of Domestic Firms: 2000-2003

	2000		2001		2002		2003		Total	
	Non-Exporting Domestic Firms	Exporting Domestic Firms	Non-Exporting Domestic Firms	Exporting Domestic Firms	Non-Exporting Domestic Firms	Exporting Domestic Firms	Non-Exporting Domestic Firms	Exporting Domestic Firms	Non-Exporting Domestic Firms	Exporting Domestic Firms
Number of Observation	88645	19401	97374	21136	99451	23839	109553	26347	395023	90723
Average output value (10000 yuan)	26323	116143	28201	117195	31783	123749	35684	141766	30741	125759
	(88986)	(638757)	(103926)	(693802)	(135355)	(764732)	(135689)	(975163)	(118983)	(792419)
Average number of employed workers (person)	234	765	213	640	206	579	193	546	210	623
	(507)	(2671)	(504)	(2390)	(561)	(2091)	(439)	(2010)	(503)	(2277)
Net value of fixed assets (10000 yuan)	6868	31888	6845	29766	6965	27252	6649	27441	6826	28884
	(43102)	(265715)	(54193)	(284308)	(59056)	(272385)	(43801)	(266796)	(50507)	(272210)
Average Intermediate Input Value (10000 yuan)	20271	89672	21765	91458	24451	95696	27225	108933	23611	97216
	(70230)	(496880)	(84692)	(553411)	(109044)	(604997)	(107446)	(766945)	(95237)	(624804)
Firms' Productivity (ln(TFP) Index)	1.06	0.95	1.06	0.95	1.06	0.95	1.07	0.98	1.06	0.96
	(0.83)	(0.76)	(0.81)	(0.75)	(0.81)	(0.75)	(0.84)	(0.81)	(0.82)	(0.77)
K/L ratio (10000 yuan/person)	27.2	25.0	29.5	24.7	29.7	24.6	30.7	25.1	29.4	24.9
	(107.1)	(88.8)	(101.6)	(53.4)	(60.8)	(48.5)	(60.7)	(62.8)	(84.1)	(64.1)

Note: Numbers in brackets are standard deviations.
Source: Authors' own calculation.

Table 2. Intra-sector FDI Firms' Output Share and Inter-sector FDI Impact: 2000-2003 (unit: %)

Sectors	2000			2001			2002			2003			Total		
	Hori_FDI	Down stream_FDI	Upstream_FDI	Hori_FDI	Down stream_FDI	Upstream_FDI	Hori_FDI	Down stream_FDI	Upstream_FDI	Hori_FDI	Down stream_FDI	Upstream_FDI	Hori_FDI	Down stream_FDI	Upstream_FDI
Processing of Food from Agricultural Products	15.1	4.5	1.7	17.0	4.8	1.8	16.9	4.6	1.7	17.2	4.6	1.8	16.6	4.7	1.7
Manufacture of Food	28.7	0.8	6.6	32.6	0.9	7.1	30.4	0.9	7.0	30.2	1.0	7.3	30.6	0.9	7.0
Manufacture of Beverage	19.5	0.3	6.1	21.3	0.4	6.4	23.1	0.4	6.3	25.0	0.4	6.4	22.3	0.4	6.3
Manufacture of Tobacco	0.1	0.0	1.4	0.3	0.0	1.3	0.2	0.0	1.4	0.2	0.0	1.3	0.2	0.0	1.4
Manufacture of Textile	13.3	8.6	3.7	14.2	8.8	3.3	14.7	8.8	3.7	16.4	9.1	3.5	14.8	8.8	3.5
Manufacture of Textile Wearing Apparel, Footware, and Caps	31.9	1.1	9.3	32.5	1.2	9.3	32.0	1.2	9.5	33.4	1.3	10.1	32.6	1.2	9.6
Manufacture of Leather, Fur, Feather and Related Products	41.7	2.3	5.8	40.1	2.4	6.1	39.3	2.4	6.0	38.8	2.6	6.4	39.8	2.5	6.1
Processing of Timber, Manufacture of Wood, Bamboo, Rattan, Palm, and Straw Products	17.8	7.2	3.7	16.6	7.6	3.9	16.1	7.9	4.0	18.8	8.3	4.2	17.3	7.8	4.0
Manufacture of Furniture	32.5	1.4	10.6	35.0	1.5	10.6	36.2	1.5	9.8	39.5	1.5	10.3	36.2	1.5	10.3
Manufacture of Paper and Paper Products	22.3	12.6	5.0	23.3	13.4	5.2	24.7	13.5	5.3	23.6	13.9	5.4	23.6	13.4	5.2
Printing, Reproduction of Recording Media	20.5	3.3	10.8	22.0	3.6	11.0	22.4	3.6	11.3	22.8	3.8	11.2	22.0	3.6	11.1
Manufacture of Articles For Culture, Education and Sport Activity	45.9	0.5	13.7	47.4	0.5	13.9	47.7	0.5	13.7	49.9	0.5	13.9	48.0	0.5	13.8

To be continued…

Table 2. Continued.

Sectors	2000			2001			2002			2003			Total		
	Hori_ FDI	Down stream _FDI	Upstre am_F DI	Hori_ FDI	Down stream _FDI	Upstre am_F DI	Hori_ FDI	Down stream _FDI	Upstre am_F DI	Hori_ FDI	Down stream _FDI	Upstre am_F DI	Hori_ FDI	Down stream _FDI	Upstre am_F DI
Processing of Petroleum, Coking, Processing of Nuclear Fuel	3.9	4.1	1.3	3.7	4.4	1.4	6.9	4.6	1.4	6.1	4.9	1.5	5.3	4.5	1.4
Manufacture of Raw Chemical Materials and Chemical Products	14.7	13.5	3.4	16.1	13.7	3.5	16.7	13.7	3.8	18.6	14.3	3.9	16.7	13.9	3.7
Manufacture of Medicines	11.2	0.1	4.5	10.5	0.1	4.7	11.4	0.1	4.7	11.3	0.2	4.9	11.1	0.1	4.7
Manufacture of Chemical Fibers	17.8	13.2	7.5	14.3	13.8	7.8	13.9	14.1	7.9	11.8	15.1	8.6	14.1	14.1	8.0
Manufacture of Rubber	25.1	10.2	5.8	25.3	11.0	5.8	28.3	11.1	6.0	27.0	12.1	6.3	26.5	11.2	6.0
Manufacture of Plastics	31.5	13.1	8.4	31.2	14.2	8.7	30.4	14.4	8.9	32.3	15.4	9.7	31.4	14.4	9.0
Manufacture of Non-metallic Mineral Products	11.6	5.3	5.2	12.6	5.9	5.3	12.5	6.0	5.5	11.5	6.4	5.7	12.1	6.0	5.4
Smelting and Pressing of Ferrous Metals	3.6	9.3	3.6	4.2	9.7	3.7	4.4	10.0	4.1	5.1	10.7	4.1	4.4	10.0	3.9
Smelting and Pressing of Non-ferrous Metals	7.2	14.5	3.3	7.6	15.1	3.4	7.3	15.4	3.6	8.5	16.3	3.6	7.7	15.4	3.5
Manufacture of Metal Products	26.1	8.0	5.7	25.2	8.7	5.6	25.8	8.9	5.5	25.3	9.5	6.0	25.6	8.9	5.7
Manufacture of General Purpose Machinery	13.5	5.9	7.6	13.7	6.6	7.8	15.8	6.6	7.6	17.8	7.3	8.0	15.4	6.7	7.8
Manufacture of Special Purpose Machinery	9.8	1.8	9.1	13.0	1.9	9.4	12.7	1.9	9.5	14.7	2.1	10.2	12.7	1.9	9.6

To be continued…

Table 2. Continued.

Sectors	2000			2001			2002			2003			Total		
	Hori_FDI	Downstream_FDI	Upstream_FDI	Hori_FDI	Downstream_FDI	Upstream_FDI	Hori_FDI	Downstream_FDI	Upstream_FDI	Hori_FDI	Downstream_FDI	Upstream_FDI	Hori_FDI	Downstream_FDI	Upstream_FDI
Manufacture of Transport Equipment	16.5	1.1	6.1	18.3	1.2	6.2	18.2	1.3	6.4	21.9	1.3	6.8	18.9	1.2	6.4
Manufacture of Electrical Machinery and Equipment	23.8	8.7	10.9	24.1	9.9	11.1	24.7	10.1	10.9	26.4	10.9	11.3	24.9	10.0	11.1
Manufacture of Communication Equipment, Computers and Other Electronic Equipment	47.1	2.5	5.2	54.7	2.7	5.4	55.0	2.8	5.3	59.3	2.9	5.4	54.7	2.8	5.3
Manufacture of Measuring Instruments and Machinery for Cultural Activity and Office Work	52.1	4.3	18.1	57.9	4.6	19.6	57.7	4.7	18.5	59.8	5.1	19.3	57.3	4.7	18.9
Manufacture of Artwork and Other Manufacturing	31.7	5.7	5.8	31.8	6.0	5.8	33.9	6.2	5.9	30.8	6.6	6.0	32.1	6.2	5.9
All Manufactures	20.3	6.2	6.2	21.5	6.6	6.3	22.1	6.7	6.4	23.1	7.2	6.7	21.9	6.7	6.4

Source: Authors' own calculation.

Table 3. Domestic firms' exports Behaviour by Sectors: 2000-2003

Sectors	Items	2000	2001	2002	2003	All Firms
Processing of Food from Agricultural Products	Average Export Proportion (%)	51.9	53.0	52.0	52.8	52.4
	Number of Exporting Firms	813	790	885	987	3,475
Manufacture of Food	Average Export Proportion (%)	55.0	55.0	53.4	54.3	54.4
	Number of Exporting Firms	371	371	400	431	1,573
Manufacture of Beverage	Average Export Proportion (%)	39.9	41.4	44.0	42.9	42.1
	Number of Exporting Firms	189	193	213	232	827
Manufacture of Tobacco	Average Export Proportion (%)	5.9	5.5	3.7	3.8	4.6
	Number of Exporting Firms	38	34	44	43	159
Manufacture of Textile	Average Export Proportion (%)	55.4	56.3	55.8	57.6	56.3
	Number of Exporting Firms	2,736	3,026	3,231	3,503	12,496
Manufacture of Textile Wearing Apparel, Footware, and Caps	Average Export Proportion (%)	82.7	83.4	81.8	82.0	82.4
	Number of Exporting Firms	1,896	2,196	2,698	2,850	9,640
Manufacture of Leather, Fur, Feather and Related Products	Average Export Proportion (%)	79.1	77.0	77.7	79.7	78.4
	Number of Exporting Firms	711	906	1,033	1,224	3,874
Processing of Timber, Manufacture of Wood, Bamboo, Rattan, Palm, and Straw Products	Average Export Proportion (%)	66.5	67.4	64.8	67.9	66.7
	Number of Exporting Firms	259	334	371	420	1,384
Manufacture of Furniture	Average Export Proportion (%)	66.4	66.8	66.7	69.5	67.7
	Number of Exporting Firms	161	181	240	323	905
Manufacture of Paper and Paper Products	Average Export Proportion (%)	42.6	40.2	37.0	35.7	38.8
	Number of Exporting Firms	248	247	264	266	1,025
Printing, Reproduction of Recording Media	Average Export Proportion (%)	29.4	31.5	39.4	37.1	35.0
	Number of Exporting Firms	68	70	87	112	337
Manufacture of Articles For Culture, Education and Sport Activity	Average Export Proportion (%)	73.9	77.8	76.1	78.1	76.7
	Number of Exporting Firms	462	552	662	736	2,412
Processing of Petroleum, Coking, Processing of Nuclear Fuel	Average Export Proportion (%)	36.6	23.9	29.4	18.0	28.7
	Number of Exporting Firms	106	52	128	64	350
Manufacture of Raw Chemical Materials and Chemical Products	Average Export Proportion (%)	34.2	34.0	32.5	39.7	35.3
	Number of Exporting Firms	1,387	1,398	1,482	1,722	5,989
Manufacture of Medicines	Average Export Proportion (%)	35.7	35.6	34.7	34.8	35.2
	Number of Exporting Firms	500	528	539	571	2,138

To be continued…

Table 3. Continued.

Sectors	Items	2000	2001	2002	2003	All Firms
Manufacture of Chemical Fibers	Average Export Proportion (%)	19.4	24.6	25.3	23.4	23.3
	Number of Exporting Firms	60	70	75	70	275
Manufacture of Rubber	Average Export Proportion (%)	41.6	37.4	38.3	39.9	39.3
	Number of Exporting Firms	244	233	256	260	993
Manufacture of Plastics	Average Export Proportion (%)	53.9	55.7	54.5	56.7	55.3
	Number of Exporting Firms	590	617	756	870	2,833
Manufacture of Non-metallic Mineral Products	Average Export Proportion (%)	47.8	49.7	50.0	51.6	49.9
	Number of Exporting Firms	845	927	991	1,171	3,934
Smelting and Pressing of Ferrous Metals	Average Export Proportion (%)	35.8	32.3	33.6	31.3	33.3
	Number of Exporting Firms	259	239	246	265	1,009
Smelting and Pressing of Non-ferrous Metals	Average Export Proportion (%)	34.3	28.6	33.3	34.6	33.2
	Number of Exporting Firms	245	193	275	407	1,120
Manufacture of Metal Products	Average Export Proportion (%)	62.7	63.8	65.6	66.0	64.7
	Number of Exporting Firms	1,143	1,289	1,473	1,645	5,550
Manufacture of General Purpose Machinery	Average Export Proportion (%)	38.4	40.0	41.1	42.5	40.7
	Number of Exporting Firms	1,486	1,622	1,779	2,041	6,928
Manufacture of Special Purpose Machinery	Average Export Proportion (%)	22.0	23.4	23.5	25.8	23.7
	Number of Exporting Firms	809	748	813	847	3,217
Manufacture of Transport Equipment	Average Export Proportion (%)	31.7	35.1	33.5	36.0	34.2
	Number of Exporting Firms	732	734	888	989	3,343
Manufacture of Electrical Machinery and Equipment	Average Export Proportion (%)	40.6	45.8	49.1	51.7	47.4
	Number of Exporting Firms	1,019	1,195	1,382	1,579	5,175
Manufacture of Communication Equipment, Computers and Other Electronic Equipment	Average Export Proportion (%)	45.1	45.7	42.1	45.0	44.4
	Number of Exporting Firms	542	592	661	734	2,529
Manufacture of Measuring Instruments and Machinery for Cultural Activity and Office Work	Average Export Proportion (%)	41.0	40.9	42.8	51.7	44.8
	Number of Exporting Firms	284	320	330	441	1,375
Manufacture of Artwork and Other Manufacturing	Average Export Proportion (%)	82.0	84.0	83.2	83.7	83.3
	Number of Exporting Firms	1,198	1,479	1,637	1,544	5,858
All Manufactures	Average Export Proportion (%)	52.8	55.1	55.2	56.7	55.1
	Number of Exporting Firms	19,401	21,136	23,839	26,347	90,723

Source: Authors' own calculation.

Appendix Table 1, Estimation Results from the Probit Model in the First Stage: 2001-2003

	2001	2002	2003
Dependent variable: D_Export			
Prod (TFP Index)	0.134***	0.042*	0.059***
	(0.029)	(0.021)	(0.016)
ln(K/L)	-0.033***	-0.051***	-0.066***
	(0.007)	(0.006)	(0.005)
Open Year	0.002**	0.006***	0.011***
	(0.001)	(0.001)	(0.001)
D_Scale	-0.374***	-0.300***	-0.421***
	(0.024)	(0.022)	(0.021)
RnD	0.606***	0.628***	0.550***
	(0.055)	(0.046)	(0.047)
Firm FDI Share	1.728***	1.659***	1.416***
	(0.239)	(0.219)	(0.223)
Previous Exporting Experience (ID Variable)	2.672***	3.092***	3.476***
	(0.018)	(0.020)	(0.023)
Constant	-5.180***	-13.313***	-23.651***
	(1.181)	(1.093)	(1.138)
Sector Dummies	Yes	Yes	Yes
Region Dummies	Yes	Yes	Yes
LR Chi2(61)	43972.27	52173.04	55188.1
Pseudo R-squared	0.630	0.572	0.568
Number of Observations	70076	88519	70076

Note: For the reason of concision, regional, sectoral and time dummies are not reported, but they are controlled and jointly significant in each regression.

   *** $p<0.01$, ** $p<0.05$, * $p<0.1$ and numbers in parentheses are standard error.

Source: Authors' own calculation.