Uncovering Horizontal Spillovers: When Foreign and Domestic Firms Share Common Local Input Suppliers*

Hiau Looi Kee‡

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Abstract

Based on a representative firm sample of Bangladeshi garment industry, this paper shows that the increased presence of FDI firms in the industry causes those domestic firms that share common local input suppliers with the FDI firms to gain in terms of product scope and efficiency. These results are supported by reduced form and structural regressions, derived from a multi-product firm model with a production technology that has love in variety in inputs. At the sample mean, FDI firms explain one third of the productivity gains within domestic firms. FDI firms help promote new local input variety while improve the quality of existing local inputs. By focusing on the use of common local input suppliers between FDI and domestic firms, this paper presents a plausible channel for horizontal spillovers to materialize.

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Keywords: Foreign direct investment, horizontal spillovers, backward linkages, local input suppliers

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†Development Research Group, The World Bank, Washington, DC 20433, USA; Tel. (202)473-4155; Fax: (202)522-1159; e-mail: hlkee@worldbank.org
“LSI manufactures garment accessories in Bangladesh since 1999. Among other factors, serving FDI garment firms was an important reason for us to set up our plant in Dhaka, EPZ. At the beginning, the share of FDI garment firms in our total sales was about 20%. Now it is 35-40%. Many Bangladeshi garment firms benefitted from LSI working with FDI garments firms, and to comply to the standard of FDI garment firms ... which requires LSI to upgrade and expand product range, capacity, efficiency, and to reduce our costs and lead time. Moreover, LSI always shares the market intelligence we learned from our FDI garment clients regarding the latest product requirements and fashion trend with our other clients. Thus, the domestic garment firms that buy from us can further improve themselves based on the information.” – Rachel Wu, Managing Director, LSI LTD, November 2010.

1 Introduction

Many countries provide financial incentives such as tax holidays or subsidies, and import duty exemptions to attract foreign direct investment (FDI). Besides job creation, the presence of FDI is expected to generate benefits in the domestic economy through some unmeasured “productivity or technology spillover effects.” Such policies could be justified in theory. For example, Findlay (1978) provides a dynamic model to show the role of FDI firms in transferring technology from the advanced to the backward countries. Rodriguez-Clare (1996) further specifies the channel via which such spillover may take place, which is when FDI firms lead to the establishment of local industrial sectors that supply to the industry they operate in and boost the productivity of all domestic firms that use local inputs. Finally, focusing more on pecuniary externalities, Markusen and Venables (1999) presents an analytical model where FDI firms may act as a catalyst for industrial development if they generate enough demand to support the upstream industry through backward linkages, which further foster the downstream industry through forward linkages. However, this may be an area where policies and theories are ahead of evidence.

To date, evidence of “horizontal” spillover effects – the productivity boost to the domestic firms due to the presence of foreign or multinational firms in the same industry, have been quite elusive. While earlier papers based on case studies (e.g. Caves, 1974) or cross industry evidence
(e.g. Blomstrom and Persson, 1983; Blomstrom and Wolff, 1994) tend to conclude that there exists a positive correlation between the presence of FDI in an industry and the average productivity of domestic firms, recent papers based on firm or plant level statistics have found the opposite. Aitken and Harrison (1999) is first to cast doubt on the horizontal spillover hypothesis using a panel of Venezuelan firms. They find that the productivity of domestic firms is negatively correlated with the presence of foreign firms in the same industry, because foreign firms intensify market competition and force the domestic rivals to produce at a suboptimal scale. Haddad and Harrison (1993), Djankov and Hoekman (2000) and Konings (2001) use data sets from other developing countries and arrive to similar results.\textsuperscript{1} Not only do these empirical results contradict the theoretical findings, they also challenge governments’ efforts in using financial incentives to attract FDI, leaving the policy makers and theorists in limbo.\textsuperscript{2} Such unresolved puzzles deserve further investigation.

However, it is possible that the existing empirical papers may have overlooked potential horizontal spillover by relating the presence of foreign firms in an industry to the productivity of domestic firms in the same industry, without going through the backward linkage channel as suggested in theories. This is the point of departure for this paper. Putting backward linkages front and center, this paper specifically looks for evidence of productivity spillover of FDI firms when they share common local input suppliers with domestic firms. A firm level data set of Bangladesh’s garment sector is specifically collected to study this issue.\textsuperscript{3,4} The data set consists on a stratified random sample of 10 percent of the domestic firms and 100 percent of the FDI firms in the apparel sector of Bangladesh.\textsuperscript{5} Each of these firms is asked to identify their top three local input suppliers. It is therefore possible to link domestic firms only to a subset of FDI firms that share their local input suppliers within an industry, and not rely on using the presence of all foreign firms in an industry.

\textsuperscript{1}One exception is Haskel, Pereira and Slaughter (2007), who found a small but statistically significant evidence for positive spillovers in a study of UK manufacturing plants.

\textsuperscript{2}For an excellent review of this topic, please refer to Harrison and Rodriguez-Clare (forthcoming).

\textsuperscript{3}In 2004, this data set was collected by the World Bank jointly with the government of Bangladesh in order to study the effect of FDI on domestic garment firms. The ultimate purpose of the project is to inform the government whether it is worthwhile to liberalize the garment sector for more FDI in anticipation of the end of Multi-Fiber Agreement in 2005. Many restrictions have been removed since then given the findings of positive spillovers in the previous draft of this paper in the Bank’s report.

\textsuperscript{4}Demitova, Kee and Krishna (2006) also uses the same data set to study the sorting behavior of firms when they face very different demand shocks and trade policy regimes in different markets.

\textsuperscript{5}There are only about 49 FDI garment firms in Bangladesh at the time the survey was collected and I made sure that we visited all of them. However not all firms provide all information necessary for the regression analysis. After dropping firms that have incomplete data, I am left with 41 FDI firms.
For the ease of discussion in this paper, two firms are considered *siblings* if they share a common local supplier. For each firm, the presence of its FDI siblings in an industry is hereafter referred to as *sibling foreign presence*. And given that we have all the FDI firms in the sample, we have the complete list of the top three local suppliers that work with FDI firms in Bangladesh to construct sibling foreign presence for each of the domestic firms in the data set. The main identification strategy of this paper is thus to relate the productivity of domestic firms to its sibling foreign presence, i.e. to relate domestic firm’s productivity to the presence of their FDI siblings in an industry.

There are possibly two reasons to believe that horizontal spillover may exist among domestic firms and their FDI siblings. First, it is through input variety. As mentioned before, a FDI-induced agglomeration effect may lead to an expansion of local intermediate input variety which creates positive externalities on domestic firms that use those inputs. Rodriguez-Clare (1996) nicely provides a theoretical framework to formalize this idea. In the paper, he assumes that there is love of variety for inputs in the final good production. Thus an increase in input variety due to the presence of multinational firms raises the productivity of domestic firms. In other words, clustering of foreign firms helps support a more sophisticated local intermediate input industry, which indirectly benefits those domestic firms in the same final good industry as more and more of these specialized inputs are now locally available (Marshall, 1920). Second, it is through input quality or the efficiency of input suppliers. FDI firms may make their local input suppliers “better,” and indirectly benefit their domestic siblings. As shown in Javorcik (2004) and Javorcik and Spatareanu (2009), FDI firms may transfer technology to their local suppliers which make them more productive. It is therefore conceivable that some of these superior technology or productivity gains may benefit the domestic firms that use the same local suppliers. In fact, a recent paper by Lin and Saggi (2007) nicely provides a theoretical model motivated by this exact channel of spillover. In the model, FDI firms and their local suppliers may agree to exclusivity in order to foreclose productivity or technology spillover to domestic firms. However, even without the transferring of technology, it could also be because working with FDI firms that often come with larger and more reliable orders, the local suppliers may achieve economy of scales, improve product quality and consistency, which indirectly benefit the domestic firms that use them.

Access to better and more intermediate input variety has been shown to be important in explaining firm productivity gains in some recent papers, in the context of trade liberalization. Using
firm level data on Indonesia and India, Amiti and Konings (2007) and Goldberg, Khandelwal, Pavcnik and Topalova (forthcoming), successfully establish the causal relationship between trade liberalization and productivity gains of domestic firms when these firms have access to new and improved imported inputs once tariffs on intermediate inputs are lowered. In the same spirit, this paper argues that the presence of FDI firms may also facilitate domestic firms to have better access to new or improved local input varieties, which boost the productivity of domestic firms. This is possible, if the presence of FDI firms indeed induced entry into the upstream industries as suggested in Rodriguez-Clare (1996) and Markusen and Venables (1999). Figure 1 presents just that, where the number of FDI firms in the garment industry is plotted alongside the number of local input suppliers in the upstream industries in Bangladesh from 1984 to 2003.6 Not only are the two series closely correlated, results from least squares regressions further confirm that the number of FDI firms in the garment industries can explain the number of local input suppliers, even after controlling for the number of domestic garment firms and a time trend. Granger causality tests also suggest that at this aggregate level, FDI firms granger-cause number of local input suppliers to increase and not the reverse.7 Whether these rising local suppliers help facilitate spillover between FDI and domestic firms is the subject of our empirical exercise further on in this paper, the message Figure 1 is conveying is that there exists a conducive environment for spillover to take place, as suggested in theories. Thus, in a way, a liberal FDI regime may compensate for an environment with high trade costs, due to tariffs, transport or communication costs, if the local intermediate good sectors can produce more input varieties to satisfy the captured customers in the downstream industries. Note that during the sample period, Bangladesh does not have any significant changes in their tariff policies and garment exporters enjoy duty drawbacks on imported inputs.

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6 Data on the number of local input suppliers is constructed by searching on-line the year of establishment of each of the local input suppliers provided by all the firms in the current survey.

7 I did the following two versions of Granger Causality tests (one in level and one is detrend):

\[
\begin{align*}
F DI_t &= \beta_0 + \beta_1 F DI_{t-1} + \beta_2 Suppliers_{t-1} + \varepsilon_{1t} \\
Suppliers_t &= \gamma_0 + \gamma_1 F DI_{t-1} + \gamma_2 Suppliers_{t-1} + \varepsilon_{2t}
\end{align*}
\]

(1)

\[
\begin{align*}
F DI_t &= \beta_0 + \beta_1 F DI_{t-1} + \beta_2 Suppliers_{t-1} + \beta_3 trend_t + \varepsilon_{1t} \\
Suppliers_t &= \gamma_0 + \gamma_1 F DI_{t-1} + \gamma_2 Suppliers_{t-1} + \gamma_3 trend_t + \varepsilon_{2t}
\end{align*}
\]

(2)

In both version, F-tests reject the null hypothesis that \( \beta_2 = 0 \), with a 95% confidence level, while fail to reject the null hypothesis that \( \gamma_1 = 0 \).
Besides the information on local suppliers, there are other traits of this data set that made it well suited for this study. There is information in the data to construct firm specific price indexes on output and materials, which significantly improve the measurement of firms’ output and productivity. Without firm specific output prices, most papers in the literature have been using some industry price indexes to deflate revenue of all firms in order to obtain their output level. Given that more productive firms likely to have a lower-than-average firm specific price, the use of industry price indexes may systematically underestimate the output of the more productive firms and therefore underestimate their productivity. The converse is true for the less productive firms. This paper is able to overcome such biases by using the firm specific prices. Equally important is the used of firm specific material prices to deflate material costs. There may be a concern that the presence of FDI firms may drive up prices for the intermediate inputs for those domestic firms that share their common local input suppliers. This will cause material costs for domestic firms to be higher. However, given that we have firm specific material prices, we are deflating the higher material costs with the higher prices, which will not affect the quantity of material used, and therefore not affecting the productivity estimation. If instead of firm specific material price, we use industry material price to deflate the higher material costs, we will over-estimate the quantity of material used, and therefore underestimate the productivity of domestic firms that used common input suppliers with the FDI firms. This also highlights that the results of this paper is not driven by pecuniary externality due to the presence of FDI firms.

In addition, this data set has product and destination specific sales information of each firm, from which we can construct a product linkage and a market linkage variable to control for product or market specific demand shocks driven by changes in consumer preference or trade policies. These variables also control for possible horizontal spillover from FDI firms to those domestic firms that produce same products or exporting to same market. Finally, given that sibling foreign presence, which is the presence of the foreign siblings of each firm, is time-varying firm specific, in addition to firm fixed effects, we can also control for industry-region-year fixed effects in a panel regression to wipe out all time-varying industry level omitted variables such as government policies, aggregate productivity and demand shocks, and market competition. This is in sharp contrast with the previous literature which relies on the presence of all FDI in an industry to identify horizontal spillover, when the variable is by construction common across all firms within an industry and may
be influenced by other time varying industry variables. By looking at sibling foreign presence, the channel for horizontal spillover is also better specified.

The main challenge of using sibling foreign presence to identify productivity spillover is endogeneity, given that it depends on firms’ choice of local suppliers and may be correlated with the productivity of the firms. However, firm fixed effects are included in all the regression specifications, so the endogeneity issue only arrives if within firm increase in sibling foreign presence is correlated with productivity change of domestic firms. In other words, the choice of local suppliers that are constant through out the sample period will not affect estimation. Nevertheless, sibling foreign presence may change within firm over time due to the following reasons. First, is the increase in the number foreign siblings due to domestic firms choose to buy from new local suppliers or new FDI firms buy from the existing local suppliers of domestic firms. This typically leads to a within firm jump in sibling foreign presence from year to year; Second, it is because the presence of foreign siblings may increase over time as some of the foreign siblings expand their investment. This generally shows up as a more gradual increase in sibling foreign presence. Third, it could be because other firms expand their market share and cause the market share of FDI siblings to decrease. These changes may be subjected to selection bias and endogeneity issues. For example, domestic firms that are becoming more productive over the year may select to work with new local suppliers that sell to FDI firms and cause their sibling foreign presence to increase. Alternatively, it could be because local suppliers exogenously become better over time and improve the productivity level of all their clients, domestic and FDI firms alike, and the FDI firms respond by investing more and increase their presence in the industry. This effect may also drive the positive correlation within firm between domestic firm productivity and sibling foreign presence. Finally, up and rising domestic firms may respond to their positive productivity shocks by expanding their market share and cause their siblings market shares to decrease. This effect may lead to a negative correlation between domestic firm productivity and sibling foreign presence.

To address these issues we exploit an unanticipated trade policy shock in the EU that causes the sibling foreign presence of domestic firms to change exogenously, without any direct impact on the productivity of these domestic firms. In 2000, the EU unexpected announced that it will implement Everythin-But-Arm (EBA) Initiative which formally provides duty free and quota free access for all products from the 48 Least Developed Countries (LDS), including Bangladesh. Depend on the
sub-industry and export destinations, different FDI firms in Bangladesh reacted very differently to such policy announcement – while those woven FDI firms that export to the EU increase their investment and hence their market presence, their reaction cause the market presence of those FDI firms that do not export to the EU to decrease. Such reshuffling of market presence among FDI firms exogenously affect the sibling foreign presence for domestic firms – domestic firms that have FDI siblings exporting to the EU may see an increase in their sibling foreign presence, while domestic firms that have FDI sibling do not export to the EU experienced a decrease in their sibling foreign presence. We relate such exogenous changes in the sibling foreign presence to the within firm changes in firm performance of domestic firms to identify horizontal spillover.

Firm performance indicators or measurements are themselves a hotly research area. While the literature have been focusing on the unobserved firm productivity to study spillover, this current paper looks at multiple firm performance measures, which include product scope per worker, sales per worker, output per worker and estimated TFP (OLS and augmented Olley-Pakes due to Ackerberg, Benkerd, Berry and Pakes (forthcoming)). This is because the unobserved firm productivity may be subjected to unknown estimation and measurement errors. By looking at a wider range of performance indicators, the results of the paper are not specific to the way firm productivity is measured. Nevertheless these different performance indicators yield are very similar and consistent results. In a reduced form setting, sibling foreign presence is positively correlated with product scope per worker, sales per worker, output per worker and the TFP of the domestic firms, a result that is consistent with the horizontal spillover hypothesis. The IV regressions further confirm that sibling foreign presence cause the performance of domestic firms to be better. At the sample mean, sibling foreign presence is shown to explain about a third of the productivity gain within firms over the 5 year sample period. This result is robust to the controlling for firm fixed effects, firm specific time trend, industry-region-year fixed effects, and other firm level variables. The results hold even in the subsample of firms do not export to the EU whose performance should not be affected by EBA other than through sharing common local input suppliers with those FDI firms that export to the EU. Moreover, in a placebo experiment when FDI siblings are randomly assigned to domestic firms, sibling foreign presence becomes insignificant, suggesting that the original matching of domestic firms to FDI firms that share local suppliers are not spurious. Controlling for the links between domestic firms and FDI firms through their product space and export markets do not
change the results. The horizontal spillover result is also not driven by those firms that were set up by the ex-employees of FDI firms, which may be another source of horizontal spillover.

To reconcile our finding of positive horizontal spillover with the existing literature which often finds negative or insignificant horizontal spillover, we redo the above reduced form estimations using the conventional industry foreign presence variable, instead of our sibling foreign presence variable. Controlling for firm and year fixed effects, the results shows that industry foreign presence is indeed negatively correlated to the productivity of domestic firms. This reproduces the market stealing effect of FDI firms. However this finding hides tremendous heterogeneity among domestic firms, given that some domestic firms share common suppliers with FDI firms, some share common products and/or markets with FDI firms. When we interact industry foreign presence with dummy variables for domestic firms that share suppliers with FDI firms, domestic firms that share product space with FDI firms and domestic firms that share markets with FDI firms, only in the case when domestic firms have FDI siblings that we find statistically significant effect and it is positive. The negative effect on domestic productivity due to the industry presence of FDI firms is no longer statistically significant. This is true even after we control for aggregate demand and productivity shocks. Finally, to examine the hypothesis that FDI firms cause the local input variety to increase which subsequently increases the productivity of domestic firms, we rely on structural regressions, derive directly out of a simple multi-product firm model when firms have love of variety in inputs similar to Ethier (1982) and Rodriguez-Clare (1996). The model shows that firm’s TFP can be decomposed into two terms, one depends positively on input variety and one depends on unobserved firm productivity. In addition, the product scope of firm depends positively on input variety, unobserved productivity and real input prices. Through instrumental variable regressions, we show that exogenous increase in FDI firms in the garment sector causes the number of local input variety to increase, which lead to statistically significant productivity and product scope gains for domestic firms.

In many ways finding horizontal spillover effects in the Bangladeshi garment sector may not be a total surprise. After all, some have regarded the Bangladeshi garment sector as the shining success story whereby in the early 1980s FDI firms help creating a vibrant industry in a least developed country (Rhee, 1990; Aitken, Hanson and Harrison, 1997). Thus results in this paper may not be generalized to other countries. However, the result in this paper may suggest one possible reason
why many have not found significant spillover in other developing countries could be because the absence of backward linkages from FDI firms. Even after careful controlling of simultaneity and omitted variable bias, if FDI firms are very different and do not share common local suppliers with domestic firms, then it may be hard for horizontal spillover to materialize. Thus, one policy message could be that to facilitate horizontal spillover, governments should attract foreign investments that may have significant backward linkages with the domestic economy and may share common local input suppliers with domestic firms.

The rest of the paper is organized as follows: Section 2 describes the theories and intuition behind horizontal spillover effects and defines the key variables of the paper. Section 3 describes the data set. Regression results are presented in Section 4. Section 5 concludes. Appendix of the paper provides some details on the construction of firm specific price index and the estimation of firm productivity.

2 Horizontal Spillover of FDI: Theories, Intuitions and Definitions

The theories and intuitions of horizontal spillover effects of FDI, whereby domestic firms benefit from the presence of foreign firms in the same industry, stem from the potential positive externalities generated due to a FDI-induced agglomeration. In the classic *Principles of Economics*, Marshall (1920) details possible benefits of such industry agglomerations. First is technology or knowledge spillover among firms through contact of employees, where “if one men starts a new idea, it is taken up by others and combined with suggestions of their own; and thus it becomes the source of further new ideas.” Second is through backward linkages that the clustering of firms increases the industry demand for specialized inputs, which may lead to “the growth of subsidiary trades,” proliferation and improvement of local input varieties and create positive externalities on all firms that use these specialized inputs. Third is it provides a “market for special skills and highly specialized machinery,” which reduces search costs for firms. It is therefore quite promising that by attracting foreign firms to set up subsidiaries in a host country, the domestic firms may reap some of these Marshallian externalities and become more productive. This is particularly so when these foreign subsidiaries are often found to receive some exclusive technology or trade secretes from their parent companies in the developed countries, and are often more productive than their local counterparts
in the developing countries (see Aitken and Harrison, 1999).

While there is no wide spread support for the horizontal spillover of FDI in general to date, this paper focuses on a case where we may expect to observe horizontal spillover. This is when FDI firms and domestic firms share a common local supplier, or, using the jargon of this paper, when they are siblings. The data set consists of a sample of garment firms in Bangladesh, spreading across the woven and non-woven industries. The local suppliers are those firms that produce intermediate inputs and garment accessories, such as fabrics, threads, zippers, buttons and labels in Bangladesh. The hypothesis here is that foreign firms, by buying local buttons or zippers, generate positive externalities to their domestic siblings in the same industry. The reasons such positive externalities may exist could be the following.

First, as the presence of foreign firms leads to an expansion in the local intermediate input industries, those domestic firms that actually use these local inputs are directly reaping this second Marshallian externality. Rodriguez-Clare (1996) provides a theoretical model to formalize this idea. He assumes (i) love of variety for inputs in the final good production, (ii) domestic firms must buy all their inputs locally, and (iii) increasing returns to scale in the production of inputs. Hence, by increasing the demand for inputs, a final good FDI firm helps “bring forth a greater variety of specialized inputs, thus generating a positive externality to other final good producers.” A finding that the productivity of domestic firms are positively correlated with the presence of their FDI siblings could lend support to this theoretical model which has yet been substantiated.

Second, FDI firms may improve the quality and productivity of local suppliers and indirectly benefit those domestic firms that use these suppliers. Besides the increase in local input variety due to the presence of foreign firms, existing local suppliers may become more productive and consistent as they do more business with the FDI firms. Javorcik (2004) provides empirical evidence for such phenomenon, which is also known as the “vertical spillover” of FDI. This could be driven by technology transfer from FDI firms to the local suppliers, or tighter quality control imposed by FDI firms on the local suppliers. It may also be because the local suppliers achieve economy of scales by working with FDI firms which are typically much larger. Consequently, it benefits the domestic firms that use these suppliers.

Note that it may not be possible to empirically separate the above two reasons for spillover to take place among siblings. It is that the presence of foreign firms causes both quality upgrading
and variety expansion in the local input market simultaneously. Casual inspections of the current data set suggest that this is indeed the case. Some of the local suppliers are themselves subsidiaries of very successful multinational firms, such as YKK (Bangladesh), a subsidiary of the Japanese YKK group which is the world largest zipper producer, and Coats (Bangladesh), a subsidiary of Coats Plc. which is the global leader in sewing threads from the UK. When these suppliers come to Bangladesh to serve the domestic markets, particularly the FDI garment firms in Bangladesh, both the quality and variety of locally available inputs significantly improved and benefits other domestic firms that use these inputs.

Here are some examples of siblings in our data set. Euro Mode Fashion LTD is a 100 percent foreign own garment firm from South Korea. Its main product lines include men’s and women’s jackets. It has listed R.M. Interlining as one of its top three local suppliers. Interlining is the material added between the top fabrics and the lining of a jacket to give extra warmth. There are many domestic firms that make jackets, but only New Star Fashions LTD listed R.M. Interlining as one of its top three suppliers. So for this paper, Euro Mode Fashion LTD and New Star Fashions LTD are considered siblings. Euro Mode Fashion also listed LSI Industries as one of its top suppliers. LSI Industries is a Taiwanese firm in Bangladesh that specialized in garment accessories that are widely used by many Bangladeshi garment firms, including Tammam Design LTD. Besides LSI Industries, Tammam Design also uses Beximco, which is a Bangladeshi textile producer, supplying to FCI (BD) LTD, a fully British own garment firm and Beximcom Fashions, a joint venture garment firm between Bangladesh and UK. So Tammam Design has three FDI siblings. With these sibling relationships in mind, we define the following variables.

**Definition 1** Foreign presence \((FP_{it})\) of firm \(i\) in year \(t\) is the product of firm \(i\) foreign ownership share \((FS_i)\) and its capital share in industry \(j\) in year \(t\),

\[
FP_{it} = \sum_{i \in j} \frac{K_{it}}{K_{it}} FS_i. \tag{3}
\]

It captures how much influence the foreign capital each firm has in the industry, with influence being measured by the share each firm in industry capital stock.

In the original specification, Aitken and Harrison (1999) uses employment share to measure the
influence of firms in an industry. Given that employment is likely to be endogenous to contemporary changes in firm productivity, while by construction, capital is predetermined by the investment in period \( t - 1 \), here we use capital share. Aitken and Harrison (1999) also find that using capital share yield similar results.

**Definition 2** Industry foreign presence \((IFP_{jt})\) in industry \( j \) in year \( t \), is the sum of firm foreign presence across all firms in \( j \) in \( t \),

\[
IFP_{jt} = \sum_{i \in j} FIPS_i = \frac{\sum K_{it} FIPS_i}{\sum K_{it}}. \tag{4}
\]

It is also equivalent to averaging the foreign ownership share of each firm in the industry, with weight equals to each firm’s capital share in the industry.

**Definition 3** Let \( S_{it} \) be the set of local suppliers of firm \( i \) in year \( t \). Then firm \( i \) and firm \( k \) are siblings in \( t \) if \( S_{it} \cap S_{kt} \neq \emptyset \). Consequently, \( \forall s \in S_{it} \), dummy variable, \( S^s_{ikt} \), equals one, if \( s \in S_{kt} \), or

\[
S^s_{ikt} = \begin{cases} 
1, & \text{if } s \in S_{it} \cap S_{kt} \\
0, & \text{if } s \notin S_{it} \cap S_{kt}
\end{cases}. \tag{5}
\]

In other words, \( S^s_{ikt} \) is a supplier specific sibling dummy that indicates whether supplier \( s \) is a common supplier of \( i \) and \( k \) in year \( t \). Alternatively, let \( NS_{ikt} \) be the total number of common suppliers between \( i \) and \( k \) in \( t \),

\[
NS_{ikt} = \sum_{s \in S_{it}} S^s_{ikt}. \tag{6}
\]

Then \( i \) and \( k \) are siblings in \( t \) if \( NS_{ikt} \geq 1 \).

Note that sibling firms in our context have nothing to do with their ownership structure, and certainly do not imply that they share same parent firms or are part of the same conglomerate group. Moreover, even though we only have information of the set of local suppliers for each firm in 2003, some suppliers are only available in the later part of the sample period. For firms that use

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\(^8\)see Appendix on construction of capital and productivity estimation.
these newer suppliers, their sets of local suppliers exhibit year to year variations. This is why $S_{it}$ and $S^s_{ikt}$ are indexed by $t$.

**Definition 4** Sibling foreign presence ($SFP_{it}$) of firm $i$ in year $t$, is constructed by summing the foreign influence of all siblings of $i$ in $t$ from all the local suppliers of $i$,

$$SFP_{it} \equiv \sum_{s \in S_{it}} \sum_{k \in j} FP_{kt}s^s_{ikt} = \frac{\sum_{k \in j} \sum_{s \in S_{it}} K_{kt}FS_{k}s^s_{ikt}}{\sum_{k \in j} K_{kt}} = \frac{\sum_{k \in j} K_{kt}FS_{k} \sum_{s \in S_{it}} S^s_{ikt}}{\sum_{k \in j} K_{kt}} = \frac{\sum_{k \in j} K_{kt}NS_{ikt}FS_{k}}{\sum_{k \in j} K_{kt}}.$$  

(7)

It is also equivalent to averaging the foreign ownership share of $i$’s siblings in $j$, weighted by each sibling’s capital share in the industry and the number of common input suppliers with the sibling in year $t$. Those domestic firms that have at least one FDI sibling is identified by a dummy variable FDI sibling, $FDIS_{it}$:

$$FDIS_{it} = \begin{cases} 1, \text{ if } SFP_{it} > 0 \\ 0, \text{ if } SFP_{it} = 0 \end{cases}.$$  

(8)

In other words, $FDIS_{it}$ indicates whether firm $i$’s sibling foreign presence is positive.

Note that, unlike $IFP_{jt}$, which by construction is common across all firms in an industry in a given year, $SFP_{it}$ is time varying but firm specific. It depends on the foreign presence of each sibling of each firm as well as the number of common local suppliers with each sibling in each year. Moreover, while $SFP_{it}$ is typically less than $IFP_{jt}$, mathematically it is possible for $SFP_{it}$ to be greater than $IFP_{jt}$, if some siblings have multiple common suppliers with the firm. In the previous example, for domestic firm New Star Fashions, its $SFP_{it}$ equals to the $FP_{it}$ of Euro Mode Fashion, and for Tammam Design, its $SFP_{it}$ is the sum of $FP_{it}$ of Euro Mode Fashion, FCI (BD) and Beximco Fashions. The more and larger FDI siblings a domestic firm has, the higher is its $SFP_{it}$. So in this case, the $SFP_{it}$ of Tammam Design is higher than that of New Star Fashions, even though, given that both firms are in the same industry, their $IFP_{jt}$ are the same. More importantly, the within firm changes in $SFP_{it}$ will be larger for Tammam Design than for New Star Fashions, even though the within firm changes of $IFP_{jt}$ for both the firms are the same. It is this greater variation in within firm $SFP_{it}$ enable us to better pin down the effect of horizontal spillover, and the hypothesis of this paper is that those firms that have a larger within firm change
in $SFP_{it}$ will experience a higher productivity gain as a result. However, this does not imply that those firms that have a higher $SFP_{it}$ should have a higher productivity. In fact self selection would suggest that those firms that select those new local input varieties as they become available due to the presence of foreign firms, are presumably less productive, as the more productive firms probably have access to the same varieties via imports, and as such may not benefit from it. Figure 2 illustrates how $IFP_{jt}$ and $SFP_{it}$ are calculated in an example with two domestic firms, four FDI firms and four local suppliers.

3 Data

Firm level survey was conducted from the period of November 2004 to April 2005, which covers a stratified random sample of 350 firms, which is about 10% of the total population of the domestic firms and 100% of FDI firms currently operating in Bangladeshi garment sector. Sample is stratified to reflect the population distribution of firms by size, by industry (woven garments vs. non-woven garments) and by location (Chittagong, Chittagong-EPZ, Dhaka and Dhaka-EPZ). After cleaning up the data to exclude outliers and firms with incomplete information, there are a total of 297 firms in the 5 year unbalanced panel data set of 1213 observations, from 1999 to 2003. In this unbalanced panel data set, the composition is 68 percent in woven industry and 32 percent in non-woven industry, roughly reflects the population of firms in the garment sector. Among the sampled firms, 14% have positive foreign equity, while the remaining 86% are purely domestic owned.

Table 1 presents the sample means of the key variables by woven and non-woven industries and by equity ownership. It is clear that in both industries FDI firms are in general larger in sales and exports, they purchase more material inputs, including imported materials, they hire more employees, and have more capital. All these presumably suggest that foreign firms are more productive.

However, it is not a prerequisite that FDI firms are more productive in a $TFP$ sense for horizontal spillover to take place. To promote the improvement and expansion of locally available inputs, it is necessary for FDI firms to increase the industry demand for these inputs, a point emphasized greatly in Rodriguez-Clare (1996). Given that FDI firms are much larger on average in the current data set, this is likely to be the case. In fact, given its size, a typical FDI firm
in the current sample source 83 percent more local inputs than domestic firms, even though only 20 percent of their inputs are locally supplied while the comparable figure for domestic firm is 32 percent. This is consistent with a finding of horizontal spillover.

Table 2 presents the sample means of industry foreign presence, FDI sibling and sibling foreign presence of the domestic firms in the sample by industries. On average, there is more foreign presence in the woven industry than in non-woven industry, judging by their industry foreign presence, but the difference is only about 8 percentage points. The contrast is larger between two industries when we focus on the siblings. On average, 47 percent of domestic firms in woven industry has FDI siblings, while only 18 percent of domestic firms in the non-woven industry has FDI siblings. And the average sibling foreign presence in woven industry is 5.4 percent, nearly 10 times higher than that of non-woven industry. This is true even if we restrict the comparison to only those domestic firms with FDI siblings. The sibling foreign presence for domestic firms with FDI siblings in the woven industry is 11.7 percent, while the same variable for non-woven is only 2.9 percent. Differences between the two industries may be driven by other industry level variables, such as trade policies and demand shocks. We will instead rely only on the within firm variations in sibling foreign presence in the regressions.

4 Everything-But-Arm Initiative of EU

In 2000, the EU announced that it will implement the “Everything But Arm” (EBA) initiative in 2001 which provides duty-free quota-free access to imports from all 48 Least Developed Countries, and Bangladesh is one of them. However, to enjoy such trade preference, rules of origin (ROOs) requirement of the products must be met. There are two sub-industries within the garment sector of Bangladesh, one consists of firms producing woven apparels and the other consists of firms producing non-woven apparels, such as knitwears and sweaters. These two industries have very distinct production techniques, and while any the nonwoven firms can easily satisfy ROOs, only the larger woven firms, many of them are FDI firms, find it profitable to meet ROOs by using local inputs that are typically more expensive. Thus, the announcement of EBA in 2000 prompted differential impact on the investment and capital share of the firms depends on whether they

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9 Please refer to Demidova, Kee and Krishna (2008) for a discussion of how ROOs of the EU add an additional layer of fixed and marginal costs for firms exporting to the EU.
export to the EU and the industry they are in. In other words, the announcement of EBA in 2000 prompted the woven FDI firms that export to the EU to investment and expand their market share, and at the same time increase their demand for local inputs to meet ROOs. Figure 2 presents the share of FDI firms in the industry capital. While FDI firms that export to the EU generally have a larger presence in the industries relative to FDI firms that do not export to the EU, the presence increases only in woven subindustry. The news of EBA caused the market share of FDI firms that export to the EU to increase from 38 percent in 1999 to 43 percent in 2000 and stabilized to 42 percent in 2003. On a contrary, the share of those woven FDI firms that do not export to the EU dropped from 6 percent in 1999 to 0.7 percent in 2000 and barely increased to 1.6 percent in 2003. Such distinct movements of market shares among different FDI firms in different subindustries are a result of an unanticipated exogenous policy change in the EU that may affect sibling foreign presence of some domestic firms. We will use the impact of the EBA announcement on the market presence of those woven FDI firms as an instrument for the exogenous increase in the sibling foreign presence. The exclusion restriction here is that the announcement and implementation of EBA has no direct impact on the productivity of domestic firms. This exclusion restriction is motivated by the findings in the literature that while the more productive firms may self select into exporting, but further exporting may not have feedback effects on the productivity of exporters (Clerides, Lach and Tybout, QJE, 1998; Bernard and Jensen, JIE, 1999). However, some recent papers find that exporting may further promote productivity gains (Van Biesebroeck, JIE, 2006; De Loecker, JIE, 2007; Fernandes, JIE, 2007). As a robustness check, we also run both the first stage and second stage IV regressions on a subset of domestic firms that do not export to the EU given that in this case trade policy of EU should not directly affect the productivity and performance of these firms.

5 Foreign Investment Policy of Bangladesh

According to the Board of Investment of Bangladesh, the policy framework for foreign investment in Bangladesh is based on the Foreign Private Investment (Promotion and Protection) Act, 1980, which ensures legal protection to foreign investment in the country against nationalization and expropriation. It also guarantees non-discriminatory treatment between foreign and local investment
and repatriation of proceeds from sales of shares and profit. Other major laws affecting foreign investment are the Bangladesh Export Processing Zones Authority Act (1984), the Companies Act (1994) and the Industrial Policy (1999). In addition, foreign investors are also required to follow the regulations of Bangladesh Bank and NBR for taxation and customs matters. During the sample period, while foreign investment is welcome in all sectors,\textsuperscript{10} it is discouraged in the following areas: ready-made garments, banks, insurance companies and other financial institutions. The reason why FDI is discouraged in the garment sector, presumably is to protect the existing firms from sharing quota allocations and trade preferences in the US and EU. Such restriction has been relaxed in the Industrial Policy (2005), once quota system under the Multi-Fiber Agreement was abolished. In other words, during our sample period, 1999-2003, while existing FDI firms are allowed to expand and invest with no restriction on their capital and machinery, entry of new FDI firms in Bangladesh is very rare (only 6 new FDI firms established during the period), and is highly regulated by the government. We exploit this unique policy environment that restrict entry of new FDI firms during our sample period by assuming that any increase in the number of FDI firms from 1999 to 2003 are taken as exogenous to the productivity of domestic firms and the availability of local input suppliers, since it is restricted by the government.

6 Reduced Form Regression Results

As mentioned above, there are two industries in the garment sector of Bangladesh, namely woven and non-woven industries. These two industries have very different production structure and technique. The Appendix discusses how two separate industry specific production functions are estimated using Ackerberg et al (2007) in a three step procedure that take into account endogeneity of labor and material inputs, and how input and investment decisions may depend on the FDI status of the firms. This is similar to De Loecker (2007) to allow production function to depend on exporter status. Here we focus on testing the hypothesis of horizontal spillover through sibling foreign presence while taking the estimated firm productivity as given. The appendix also contains a discussion on the construction of the very crucial firm specific price indexes. Output and mate-

\textsuperscript{10} with the exception of (a) manufacturing of arms and ammunition or other defence equipment, (b) forest plantation and mechanized extraction of reserved forests, (c) the production of nuclear energy, and (d) security printing (currency notes) and minting.
aterial inputs of firms used in the production function estimation are constructed by deflating total revenue and cost of materials using these firm specific output and material price indexes. This significantly improves what Haskel, Pereira and Slaughter (2007) describes as a “pervasive problem in the literature on micro panels” that uses industry price prices in place of the often missing firm level prices.

6.1 Backward linkages: Do FDI firms increase the demand for local intermediate inputs?

One of the reasons why we may expect to observe horizontal spillover from FDI firms to their domestic siblings is that the presence of foreign firms significantly increase the industry demand for local inputs, which may then lead to quality upgrading and variety expansion in the intermediate input industry. One way to establish this point is to see whether FDI firms typically demand more local inputs than otherwise comparable domestic firms in the same industry. Table 3 presents the results of the following regression:

\[
\ln (\text{domestic materials})_{it} = \alpha_{jkt} + \alpha_{FDI} FDI_i + \mathbf{X}_{it} \beta + \varepsilon_{it}. \tag{9}
\]

The dependent variable of this table is the log of the value of domestic material used by firm \(i\) in year \(t\), where firm \(i\) is operating in industry \(j\) and location \(k\). This variable is constructed by subtracting the cost of total imported materials from the cost total materials of each firm. Depends on the columns, right-hand side variables may include industry-location-year fixed effects, \(\alpha_{jkt}\), a dummy variable, \(FDI_i\), which equals one if firm \(i\) is a FDI firm, and other firm level control variables, \(\mathbf{X}_{it}\), which include dummy variables for firms that export to the EU and the US, productivity, capital stock, age and output of firm \(i\) in year \(t\). The sample used in this table consists of an unbalanced panel of FDI and domestic firms in both the industries from 1999 to 2003. A positive estimate of \(\alpha_{FDI}\) would suggest that, all else equal, a typical FDI firm uses more domestic materials than a domestic firm.

The log of local materials is first regress on FDI status in Column (1).\(^{11}\) At sample mean, FDI

\(^{11}\)FDI dummy equals one when the firms have any positive foreign equity. In our sample, the minimum foreign ownership is 25 percent.
firms are revealed to have a statistically larger demand for local input. This is true even after clustering the standard error by industry-location-year to allow for correlation of the dependent variable within the cluster unit. However, this estimate is clearly bias since firms in different industry, location and year may face different supply for local inputs, which makes it necessary to control for a full set of industry-location-year fixed effects. Specifically, different industry may have differences in the supply for local materials as certain specialized materials may not be available locally. Likewise, firms in different regions may have different material sourcing patterns. Finally, the availability of local materials may change over time. Result in Column (2) shows that controlling for industry-location-year fixed effects, $\alpha_{jkt}$, FDI firm status only have a marginally significant effect on the demand for local inputs. The point estimate is positive, but its p-value is only 0.109.\textsuperscript{12}

However, there are other factors that may affect the demand for local materials within industry, location and year that may still bias the result. An important one is the trade policies of the different export destinations of the firms during the sample period (1999-2003). The most important markets for the garment exports from Bangladesh are the EU and the US. Due to its least developed country status, Bangladeshi garments may enter the EU free of duties and quotas if the strict rules of origins are satisfied. Such rules required that majority of the materials used in the production of clothing are from Bangladesh (yarn-forward rule). Thus in order to take advantage of the EU trade preference, firms are forced to source locally. In contrast, apparel products from Bangladesh face quotas and tariffs in the US, but there is no local input requirements.\textsuperscript{13} As such we expect firms that export to the EU have higher demand for local inputs while firms that export to the US have lower demand for local inputs. Given that FDI firms may specialized in different markets, without controlling for their markets, the FDI variable may not be significant. Column (3) includes EU exporter dummy and US exporter dummy in the regression. As expected, the coefficient for the EU exporter dummy is indeed statistically positive while the reverse is true for the US exporter dummy. Most importantly, FDI firms are now shown to have a significantly larger demand for local inputs. On average, controlling for the export markets, the demand for domestic materials for FDI firms are about 50 percent higher than the domestic firms within the same industry, location and year.

\textsuperscript{12} Standard errors presented in this table are clustered by industry, location and year to allow for possible correlation in the dependent variable within the cluster cells. Using White robust standard errors do not change the results.

\textsuperscript{13} Please see Demidova, Kee and Krishna (2006) for a more in depth discussion.
The reason why FDI firms have larger demand for domestic inputs is because they are larger. This is the scale effect necessary to establish a FDI-induced agglomeration. To verify this point, we include three controls for firm size in Column (4). They are firm productivity, firm capital stock and firm age. This is because more productive firms may grow larger, while firms that have a larger capital stock or older firms are usually larger. Result shows that controlling for firm size, FDI firms are no longer any different then domestic firms in their demand for local inputs. Column (5) directly includes the log of firm output in the regression, the result is the same.

Overall, results presented in this table suggest that FDI firms may increase the industry demand for local inputs, given their size and scale. This result is consistent with a FDI-induced agglomeration effect which may lead to the expansion in local input variety as well as the quality improvement of local inputs and benefit all domestic firms that use these local inputs.

6.2 Horizontal spillover: Do FDI firms improve the productivity of their domestic siblings?

To study the potential horizontal spillover from FDI firms to their domestic siblings, we relate the performance of domestic firms to their sibling foreign presence, as defined in equation (7), in a domestic firm only panel data set:

\[
\ln y_{it} = \alpha_i + \alpha_{jkt} + \alpha_{SFP}SFP_{it} + X_{it}\beta + \beta_iTrend_{it} + v_{it},
\]

where the dependent variable \((y_{it})\) includes the product scope per worker, sales per worker, output per worker, TFP estimated via OLS and TFP estimated via augmented Olley-Pakes procedures of domestic firms in our sample. Positive estimate of \(\alpha_{SFP}\) suggests positive spillover from FDI garment firms to domestic garment firms. Given that the hypothesis of horizontal spillover are inherently about whether within firm performance changes can be attributed to changes in foreign presence over time. It is thus necessary to control for firm fixed effects, \(\alpha_i\), in the panel regressions, (10), and only rely on the within firm variations of performance and sibling foreign presence to identify the coefficient. In other words, between firm productivity changes, such as the exiting of inefficient firms as market is toughened due to the increased presence of FDI firms, while may be important, should not affect or explain the within coefficient on sibling foreign presence.
6.2.1 Omitted variable bias

Equation (10) controls for industry-location-year specific effects, $\alpha_{jkt}$, to wipe out any macro omitted variables are common among all firms within the same industry, location and year that may affect the performance of domestic firms and sibling foreign presence. Such variables may include industry specific demand and productivity shocks, government policies that favor domestic firms, investment climate change in the export processing zones, or trade policy changes of the main markets such as the EU and the US. It also controls for industry foreign presence and the resulting market competition specific to an industry in a given year. In addition, firm level control variables, $X_{it}$, are also included, which are age, the share of imported materials in total material cost, and the share of materials in total sales. This is because overseas buyers may request Bangladeshi firms to use imported fabrics to ensure quality of the final products. Such business practice is typical among firms that export to the US and these firms could be more productive as the US market are more competitive. Using imported fabrics decrease the demand for domestic materials which may decrease the number of FDI siblings and cause the within firm year to year change in foreign sibling presence to be smaller. This may induce a downward bias on the coefficient for sibling foreign presence. To control for this, the share of imported materials in total materials of firm is included as a control. Another possible omitted variable is with regard to production technique. Inefficient firms tend to waste material, which leads to a high material to sales ratio. The more materials a firm uses, the more likely that this firm may have more FDI siblings since they may demand more domestic materials. This causes larger within firm year to year change in sibling foreign presence among these unproductive firms that have high materials to sales ratio, which leads to a downward bias on the coefficient on sibling foreign presence. Equation (10) controls for materials to sales ratio in the regression. Finally, the age of a firm may bias the estimate too. Specifically older firms tend to be more productive, and older firms tend to work with the more established local suppliers which are also preferred by the FDI firms. This causes an upward bias on the coefficient of sibling foreign presence.

6.2.2 Selection bias, endogeneity and reversed causality

While the beauty of using sibling foreign presence to study horizontal spillover is that $SF_{Pi}$ is firm specific and time varying, which allows us to control for industry-location-year fixed effects
to wipe out the influence of macro variable, the short coming of using $SFP_{it}$ is also that it is a firm level variable that is subjected to selection bias, endogeneity and reversed causality. We may worry that as a domestic firm performs better over time, it may choose to buy from local suppliers that also work with FDI firms, such self-selection will cause an upward bias in the least squares estimate of $\alpha_{SFP}$. There is also a concern that if a local supplier become exogenously better, it improves the performance of all its clients, and some of these FDI firms may expand their market presence as a result. Such simultaneity problem will also cause an upward bias in the least squares estimate of $\alpha_{SFP}$. Finally, as a domestic firm become better over time, it may expand its market share, which causes the market shares of FDI firms to decrease and lead to a smaller $SFP_{it}$, in other words, within firm performance changes may cause $SFP_{it}$ to change. This reversed causality will result in a downward bias in the least squares estimate of $\alpha_{SFP}$. Another source of downward bias in the least squares estimate of $\alpha_{SFP}$ is measurement errors. The overall bias in least squares estimate of $\alpha_{SFP}$ is not clear a priori, it depends on whether reversed causality and measurement errors dominates selection bias and endogeneity bias.

To address these issues, here we exploit an unanticipated change in the EU trade policy which prompted exogenous changes in $SFP_{it}$. In 2000, the EU announced the implementation of Everything-But-Arm (EBA) Initiative in 2001, which formally granted duty-free and quota-free access to the EU market for products from the 48 Least Developed Countries, including Bangladesh. Table 4 presents the first stage estimations, where we regress $SFP_{it}$ on a dummy variable which equals one if domestic firm $i$ has a FDI sibling that exports to the EU in year $t$, $FDIS_{EUi_t}$, and the triple interaction term between $FDIS_{EUi_t}$ and an EBA dummy that equals to one for 2000 onwards and a woven industry dummy variable:

$$SFP_{it} = \gamma_1 FDIS_{EUi_t} + \gamma_2 FDIS_{EUi_t} * woven_i * EBA_t + Z_{it} \gamma + \zeta_{it}, \tag{11}$$

where $Z_{it}$ has all the right-hand side variables of (10). We expect $\gamma_1$ and $\gamma_2$ to be positive which would suggest that conditional of domestic firm $i$ having a FDI sibling that is exporting to EU in year $t$, sibling foreign presence of firm $i$ is higher if firm $i$ is in the woven industry in years since the announcement of EBA. Column (1) of Table 4 presents the result based on a subset of domestic firms that do not export to the EU, Column (2) further controls for firm specific time trend in
the regression. Likewise, Column (3) shows the first stage regression based on the full sample of domestic firms who may or may not export to the EU, while Column (4) controls for firm specific time trend in this full sample. Given that the instrumental variables only vary by industry and year, we cluster the standard errors by industry-year in all the columns. The estimated $\gamma_1$ and $\gamma_2$ are positive and statistically significant, with F-statistics that are greater than 10, suggesting that these instrumental variables have explanatory power on $SFP_t$.

Tables 5, 6, 7 and 8 present the second stage regressions according to (10) for the restricted sample of domestic firms do not export to the EU and for the full sample of domestic firms who may or may not export to the EU. These tables also present the least square estimations and compare them to the IV estimates. The difference between Tables 5 and 6 is that firm specific time trend are included in the later; likewise for Tables 7 and 8. In all tables, the IV estimates for $\alpha_{SFP}$ are larger than the LS estimates, suggesting that the downward bias due to measurement errors and reversed causality between the performance of domestic firms and their sibling foreign presence dominates the upward biases due to selection and endogeneity. For the restricted sample of domestic firms that do not export to the EU, exogenous increase in sibling foreign presence due to EBA causes these domestic firms to have better performance, in terms of a higher product scope per worker, sales per worker, output per worker, and TFP (estimated with OLS and the augmented Olley Pakes procedure). This is the sample of firms that EBA should have not direct impact on their performance other than through their FDI siblings that export to the EU, and thus satisfy the exclusion restriction. Controlling for firm specific time trend do not change the results. These results are very similar in the full sample of domestic firms, except that the exogenous increase in sibling foreign presence due to EBA does not seem to have an effect on the product scope per worker.

In summary, by exploiting exogenous changes in sibling foreign presence due to EBA, we show that domestic firms benefit from the increased presence of their FDI siblings, a result that is consistent with horizontal spillover from the FDI garment firms to the domestic garment firms. Based on the estimate in Column (10) of Table 8, a one percentage point increase in sibling foreign presence is associated with a 3 percentage gain in productivity for domestic firms on average. From 1999 to 2003, the average within firm gain in productivity among domestic firms is about 8 percent, while the average change in sibling foreign presence is 1%. A back of an envelope calculation would
then suggest that the increase in sibling foreign presence throughout the sample period could explain about a third of the within firm productivity gain. This result is important statistically and economically.\footnote{It should be noted that instead of these IV estimations, we also used lagged SFP_{it} and more control variables to address selection bias, endogeneity and reversed causality in a previous draft of this paper. The results are very similar to the IV estimation. This set of results are available upon request.}

7 Robustness Checks

7.1 Other possible channel of horizontal spillover

Could horizontal spillover between FDI and domestic firms be transmitted through other channels then the use of common local input suppliers? Particularly, could the above results be driven by the linkage between FDI and domestic firms when they produce the same products or export to the same market? To study these other channels, we construct two variables to capture the market presence of those FDI firms that have common products or common market with each domestic firm. Specifically, product foreign presence (PFP_{it}) of each domestic firm i in industry j and year t is defined as the following:

\begin{equation}
\text{PFP}_{it} = \sum_{p \in \mathbf{P}_t} \sum_{k \in j} \frac{K_{kt}}{K_{jt}} FS_k R^p_{ik} = \sum_{k \in j} \frac{K_{kt}}{K_{jt}} FS_k \sum_{p \in \mathbf{P}_t} R^p_{ik},
\end{equation}

where $\mathbf{P}_t$ is the set of products (HS 6 digit goods) for i in t, and $R^p_{ik}$ is a dummy variable equals one if i and k are rivals in product p. Note that there is no time index for $R^p_{ik}$ since we only have information of the product mix of firms in 2003. So PFP_{it} for each firm i is the weighted average of the foreign presence of all its product rivals in industry j, with weights reflect their shares of capital in j and the number of common products with i.

Similarly, market foreign presence (MRFP_{it}) of each domestic firm i in industry j and year t is constructed as the following:

\begin{equation}
\text{MFP}_{it} = \sum_{m \in \mathbf{M}_t} \sum_{k \in j} \frac{E^m_{kt}}{E^m_{jt}} FS_k R^m_{ikt},
\end{equation}

where $\mathbf{M}_t$ is the set of export markets for i in t, $E^m_{kt}$ is the value of export of firm k to market m.
in year $t$, $E_{jt}^m$ is the total value of export of industry $j$ of Bangladesh to market $m$ in year $t$, and $R_{ikt}^m$ is a dummy variable equals one if $i$ and $k$ are rivals in market $m$ in year $t$. Table 2 presents the sample average of $PRFP_{it}$, $MRFP_{it}$, $R_{ik}^p$ and $R_{ikt}^m$ by industry. There are about 90 percent of domestic firms share at least one common product with a FDI firm and more than 97 percent of domestic firms that share common output markets with FDI firms. This is not too surprising since most firms export to the EU, or the US or both, and produce similar products. Relative to sibling foreign presence, product and market rival foreign presence are also significantly higher, which potentially may explain more of the within firm productivity gain over the sample period.

Alternatively, could horizontal spillover happen between domestic firms when they share common local input suppliers? To understand this, we construct the following domestic sibling presence variable $(DSP_{it})$ for each domestic firm $i$ in year $t$:

$$DSP_{it} = \sum_{s \in S_{it}} \sum_{k \in j} (1 - FP_{kt})S_{ikt}^s.$$  \hspace{1cm} (14)

Table 9 presents the regression results when we relate product foreign presence, market foreign presence and domestic sibling presence to product scope per worker and TFP of the domestic firms. In all cases, these other possible channels of spillover are not statistically significant, suggesting that these are not important channel for horizontal spillover to take place.

### 7.2 Placebo experiment – random siblings

Another concern could be that the sibling relationship is somehow random and the finding of horizontal spillover is just coincidental. Columns (4) and (8) of Table 9 use artificial sibling foreign presence that are constructed when domestic firms are randomly assigned FDI siblings. In this placebo experiment, the randomized sibling foreign presence does not have consistent pattern in affecting firm performance – while it is positive and significant in explaining product scope per worker, it is negative and insignificant in explaining TFP. This is in sharp contrast to the previous finding where foreign sibling presence is consistently important in explaining firm performance. This suggests that the previous findings of horizontal spillover may not have been a fluke.
7.3 Evidence based on industry foreign presence

If the finding of horizontal spillover through the common local supplier relationship between domestic and FDI firms are of any importance, one may expect to see some similar results at a more aggregate level based on industry foreign presence. After all an increase in sibling foreign presence may be due to an increase in industry foreign presence. The difficulty here is that industry foreign presence is time varying industry specific. To assess its effect on the productivity of domestic firms in a panel regression, we no longer can control for industry-location-year fixed effects, which may thus lead to omitted variable bias that need to be dealt with more carefully. In addition, industry foreign presence by construction does not have variation across firms with an industry-year. It is therefore necessary to cluster the standard errors by industry-year to avoid the classic macro variable in micro unit problems (Moulton, 1990). Table 10 presents the results according to the following regression:

\[
\ln TFP_{it} = \alpha_i + \alpha_t + \alpha_{IFP} IFP_{jt} + X_{jt} \beta + \nu_{it}.
\]

Column (1) of Table 10 shows that controlling for firm fixed effects and year fixed effects, least squares estimate of \( \alpha_{IFP} \) is negative suggesting that industry foreign presence is negatively correlated with domestic firm productivity. This result resonates the previous findings of the literature, and could be driven by the market stealing effect of FDI firms. However, this result hides tremendous heterogeneity among firms, given that some firms have FDI siblings, while other may share common products or markets with FDI firms. Column (2) allows domestic firms that have foreign siblings, or have common products or markets with the FDI firms to have different \( \alpha_{IFP} \). Result shows that only when domestic firms share common local input suppliers with the FDI firms that we observe a statistically significant effect and it is positive. On the other hand, sharing common market with FDI firms appear to have a negative effect on the productivity of domestic firms, but the effect is not statistically significant. Column (3) controls for aggregate demand and productivity shocks of each industry in each year using the total industry export to the EU and the US, as well as the average productivity of the industry. The result is very similar to that of Column (2). Overall this exercise supports our previous findings that sharing common local input suppliers with FDI firms is an important way for domestic firms to perform better.
8 Structural Regressions

To formally study the role of FDI in promoting the variety of local input which causes productivity of domestic firms to increase, we rely on the following structural model motivated by Ethier (1982), Rodriguez-Clare (1996) and Feenstra and Kee (2008). There are two sectors in the economy, a differentiated intermediate input sector, producing $N$ variety of input, $m_n$, $n = 1, ..., N$, and a differentiated final good industry, producing output $Y$, based on a production function which depends on labor, $L$, capital, $K$, and all the intermediate inputs, $m_n$, with a constant elasticity of substitution, $\sigma > 1$ among the different varieties of intermediate input. The final good industry has $i = 1, ..., I$ firms, and some of these firms are FDI firms. The number of FDI firms are exogenously given in the model (regulated by the government). Specifically, a typical firm $i$ in the final good sector has the following production function (year subscript omitted),

$$Y_i = \phi_i \left[ \sum_{n=1}^{N} \frac{\sigma-1}{\sigma} \frac{\alpha_M}{M_i} L_i^{\alpha_L} K_i^{\alpha_K} \right]$$  

(15)

In a symmetric equilibrium where $m_{ni} = m_{i}$, (15) can be rewritten as

$$Y_i = \phi_i N^{\frac{\alpha_M}{\sigma-1}} M_i^{\alpha_M} L_i^{\alpha_L} K_i^{\alpha_K}, \quad (16)$$

with $M_i = N m_i$, is the total amount of intermediate input used in the production of $Y_i$. Holding $M_i$ fixed, (16) shows that an increase in $N$ raise $Y_i$. Taking logs on both side of (16) , and define the total factor productivity (TFP) of firm $i$ as the following:

$$\ln TFP_i \equiv \ln Y_i - \alpha_M \ln M_i - \alpha_L \ln L_i - \alpha_K \ln K_i,$$

then it is clear that an increase in $N$ will raise $i$’s TFP, given that $\sigma > 1$ :

$$\ln TFP_i = \ln \phi_i + \frac{\alpha_M}{\sigma - 1} \ln N. \quad (17)$$

In an open economy, the total variety of intermediate inputs available for the final good sector
is the sum of the locally produced variety, \( N^D \), and the imported variety, \( N^I \),

\[
N = N^D + N^I,
\]

which implies that an increase in the local variety of input will increase the productivity of the final good sector,

\[
\ln TFP_i = \ln \phi_i + \frac{\alpha M}{\sigma - 1} \ln (N^D + N^I).
\]  

(18)

In equilibrium, \( N^D \) depends on the aggregate demand of the final good industry, which could increase due to the entry of FDI firms,

\[
N^D = f (FDI).
\]  

(19)

Equation (18) presents the structural relationship between firm productivity and the number of input variety. This equation can be easily estimated based on data on the number of local and imported inputs. We proxy \( N^D \) using the number of local input suppliers and we proxy \( N^I \) based on the number of imported intermediate inputs variety.\textsuperscript{15} And the sum of the number of local input suppliers and the number of imported input variety gives us \( N \). Given that the number of local input suppliers and the number of imported input variety probably measure \( N^D \) and \( N^I \) with errors, we expect the least square estimates to have downward bias.

Columns (1) and (2) of Table 11 present the least squares results. Column (1) ignores the number of imported input variety, \( N^I \), and only focuses on the relationship between productivity and local input variety, while Column (2) includes both local and imported input variety in the regression. Firm fixed effects are used to control for \( \ln \phi_i \), and given that \( N^D \) and \( N \) are common across all firms within a year, the standard errors are clustered by year. Both columns show that there is a positive and significant relationship between the productivity of domestic firm and the number of input variety. However, these results can be downward bias given that \( N^D \) and \( N \) are measured with errors.

\textsuperscript{15}In the survey, firms report the HS 6 digit codes for the inputs they used for production. For each of these HS 6 digit inputs, we consider import for different countries as different varieties. We match these HS codes with Bangladesh bilateral import data from Comtrade to construct the number of unique imported input variety for each year, from 1999 to 2003.
To show empirically that an increase in the number of FDI firms in the final good industry may lead to an increase in the number of local input variety, and thus the TFP of domestic firm in the final sector, we instrument $N^D$ using the number of FDI firms in a first stage regression. In addition, we use the international price of cotton fabrics as an instrument for $N^I$. Here the exclusion restriction is that the number of FDI firms in Bangladesh garment sector is exogenous and have no direct impact on the productivity of domestic firms other than through local input variety. This is justifiable given that during the sample period, foreign investment in the garment sector is discouraged under Bangladesh Investment Policy 1999. While existing FDI firms may invest and expand their capacity, new FDI entry is highly regulated by the government which make the total number of FDI firms de facto exogenous during the sample period. On the other hand, the world price of cotton fabrics clearly shouldn’t affect the productivity of domestic garment firms other through its negative impact on imported fabrics variety.

Columns (3) and (4) of Table 11 presents the second stage results. The IV estimates are both positive and statistically significant. These estimates are also larger than the least squares estimates suggesting that the IV estimates are better in handling measurement errors in $N^D$ and $N^I$. In both cases, the first stage regressions have good F statistics and the expected signs. These results confirm that an increase in the number of FDI firms raises the number of local input variety and the total input variety, which leads to higher productivity for domestic firms.

To study the effect of FDI on product variety of the final good sector, consider that for each firm $i$, $Y_i$ represents a composite output of different final good varieties,

$$Y_i = \left[ \sum_{v_i=1}^{V_i} y_{v_i} \right]^{\frac{1}{\lambda+1}}, \lambda < 0. \quad (20)$$

Think of $Y_i$ as the production possibility frontier (PPF) of firm $i$ (e.g. GAP, Old Navy), and each firm $i$ produces many varieties of the final good (e.g. T-shirts, sweaters). The concavity of $Y_i$ is ensured by $\lambda < 0$, which is the constant elasticity of substitution in production between the different varieties of $y_{v_i}, v_i = 1, ..., V_i$. Combining (16) with (20) shows that an expansion of the variety of intermediate inputs works much like a positive productivity shock which causes a outward shift.

---

16 International price of cotton fabrics is constructed using the unit value of Indian’s export of cotton fabrics to the world according to data from Comtrade.
in firm $i$’s PPF, and at given prices of each final good variety, may lead to an expansion in the output variety as some previously not profitable varieties may now become profitable. Figure 4 demonstrates this for a two variety case. Under the fixed price level, in the original equilibrium, firm $i$ only produces variety 1, but as the PPF shifts out due to an increase in input variety, firm $i$ also produces variety 2 in the new equilibrium.

To formally show that, we consider a symmetric equilibrium, where within each firm $i$, the price for each variety of $Y$ is the same which ensures that the quantity produced for each variety is also the same,

$$p_{v_i} = p_i, \text{ and } y_{v_i} = y_i.$$  \hspace{1cm} (21)

This implies that aggregate bundle of goods produce by $i$ equals to the quantity of each variety times the total output variety of $i$ raise to a positive power:

$$Y_i = V_i^{\frac{1}{\alpha - 1}} y_i.$$  \hspace{1cm} (22)

We can therefore rewrite the production function in terms of output per variety as the following,

$$y_i = V_i^{\frac{\lambda}{\alpha - 1}} \phi_i N^{\alpha_M} M_i^{\alpha_M} L_i^{\alpha_L} K_i^{\alpha_K},$$  \hspace{1cm} (23)

which shows that given the same amount of inputs, if firm $i$ produces more variety of output, the quantity for each variety is smaller.

To produce each unit of $y_i$, firm $i$ minimize the cost of production, which results in the following unit cost function (assuming $\alpha_M + \alpha_L + \alpha_K = 1$),

$$c_i = \kappa V_i^{\frac{\lambda}{\alpha - 1}} \left[ \phi_i N^{\alpha_M} \right]^{-1} P_i^{\alpha_M} P_L^{\alpha_L} P_K^{\alpha_K},$$  \hspace{1cm} (23)

where $P_j, \forall j = \{M, L, K\}$, is the price of intermediate input, labor and capital, and $\kappa$ is a constant depends on the $\alpha’s$. Equation (23) implies that an increase in the variety of intermediate input push down the unit cost to produce $y_i$. In contrast, given input prices and variety, an increase in output variety raise the cost for each variety. Given $c_i$, to maximize profit, firm $i$ will set the price
for each variety to be a fixed markup over $c_i$,

$$p_i = \mu c_i = \mu \kappa V_i^{\frac{\lambda}{\lambda-1}} \left[ \phi_i N^{\frac{\alpha_M}{\sigma-1}} \right]^{-1} P_{M}^{\alpha_M} P_{L}^{\alpha_L} P_{K}^{\alpha_K}$$

(24)

with $\mu > 1$ depends on the constant elasticity of substitution between different firm $i$. Equation (24) implies that given prices of inputs and output, an increase in input variety leads to an increase in output variety:

$$V_i^{\frac{\lambda}{\lambda-1}} = \left[ \phi_i N^{\frac{\alpha_M}{\sigma-1}} \right] \frac{p_i}{P_{M}^{\alpha_M} P_{L}^{\alpha_L} P_{K}^{\alpha_K}} \frac{1}{\mu \kappa} \Rightarrow$$

$$\ln V_i = \frac{\lambda - 1}{\lambda} \left[ \theta + \phi_i + \frac{\alpha_M}{\sigma - 1} \ln N + \ln p_i - \sum_{j \in \{M, L, K\}} \alpha_j \ln P_j \right].$$

(25)

Equation (25) presents a structural relationship between product scope and the input variety of a multi-product profit maximizing firm. It shows that an increase in input variety leads to the expansion of product scope of a firm, controlling for productivity, output price and the industry prices of materials, labor and capital. It neatly shows that a rise in input variety has the similar expansionary effect on product scope as a positive productivity shock that increase the productivity a firm. Recall Figure 4, an increase in input variety or productivity will both shift the PPF out, such that under constant prices, a firm will find it profitable to produce more output variety. Given that we have shown that more FDI firms lead to more local input varieties, more FDI firms therefore cause the product scope of domestic firms to be larger. Equation (25) also shows that any reduction in input prices will also lead to an expansion in product scope for domestic firms. The finding here that increases in input variety and reduction in input prices lead to the proliferation of output variety is very similar to Goldberg, Khandelwal, Pavcnik and Topalova (forthcoming). In their paper they show that trade liberalization in India in the 1990s caused an explosion in the variety of imported intermediate inputs and reduction in the price of these inputs, which led to an expansion in product scope within firm. Here we show that a more liberalized FDI regime will also lead to an increase in local input variety, which causes domestic firms in the same industry to be more productive and has a higher product scope.

Given the linear structure, (25) can be easily be estimated using the following log linear speci-
\[
\ln V_{it} = \beta_i + \beta_N \ln N_t + \beta_{TFP} \ln \phi_{it} + \beta_p \ln p_{it} + \beta_M \ln P_{Mt} + \beta_L \ln P_{Lt} + u_{it},
\]  
(26)

where we expect \( \beta_N, \beta_{TFP} \) and \( \beta_p \) to be positive, and the coefficients for input prices to be negative.

The regression error in (26) includes the price of capital which is unobserved to us. To estimate (26), we use the firm specific output price index to proxy \( p_{it} \), the augmented_OP estimates of TFP for \( \phi_{it} \), the average firm specific input price index for \( P_{Mt} \), and wages for \( P_{Lt} \). However, it is clear that in addition for \( N_t \) being endogenous, which we will instrument using the number of FDI firms, some other right-hand side variables are also endogenous, and may depend on the number of FDI firms in the garment sector too. We need at least one independent instrument for each of the right-hand side variables for (26) to be identified. Here we use following instrumental variables: average productivity of the industry for \( \phi_{it} \), international prices of cotton and fabrics for \( p_{it} \) and \( P_{Mt} \). Wages is assumed to be exogenous due to the tremendous hidden unemployment or under-employment in Bangladesh which provide a large pool of workers relative to the size of the industry.

Table 11 presents the results. Columns (5) and (6) first present the least squares estimates when we only include firm fixed effects and the number of local suppliers or the number of total input variety on the right-hand side. While the coefficients are positive and significant, they are likely to be contaminated with measurement errors. The IV estimates are presented in Columns (7) and (8), which are positive and significant.

Columns (9) to (12) estimate (26). Columns (9) and (10) present the least squares estimates. While the least squares estimates of \( \beta_N \) are positive and significant, most of the rest of the coefficients either have wrong signs or insignificant. Columns (11) and (12) show the second stage of the IV estimates. Now all the coefficients have the right signs and are mostly significant. Most importantly, the results confirm that an increase in the number of FDI firms lead to increases in local input variety and total input variety which raise the product scope of domestic firms. The reason why the IV estimates for \( \beta_N \) is smaller than the least squares estimates is because of reverse causality – larger product scope may cause an increased demand for locally produced intermediate inputs which causes an upward bias in the least squares estimates. On a contrary, the IV estimates
are based on exogenous increases in local input variety as the number of FDI firms rises to pin down the effect on domestic product scope.

Overall, the results of the structural estimations confirm that FDI firms in the garment sector causes the number of local input variety to increase which leads to significant gains for domestic firms in terms of their productivity and product scope.

9 Conclusion

This paper studies the potential horizontal spillover from FDI firms to domestic firms in the same industry. We first present some empirical evidence based on reduced form regressions showing that when FDI and domestic firms share common local input suppliers, an exogenous increase in the presence of FDI firms in the industry will cause domestic firms to perform better in terms of product scope, sales per worker, output per worker and productivity. This result is consistent with the presence of horizontal spillover and could be driven by reasons such as the presence of FDI firms improve the local input industry through technology transfer, quality improvement or variety expansion. We then present a simple theoretical model of multi-product firm with love of variety in intermediate inputs. The model predicts that productivity and product scope of the firm rise with the expansion of the intermediate inputs in the industry. Given that FDI firms increase industry demand for intermediate inputs, which leads to the proliferation of local input variety, more FDI firms will therefore lead to higher productivity and product scope for domestic firms in the same industry. Structural regressions based on the model confirm the results.

Finding horizontal spillover in Bangladeshi garment sector may not be too surprising since some have credited foreign direct investment for the rise of the industry in the 1980s. However, the data set used in the paper is of a much later era, from 1999 to 2003, right before the phasing out of Multi Fiber Agreement that have dominated apparel trade in the developed markets. Moreover, given that horizontal spillover are identified in using within firm variation, the result is also not driven by those domestic firms that were set up by the ex-employee of FDI firms. The horizontal spillover channel identified in this paper is more nuanced. Domestic firms need not have direct contact with FDI firms, but by sharing common input suppliers, positive externalities exist in the input market and may not be able to be internalized by the FDI firms.
Thus, the result of this paper may shed lights in the literature as to why researchers do not find horizontal spillover in the past. To materialize externalities in the input market, FDI firms need to have backward linkages with the local economy. This is clearly the case of Bangladeshi garment sector, but may not apply to other countries, particularly so for the developing countries. A policy message out of this paper could be that to reap the potential spillover from FDI firms, developing countries should attract those foreign firms that have backward linkages. Not only can the local input industries benefit from FDI firms in the downstream sector via vertical spillover, domestic firms in the same industry may also benefit from the booming local input industries via horizontal spillover.

References


A Appendix

A.1 Firm Level Price Indexes

To estimate the firm’s productivity, we need to measure firm output and material input. Output and material input variables are constructed by deflating total values of sales and materials with output and material input price indexes, respectively. Due to the lack of data, industry level price indexes have long been used in the literature in place of firm price indexes. There are obvious problems in using industry price indexes to deflate firm sales and material costs. For example, our model suggests that more productive firms will charge a lower price. As such, using an industry price index, which reflects the average price level of all firms in the industry, to deflate sales of the more productive firms will under estimate the output level, which leads to an under estimation of firm productivity.

A unique strength of our data is the fact that we have data on prices at the firm level, which allows us to construct firm specific price index that are consistent across years and firms. Eslava, Haltiwanger, Kugler and Kugler (2004) construct a Tornqvist price index for each firm which is consistent within firms over time. The firm price index is a weighted average of unit value changes for each of the product the firm produces in each year, with weights that reflect the average share of the product in total sales of the firm in two consecutive years. However, by setting each firm price index equal to 1 in the base year, cross firm variation is ignored. This can hide firm heterogeneity in terms of productivity.

In our firm survey we have information on the value and quantity of the five main products for each firm in 2003. We can, therefore, construct a weighted average unit value of products for each firm in 2003 with weights reflecting the share of each product in the total sales of the firm. This will be the firm product price level in 2003. The industry price level in 2003 is constructed by taking the weighted average of the firm price level with weights reflect the size of the firm in the industry. By dividing the firm price level by the industry price level, we obtain a cross sectional firm price index in 2003. Firms that have a firm price level higher than the industry price level will
have a firm price index in 2003 exceeding unity. Conversely, firms that have a price level less than that of the industry in 2003, will have a firm price index below unity. In this manner, the cross sectional price index will capture firm heterogeneity in 2003. Finally, to extend the firm price index to the previous years, we rely on the information provided by the firms in the survey regarding the annual change in price of their main product. In this way, the constructed multi-year firm price index will be consistent within firms across years, as well as across firms within a year. A similar procedure is used to construct firm specific material price index. We use these firm level product and material price indexes to deflate total sales and material costs of the firms to obtain output and material inputs of the firms for the production function estimation.\footnote{There may be a concern that firm specific prices may convey information on quality of the firm. Firms that have higher quality products (or more services per good), and thus, higher prices will have a higher firm price index. By deflating total sales using this firm price index, we obtain an output measurement that is quality free, i.e., is in terms of “effective units” of the good. Thus, our productivity estimates will not be contaminated with the quality of the firm’s products, which is a known problem in the existing literature, which uses an industry price index to deflate firm sales.}

\subsection{The Production Function}

We assume that the following Cobb Douglas production function holds separately for woven and non-woven industries (industry subscripts are omitted):

\begin{equation}
Y_{it} = \phi_{it} L_{it}^{\alpha_L} M_{it}^{\alpha_M} K_{it}^{\alpha_K},
\end{equation}

where \(i\) and \(t\) are the indexes for firm and year, respectively, and \(Y_{it}\), \(L_{it}\), \(M_{it}\) and \(K_{it}\) are the output, labor, materials and capital of firm \(i\) in year \(t\). Output and material input are obtained by deflating total sales and material cost using firm specific price indices which are constructed using detailed price information from the firm survey.\footnote{Please refer to the appendix for the construction of the firm specific price indexes.} The total factor productivity (TFP) of firm \(i\) in year \(t\) is \(\phi_{it}\). Let’s assume that in log, \(\phi_{it}\) can be decomposed linearly into the following,

\begin{equation}
\ln \phi_{it} = \omega_{it} + \alpha_t + \alpha_A a_{it} + \alpha_F FDI_{it} + \eta_{it},
\end{equation}

where \(\omega_{it}\) is observable to the firms at the beginning of each period before variable input choices are made, but not to the researchers. The year specific productivity, \(\alpha_t\), may capture the effects
of time and others factors that are common to all firms during a year (within an industry) and
\( \alpha_{AA}a_{it} \), is the effect of (log of ) age on productivity.\(^{19}\) We further allow FDI firms to have a different
productivity than the domestic firms by including a FDI dummy variable in (28). Whether age
and FDI status have a direct impact on the productivity of a firm remains an empirical question.
While older firms may be more established and therefore can withstand a low productivity shock,
they may also be more organized and therefore are more productive. Likewise, FDI firms may be
able to weather low productivity draw, but they may also be more productive due to the transfer
of technology from the parent firms. These scenario make \( \alpha_{A} \) and \( \alpha_{F} \) to have ambiguous signs a
priori. We will be able to test the effect of age and FDI status on productivity in the empirical
section. The last term, \( \eta_{it} \), is the truly unobserved classical error term.

Taking log of (27) and using (28), we have

\[
y_{it} = \alpha_{t} + \alpha_{A}a_{it} + \alpha_{F}FDI_{i} + \alpha_{L}l_{it} + \alpha_{M}m_{it} + \alpha_{K}k_{it} + \omega_{it} + \eta_{it},
\]

(29)

with all lower case letters are in logs. In logs, output is linearly related to the two variable inputs,
labor and materials, as well as the fixed input, capital stock. Given that \( \omega_{it} \) is observable to the
firms (but not to the researchers) before the variable input choices are made, it could be positively
correlated with \( l_{it} \) and \( m_{it} \), which would cause the least squares estimates of \( \alpha_{L} \) and \( \alpha_{M} \) to be
biased upward. However, for the woven industry, \( \omega_{it} \) and \( m_{it} \) could be negatively correlated since
more productive firms could manage to use less material while satisfying ROOs, and this would
cause the least squares estimate of \( \alpha_{M} \) to be downward biased. In addition, if larger, older firms
tend to stay in business despite low productivity, while younger, smaller firms tend to quit more
easily, such endogenous exit decisions on the part of firms will bias the least squares estimates of
the \( \alpha_{A} \) and \( \alpha_{K} \) downwards.

A.3 Estimating Productivity

To address such input endogeneity and selectivity bias, OP derive a 3-step procedure to obtain
consistent estimates of the \( \alpha \)'s. In their model, firms choose to exit or not once they know their
productivity. If they do not exit, they decide on how much to invest and make other output and

\(^{19}\)Given that all firms are exporters in our data set, \( a_{AA}a_{it} \), may also capture the effect of export experience on
productivity due to possibly learning-by-exporting.
input decisions. The productivity, \( \omega_{it} \), is assumed to be the only unobserved state variable in each year \( t \) that follows a common exogenous Markov process, which, jointly with fixed input, \( k_{it} \), and its age, determines the exit decision and investment demand, \( i_{it} \), of the firms in each period. They consider the Markov perfect Nash equilibrium, so firm’s expectations match the realization of future productivity. Then a polynomial function of \( i_{it}, k_{it} \), and (the log of ) age, \( a_{it} \), can be used to proxy for the unobserved productivity, \( \omega_{it} \). This is possible because, given \( k_{it} \) and \( a_{it} \), \( i_{it} \) is an increasing function of \( \omega_{it} \), which makes the investment function invertible. The assumption that investment is monotonically increasing with the unobserved productivity is crucial, since without it, invertibility is likely not possible. Furthermore, to control for the exit decision, they estimate a Probit regression to obtain the surviving probability and use that to control for the part of unobserved productivity that is negatively correlated with \( k_{it} \).

In our current data set, it is likely that (in addition to the unobserved productivity) firm’s investment decisions also depend on the FDI status of the firms, since FDI firms may choose to stay in business and continue to invest despite low productivity draws. This is quite evident from Table 1, where FDI firms are shown to be larger and invest more than the domestic firms. This may also suggest that FDI firms face different market structure and factor prices as the domestic firms.

To accommodate such facts, we modify OP along the lines suggested by Ackerberg, Benkard, Berry and Pakes (2006) and De Loecker (2007). Specifically, when studying the effect of exporting on firm productivity, De Loecker (2007) allows exporter to have a different investment function.\(^{20}\) In our context, given that all firms are exporters, but only some firms are FDI firms, we allow the investment function to be indexed by their FDI status,\(^{21}\)

\[
i_{it} = i_{FDI,t} (k_{it}, a_{it}, \omega_{it}) .
\]

This allow FDI firms to react differently than domestic firms when it comes to investment decision,

\(^{20}\) Alternatively, one could have modeled FDI status as a state variable, similar to capital, age and productivity, as the past exporter status in Van Biesebroeck (2006). However, this requires that FDI status changes within firms over time for some firms in the sample. This is not the case for our data set. All firms are observed either have no foreign ownership for the whole sample period, or have same FDI status throughout the sample period. Without the evolution of FDI status, it is not possible to model it as a state variable.

\(^{21}\) FDI dummy equals one when the firms have any foreign equity. In our sample, the minimum foreign ownership is 25 percent.
as capital, or age, or productivity of the firms changes. Controlling for capital, age and FDI status, the investment function is assumed to be invertible, as in the original OP set up, such that we can use a separate polynomial function of investment, capital and age as controls for the unobserved productivity, for the FDI firms and domestic firms.\footnote{Using the same data set, Demidova, Kee and Krishna (2008) estimate firm productivity, allowing for firm-market specific demand shocks. In their context, it is crucial to control for market demand shocks as they are trying to explain the breakdown of the hierarchy of firm in terms of productivity in sorting themselves into different markets. In our current application, we are most concerned about how FDI firms affect the productivity of domestic firms endogeneously through the spillover channels.}

\[ \omega_{it} = i_{FDI,t}^{-1}(k_{it}, a_{it}, i_{it}) = h_{FDI,t}(k_{it}, a_{it}, i_{it}). \]  

(30)

In other words, we can proxy the unobserved firm productivity parsimoniously with a polynomial function \( h_{FDI,t}(k_{it}, a_{it}, i_{it}) \). In addition of the FDI status, we also allow the polynomial function to be different in different time period, which explains why we index the function with \( t \). This is because the EU, the main market for garment exporters from Bangladesh, introduced the “Everything-but-Arms” (EBA) initiative in 2001, which officially removed all quota restrictions and tariff on Bangladeshi garment export. Such policy may significantly alter the market structure and factor prices of the firms. To accommodate this, we allow the polynomial function to differ between the pre- and post-EBA period. In other words, we proxy the unobserved firm productivity with 4 different polynomial functions – domestic firms in period 1999-2000; FDI firms in period 1999-2000; domestic firms in period 2001-2003; FDI firms in period 2001-2003. The coefficients of these polynomial functions are free to be different to reflect the different market conditions.

Thus our first stage estimation involves using a polynomial function \( h_{FDI,t}(k_{it}, a_{it}, i_{it}) \) to control for \( \omega_{it} \) in order to estimate the \( \alpha \) coefficients on the variable inputs, \( l_{it} \) and \( m_{it} \), which are decided after \( \omega_{it} \) are observed.

\[ y_{it} = \alpha_t + \alpha_L l_{it} + \alpha_M m_{it} + \alpha_K k_{it} + \alpha_A a_{it} + \alpha_F FDI_i + \nu_{FDI,t}(k_{it}, a_{it}, i_{it}) + \epsilon_{it}, \] 

(32)

\[ \nu_{FDI,t}(k_{it}, a_{it}, i_{it}) = \alpha_t + \alpha_K k_{it} + \alpha_A a_{it} + \alpha_F FDI_i + \omega_{it}, \] 

(33)

combines \( \alpha_t, \alpha_K k_{it}, \alpha_A a_{it} \) and \( \alpha_F FDI_i \) with \( h_{FDI,t}(.) \). Provided that \( h_{FDI,t}(.) \) is successful in
controlling for \( \omega_{it} \), the least squares estimates for \( \alpha_L \) and \( \alpha_M \) are consistent, and we denote them as \( \hat{\alpha}_L \) and \( \hat{\alpha}_M \).

To estimate \( \alpha_K \) and \( \alpha_A \), we need to control for the propensity to exit to address the endogenous exiting which is affected by size and age of the firms. For each firm \( i \), in order to maximize the present discounted value of current and future profits, the optimal exit rule having observed \( \omega_{it} \) is

\[
\chi_{it} = \begin{cases} 
1 \text{ (continue)} & \text{if } \omega_{it} \geq \bar{\omega}_{FDI,t} (k_{it}, a_{it}), \\
0 \text{ (exit)} & \text{otherwise},
\end{cases}
\]

(34)

where \( \bar{\omega}_t \) is the cutoff productivity to continue exporting.

Thus, the probability for firm \( i \) to survive in year \( t + 1 \) given information set in year \( t \), \( J_t \), is

\[
\Pr \left( \chi_{it+1} = 1 | J_t \right) = \Pr \left( \omega_{it+1} > \bar{\omega}_{FDI,t+1} (k_{it+1}, a_{it+1}) | J_t \right)
\]

\[
= \varphi_t \left( \omega_{it}, \bar{\omega}_{FDI,t+1} (k_{it+1}, a_{it+1}) \right)
\]

\[
= \varphi_{FDI,t} \left( \omega_{it}, k_{it+1}, a_{it+1} \right)
\]

\[
= \varphi_{FDI,t} (k_{it}, a_{it}, i_{it}) = P_{it+1}
\]

(35)

where the first equality holds because of the exit rule (34), the second and third equalities holds due to the assumption of the exogenous Markov process of \( \omega_{it} \), and the last equality holds because the investment function \( i_{it} = i_{FDI,t} (k_{it}, a_{it}, \omega_{it}) \) is a bijection in \( \omega_{it} \) conditional on \( (k_{it}, a_{it}) \), and \( k_{it+1} \) and \( a_{it+1} \) can be inferred from \( k_{it}, i_{it} \) and \( a_{it} \), from their laws of motion,

\[
K_{it+1} = K_{it} (1 - \delta) + I_{it+1}, \text{ and } A_{it+1} = A_{it} + 1.
\]

(36)

In other words, in second stage, we can estimate the survival probability in \( t + 1 \) non-parametrically using a period specific polynomial function of \( (k_{it}, a_{it}, i_{it}) \) in a probit regression. This would allow factors like the existence of the EBA to affect exit decisions. We denote the estimated survival probability in \( t + 1 \) as \( \hat{P}_{it+1} \).

According to (29), the expected value of output net of influence of labor and material in \( t + 1 \),
given the information set in $t$ and survival in $t + 1$ is

$$
E \left[ y_{it+1} - \alpha_L l_{it+1} - \alpha_M m_{it+1} | J_{it}, \chi_{it+1} = 1 \right] = \alpha_{t+1} + \alpha_A a_{it+1} + \alpha_F FDI_i + \alpha_K k_{it+1} + E \left[ \omega_{it+1} | J_{it}, \chi_{it+1} = 1 \right] = \alpha_{t+1} + \alpha_A a_{it+1} + \alpha_F FDI_i + \alpha_K k_{it+1} + g \left( \omega_{it}, \mathbf{P}_{it+1} \right) = \alpha_{t+1} + \alpha_A a_{it+1} + \alpha_F FDI_i + \alpha_K k_{it+1} + g' \left( \nu_t - \alpha_t - \alpha_K k_{it} - \alpha_A a_{it} - \alpha_F FDI_i, \mathbf{P}_{it+1} \right) (37)
$$

where the first equality holds because $a_{it+1}$ and $k_{it+1}$ are known in $t$ due to (36). Given the assumption of Markov process, $\omega_{it+1}$ only depends on $\omega_{it}$ and the probability of surviving in $t + 1$ is given in (35).

Equation (37) suggests that we run the following nonlinear estimation in the third stage with $g' \left( \nu_t - \alpha_t - \alpha_K k_{it} - \alpha_A a_{it} - \alpha_F FDI_i, \mathbf{P}_{it+1} \right)$ being approximated parsimoniously with a polynomial function, to obtain $\alpha_t, \alpha_A, \alpha_F$ and $\alpha_K$.

$$
y_{it+1} - \hat{\alpha}_L l_{it+1} - \hat{\alpha}_M m_{it+1} = \left( \alpha_L - \hat{\alpha}_L \right) l_{it+1} + \left( \alpha_M - \hat{\alpha}_M \right) m_{it+1} + \alpha_{t+1} + \alpha_A a_{it+1} + \alpha_F FDI_i + \alpha_K k_{it+1} + g' \left( \nu_t - \alpha_t - \alpha_K k_{it} - \alpha_A a_{it} - \alpha_F FDI_i, \mathbf{P}_{it+1} \right) + \zeta_{it} + \eta_{it}, \quad (39)
$$

where by construction, $E \left[ \zeta_{it} + \eta_{it} | J_{it}, \chi_{it+1} = 1 \right] = 0$, and $\hat{\alpha}_L, \hat{\alpha}_M$ and $\hat{\nu}_t$ are obtained from the first stage least squares regression and $\hat{\mathbf{P}}_{it+1}$ is from the second stage probit regression. We also include $l_{it+1}$ and $m_{it+1}$ on the right hand side of (38) as over-identifying restriction tests on the validity of $\hat{\alpha}_L$ and $\hat{\alpha}_M$. If the polynomial function, $h_{FDI,t} \left( k_{it}, a_{it}, i_{it} \right)$, is successful in controlling for $\omega_{it}$, and thus $\hat{\alpha}_L$ and $\hat{\alpha}_M$ are consistent, then there should have no variation of $l_{it+1}$ and $m_{it+1}$ left in (38) and the estimated coefficients should be zero.\(^{23}\) Failing to reject null hypothesis that the estimated coefficients on $l_{it+1}$ and $m_{it+1}$ are insignificant also indicates that there are no systematic measurement errors in $l_{it}$ and $m_{it}$ that are correlated with firm productivity.

\(^{23}\)In fact when we do not use $x_{it}^E$ and $x_{it}^U$ as controls for market specific demand shocks, $\mu_{it}^E$ and $\mu_{it}^U$, the one of overidentifying restriction tests was negative indicating that the $\omega_{it}$ cannot be proxied by the polynomial of $i_{it}, k_{it}$ and $a_{it}$, suggesting the inversion of $T_t$ was not valid.
A.4 Regression Results

The results of the regressions are reported in Table 12. Columns (1) to (3) present the results for the non-woven industry, and (4) to (6) are for the woven industry. The OLS estimations with no correction for endogeneity, selectivity, or year fixed effects are reported in (1) and (4). These estimates are likely to be biased as argued.

Columns (2) and (5) report the first stage results of the extended OP procedure, where a 3rd order polynomial function of investment, capital, age and FDI status (which is allowed to differ pre and post EBA) is included as a control for the unobserved firm productivity, as well as the year fixed effects. For the non-woven industry, both the coefficients on labor and materials are now lower as expected, which suggests that the endogeneity issue was important. For the woven industry, while the coefficient of labor is lower, the coefficient on materials is now higher. The higher estimate for $\alpha_M$ suggests that material input is negatively correlated with productivity in the woven industry. This could be because high productivity firms manage to save on costly domestic materials in order to satisfy the ROOs requirement in the EU market under the EBA. To check for this point, we re-run Columns (4) and (5) for those firms that do not export to the EU and therefore are not subjected to EU’s stringent ROOs requirement in the woven industry. For these firms productivity and material input should be positively correlated. The result supports our conjecture – for such firms the least squares estimate $\alpha_M$ is 0.475, which is higher than the first stage estimate of $\alpha_M$, which is 0.330.

Given the estimates presented in Columns (2) and (5), Columns (3) and (6) present the third stage estimates with correction for selectivity bias to obtain the estimates for the coefficients of capital and age. Relative to the OLS estimates in Columns (1) and (4), the estimated coefficient on capital for non-woven industry increases from 0.172 to 0.303, while for woven industry, it increases from -0.043 to 0.122 and is now statistically significant. These estimates suggest that endogenous exit decision is very important. Coefficients on age and FDI status do not appeal to be significant in both industries suggesting that age and FDI status do not shift the production function of the firms. We will formally test the effects of age and FDI status in the next section.

Finally, coefficients on labor and material in Columns (3) and (6) are not statistically significant

---

24 We checked that on average, sweaters and knitwear look alike so that we are not doing violence to the data in pooling them.
suggesting that $\bar{v}_{FDI,t}(k_{it}, a_{it}, i_{it})$ are sufficient in controlling for $\omega_{it}$ and that there is no further correlation between these variable inputs and the unobserved productivity. This also indicates that there is no systematic measurement errors in labor and materials.\(^{25}\)

Firm productivity is constructed based on the results presented in Columns (3) and (6) and forms the basis of our empirical exercise.\(^{26}\)

\[
\text{Non-Woven: } \ln \phi_{it} = y_{it} - 0.156m_{it} - 0.283l_{it} - 0.303k_{it}, \tag{40}
\]
\[
\text{Woven: } \ln \phi_{it} = y_{it} - 0.549m_{it} - 0.357l_{it} - 0.122k_{it}. \tag{41}
\]

Note that since the production functions are estimated separately in the two industries, we restrict our empirical exercises only to within industry comparisons of firm productivity, in order to avoid questionable cross regression comparisons.\(^{27}\)

\(^{25}\)There may be a concern that labor and materials have measurement errors that are correlated with productivity. For example, material costs may be inflated more for the more productive firms in order to cheat on taxes, and more productive firms may higher better workers. In addition to the overidentifying restriction tests here we also follow Griliches and Hausman (1986) to test for such errors in variable problem. This test result also shows that measurement errors are not relevant in the estimations.

\(^{26}\)How different are these estimates compare to Demidova, Kee and Krishna (2008), when market specific demand shocks are controlled for instead of the FDI status of the firms? While the point estimates of $\alpha_L$, $\alpha_M$, and $\alpha_K$ are slightly different between the two versions, simple t-tests reveal that the differences are not statistically significant with 95% confidence level.

\(^{27}\)There may be a concern that non-woven industry appears to have decreasing returns to scales, based on the point estimates of Equation (40),

\[\hat{\alpha}_M + \hat{\alpha}_L + \hat{\alpha}_K = 0.8.\]

We tested for the following null hypothesis of constant returns to scales:

\[H_0 : \alpha_M + \alpha_L + \alpha_K = 1.\]

Based on the bootstrapped standard error of 0.33, the t-statistic is -0.61, which is not statistically different from 0. Thus the constant returns to scale hypothesis is not rejected.
Figure 1: Numbers of Garment FDI firms and Local Suppliers In Bangladesh (1984=1)

- **Blue line**: number of local suppliers
- **Green line**: number of FDI firms


Values: 0, 2, 4, 6, 8, 10, 12
Figure 2: The Shares of FDI Firms in Bangladesh’s Apparel Sector, 1999-2003

Table 1: Sample Averages

<table>
<thead>
<tr>
<th></th>
<th>Non-woven Domestic</th>
<th>FDI</th>
<th>Woven Domestic</th>
<th>FDI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sales</td>
<td>2648.90</td>
<td>3894.15</td>
<td>2656.05</td>
<td>14200.00</td>
</tr>
<tr>
<td>Export</td>
<td>2538.41</td>
<td>3662.36</td>
<td>2620.61</td>
<td>14200.00</td>
</tr>
<tr>
<td>Material</td>
<td>1722.67</td>
<td>2527.50</td>
<td>1874.64</td>
<td>9665.94</td>
</tr>
<tr>
<td>Imported material</td>
<td>1013.16</td>
<td>2150.88</td>
<td>1494.03</td>
<td>8393.14</td>
</tr>
<tr>
<td>Employee (number)</td>
<td>639.55</td>
<td>946.57</td>
<td>571.81</td>
<td>1877.64</td>
</tr>
<tr>
<td>Investment</td>
<td>138.69</td>
<td>137.59</td>
<td>49.04</td>
<td>266.04</td>
</tr>
<tr>
<td>Capital</td>
<td>580.10</td>
<td>1582.38</td>
<td>734.65</td>
<td>4103.32</td>
</tr>
<tr>
<td>Age (year)</td>
<td>5.23</td>
<td>6.10</td>
<td>7.98</td>
<td>7.29</td>
</tr>
<tr>
<td>Number of firms</td>
<td>89</td>
<td>15</td>
<td>167</td>
<td>26</td>
</tr>
</tbody>
</table>

Note: All values are in US$000, except otherwise specified.
Figure 3: An Example on the Calculations of Industry Foreign Presence vs Sibling Foreign Presence

\[ \text{Industry foreign presence} = \sum_{i} \text{FP}_i \]
\[ \text{Sibling foreign presence for } A = (\text{FP}_{1A} + \text{FP}_{2A}) + (\text{FP}_{2A} + \text{FP}_{3A}) \]
\[ \text{Sibling foreign presence for } B = (\text{FP}_{2A} + \text{FP}_{3A}) + \text{FP}_{4A} \]

Figure 4: Output variety increases as PPF shifts out due to an increase in input variety
### Table 2: Sample Averages for Domestic firms

<table>
<thead>
<tr>
<th></th>
<th>Non-woven</th>
<th>Woven</th>
</tr>
</thead>
<tbody>
<tr>
<td>Industry foreign presence</td>
<td>28.68</td>
<td>36.43</td>
</tr>
<tr>
<td>FDI sibling</td>
<td>15.57</td>
<td>51.91</td>
</tr>
<tr>
<td>Sibling foreign presence</td>
<td>0.48</td>
<td>6.08</td>
</tr>
<tr>
<td>FDI product rival</td>
<td>89.52</td>
<td>92.93</td>
</tr>
<tr>
<td>Product rival foreign presence</td>
<td>13.48</td>
<td>36.61</td>
</tr>
<tr>
<td>FDI market rival</td>
<td>97.60</td>
<td>97.31</td>
</tr>
<tr>
<td>Market rival foreign presence</td>
<td>2.12</td>
<td>10.58</td>
</tr>
</tbody>
</table>

Note: All values are in percent.

### Table 3: Dependent variable: Log of Domestic Materials

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>FDI dummy variable</td>
<td>0.479***</td>
<td>0.336</td>
<td>0.440**</td>
<td>0.268</td>
<td>0.044</td>
</tr>
<tr>
<td></td>
<td>(0.166)</td>
<td>(0.205)</td>
<td>(0.196)</td>
<td>(0.205)</td>
<td>(0.201)</td>
</tr>
<tr>
<td>EU exporter dummy</td>
<td>0.363***</td>
<td>0.295**</td>
<td>0.194</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.110)</td>
<td>(0.141)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>US exporter dummy</td>
<td>-0.211***</td>
<td>-0.340***</td>
<td>0.194</td>
<td>-0.313***</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.071)</td>
<td>(0.060)</td>
<td></td>
<td>(0.156)</td>
<td></td>
</tr>
<tr>
<td>Productivity (TFP)</td>
<td>0.223***</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.045)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Capital stock</td>
<td>0.284***</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.045)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>0.163***</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.049)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Output</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.479***</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(0.033)</td>
</tr>
<tr>
<td>Industry-location-year fixed effects</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.0120</td>
<td>0.1026</td>
<td>0.1135</td>
<td>0.2028</td>
<td>0.2962</td>
</tr>
<tr>
<td>Observations</td>
<td>1143</td>
<td>1143</td>
<td>1143</td>
<td>1106</td>
<td>1143</td>
</tr>
</tbody>
</table>

Notes: Standard errors in parentheses are clustered by industry-location-year.
* *, ** *, *** indicate statistical significance at 90%, 95% and 99% confidence levels.
Productivity, capital stock, age and output are all in logs.
Productivity is constructed from columns (1) and (4) of Table 12.
<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>FDI siblings that export to EU</td>
<td>0.07***</td>
<td>0.09***</td>
<td>0.04***</td>
<td>0.04***</td>
</tr>
<tr>
<td></td>
<td>(0.01)</td>
<td>(0.01)</td>
<td>(0.01)</td>
<td>(0.01)</td>
</tr>
<tr>
<td>FDI siblings that export to EU*</td>
<td>0.02***</td>
<td>0.04***</td>
<td>0.01*</td>
<td>0.01***</td>
</tr>
<tr>
<td>Woven*EBA</td>
<td>(0.00)</td>
<td>(0.01)</td>
<td>(0.00)</td>
<td>(0.00)</td>
</tr>
<tr>
<td>Observations</td>
<td>104</td>
<td>104</td>
<td>1000</td>
<td>1000</td>
</tr>
<tr>
<td>F-stat</td>
<td>127.71***</td>
<td>202.79***</td>
<td>14.84***</td>
<td>13.46***</td>
</tr>
</tbody>
</table>

Notes: All columns include firm fixed effects, industry-region-year fixed effects, firm age, share of imported materials and share of material in sales. Standard errors are clustered by industry-year. *, **, *** indicate statistical significance at 90%, 95% and 99% confidence levels. Columns (2) and (4) also include firm specific time trend.
<table>
<thead>
<tr>
<th>Dependent Variables</th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
<th>(6)</th>
<th>(7)</th>
<th>(8)</th>
<th>(9)</th>
<th>(10)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sibling Foreign Presence</td>
<td>3.01***</td>
<td>14.51***</td>
<td>6.17***</td>
<td>24.42***</td>
<td>5.42***</td>
<td>24.53***</td>
<td>2.02**</td>
<td>12.04***</td>
<td>1.90*</td>
<td>10.86***</td>
</tr>
<tr>
<td></td>
<td>(0.41)</td>
<td>(1.50)</td>
<td>(1.14)</td>
<td>(1.41)</td>
<td>(1.36)</td>
<td>(1.36)</td>
<td>(0.84)</td>
<td>(0.72)</td>
<td>(0.92)</td>
<td>(0.55)</td>
</tr>
<tr>
<td>Age</td>
<td>0.20</td>
<td>-0.13</td>
<td>0.68</td>
<td>0.15</td>
<td>0.60</td>
<td>0.05</td>
<td>0.30</td>
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<td>0.19</td>
<td>-0.07</td>
</tr>
<tr>
<td></td>
<td>(0.28)</td>
<td>(0.08)</td>
<td>(0.41)</td>
<td>(0.12)</td>
<td>(0.42)</td>
<td>(0.12)</td>
<td>(0.18)</td>
<td>(0.07)</td>
<td>(0.17)</td>
<td>(0.09)</td>
</tr>
<tr>
<td>Imported Materials/Materials</td>
<td>-0.70</td>
<td>-0.74**</td>
<td>-1.42*</td>
<td>-1.49***</td>
<td>-1.57*</td>
<td>-1.64***</td>
<td>-0.84*</td>
<td>-0.88***</td>
<td>-0.89**</td>
<td>-0.92***</td>
</tr>
<tr>
<td></td>
<td>(0.52)</td>
<td>(0.36)</td>
<td>(0.75)</td>
<td>(0.49)</td>
<td>(0.83)</td>
<td>(0.55)</td>
<td>(0.42)</td>
<td>(0.31)</td>
<td>(0.37)</td>
<td>(0.25)</td>
</tr>
<tr>
<td>Material/Sales</td>
<td>-0.06</td>
<td>0.68</td>
<td>0.10</td>
<td>1.28</td>
<td>0.21</td>
<td>1.45</td>
<td>-0.34</td>
<td>0.30</td>
<td>-0.33</td>
<td>0.24</td>
</tr>
<tr>
<td></td>
<td>(1.03)</td>
<td>(0.64)</td>
<td>(1.73)</td>
<td>(0.88)</td>
<td>(1.81)</td>
<td>(0.95)</td>
<td>(1.14)</td>
<td>(0.66)</td>
<td>(1.03)</td>
<td>(0.62)</td>
</tr>
<tr>
<td>Observations</td>
<td>116</td>
<td>113</td>
<td>116</td>
<td>113</td>
<td>116</td>
<td>113</td>
<td>118</td>
<td>104</td>
<td>104</td>
<td>100</td>
</tr>
</tbody>
</table>

Notes: All dependent variables are in log. TFP_OLS is from (1) and (4) of Table 12; TFP_AOP is from (3) and (6) of the same table. Firm fixed effects and industry-region-year fixed effects are included in all columns. Robust standard errors in parentheses are clustered by industry-year, with degree of freedom adjustment for small sample. *, **, *** indicate statistical significance at 90%, 95% and 99% confidence levels. Sample only consists of Bangladeshi firms that do not export to the EU.
Table 6: Restricted Sample of Domestic Firms with Firm specific Time Trend

<table>
<thead>
<tr>
<th>Dependent Variables</th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
<th>(6)</th>
<th>(7)</th>
<th>(8)</th>
<th>(9)</th>
<th>(10)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>LS</td>
<td>IV</td>
<td>LS</td>
<td>IV</td>
<td>LS</td>
<td>IV</td>
<td>LS</td>
<td>IV</td>
<td>LS</td>
<td>IV</td>
</tr>
<tr>
<td>Product Scope</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sales per Worker</td>
<td>2.21*</td>
<td>7.30***</td>
<td>4.85*</td>
<td>18.43***</td>
<td>4.92*</td>
<td>18.40***</td>
<td>2.47**</td>
<td>9.05***</td>
<td>2.53**</td>
<td>8.33***</td>
</tr>
<tr>
<td>(1.07)</td>
<td>(0.52)</td>
<td>(2.23)</td>
<td>(1.07)</td>
<td>(2.27)</td>
<td>(1.15)</td>
<td>(1.03)</td>
<td>(0.55)</td>
<td>(1.00)</td>
<td>(0.55)</td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>1.52</td>
<td>0.59***</td>
<td>1.43</td>
<td>-1.06</td>
<td>1.51</td>
<td>-0.96</td>
<td>0.57</td>
<td>-0.63**</td>
<td>0.45</td>
<td>-0.62*</td>
</tr>
<tr>
<td>(1.08)</td>
<td>(0.23)</td>
<td>(3.28)</td>
<td>(0.67)</td>
<td>(3.23)</td>
<td>(0.71)</td>
<td>(1.45)</td>
<td>(0.28)</td>
<td>(1.43)</td>
<td>(0.34)</td>
<td></td>
</tr>
<tr>
<td>Imported Materials/Materials</td>
<td>0.17</td>
<td>-0.06</td>
<td>-0.21</td>
<td>-0.81***</td>
<td>-0.22</td>
<td>-0.81***</td>
<td>-0.21</td>
<td>-0.50***</td>
<td>-0.19</td>
<td>-0.45***</td>
</tr>
<tr>
<td>(0.36)</td>
<td>(0.16)</td>
<td>(0.85)</td>
<td>(0.15)</td>
<td>(0.84)</td>
<td>(0.16)</td>
<td>(0.43)</td>
<td>(0.10)</td>
<td>(0.43)</td>
<td>(0.11)</td>
<td></td>
</tr>
<tr>
<td>Material/Sales</td>
<td>-0.17</td>
<td>-0.01</td>
<td>0.92</td>
<td>1.34***</td>
<td>0.73</td>
<td>1.14***</td>
<td>-0.41</td>
<td>-0.21</td>
<td>-0.44</td>
<td>-0.29*</td>
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<tr>
<td>(0.64)</td>
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<td>(0.18)</td>
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</tr>
<tr>
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<td>116</td>
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</table>

Notes: All dependent variables are in log. TFP_OLS is from (1) and (4) of Table 12; TFP_AOP is from (3) and (6) of the same table. Firm fixed effects and industry-region-year fixed effects are included in all columns. Robust standard errors in parentheses are clustered by industry-year, with degree of freedom adjustment for small sample. *, **, *** indicate statistical significance at 90%, 95% and 99% confidence levels. Sample only consists of Bangladeshi firms that do not export to the EU. All columns include firm specific time trend.
Table 7: Full Sample of Domestic Firms

<table>
<thead>
<tr>
<th>Dependent Variables</th>
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<th>(9)</th>
<th>(10)</th>
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<tbody>
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<td></td>
<td>Product Scope</td>
<td>LS</td>
<td>IV</td>
<td>LS</td>
<td>IV</td>
<td>LS</td>
<td>IV</td>
<td>LS</td>
<td>IV</td>
<td>LS</td>
<td>IV</td>
</tr>
<tr>
<td>Sibling Foreign Presence</td>
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<td>1.18</td>
<td>3.37***</td>
<td>5.16***</td>
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<td>(0.72)</td>
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<tr>
<td>Age</td>
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<td>0.01</td>
<td>0.28***</td>
<td>0.27***</td>
<td>0.29***</td>
<td>0.28***</td>
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<td>0.24***</td>
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<td>0.19***</td>
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<td>(0.01)</td>
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<tr>
<td>Import Materials/Materials</td>
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<td>-0.10***</td>
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<td>0.18</td>
<td>0.15</td>
<td>0.15</td>
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<td>0.20*</td>
<td>0.16</td>
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<tr>
<td>Material/Sales</td>
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<td>0.04</td>
<td>1.00***</td>
<td>1.01***</td>
<td>0.81**</td>
<td>0.81***</td>
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<td>(0.02)</td>
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</table>

Notes: All dependent variables are in log. TFP_OLS is from (1) and (4) of Table 12; TFP_AOP is from (3) and (6) of the same table. Firm fixed effects and industry-region-year fixed effects are included in all columns. Robust standard errors in parentheses are clustered by industry-year, with degree of freedom adjustment for small sample.

* *, **, *** indicate statistical significance at 90%, 95% and 99% confidence levels. Sample consists of Bangladeshi firms that may or may not export to the EU.
Table 8: Full Sample of Domestic Firms with Firm Specific Time Trend

<table>
<thead>
<tr>
<th>Dependent Variables</th>
<th>Estimation Methods</th>
<th>LS</th>
<th>IV</th>
<th>LS</th>
<th>IV</th>
<th>LS</th>
<th>IV</th>
<th>LS</th>
<th>IV</th>
<th>LS</th>
<th>IV</th>
<th>LS</th>
<th>IV</th>
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<tbody>
<tr>
<td>Sibling Foreign Presence</td>
<td>0.94**</td>
<td>1.19***</td>
<td>2.15***</td>
<td>5.30***</td>
<td>1.97***</td>
<td>5.32***</td>
<td>1.08***</td>
<td>2.76***</td>
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<td>2.64***</td>
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<td></td>
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<tr>
<td>(0.32)</td>
<td>(0.20)</td>
<td>(0.20)</td>
<td>(0.39)</td>
<td>(0.17)</td>
<td>(0.38)</td>
<td>(0.09)</td>
<td>(0.12)</td>
<td>(0.09)</td>
<td>(0.08)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>0.06</td>
<td>0.06*</td>
<td>0.52***</td>
<td>0.49***</td>
<td>0.61***</td>
<td>0.58***</td>
<td>0.44***</td>
<td>0.42***</td>
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<td>0.26**</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>(0.05)</td>
<td>(0.03)</td>
<td>(0.15)</td>
<td>(0.10)</td>
<td>(0.13)</td>
<td>(0.09)</td>
<td>(0.11)</td>
<td>(0.07)</td>
<td>(0.11)</td>
<td>(0.07)</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Import Materials/Materials</td>
<td>-0.07**</td>
<td>-0.07***</td>
<td>0.39</td>
<td>0.39***</td>
<td>0.33</td>
<td>0.33**</td>
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<td>0.16**</td>
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<td>(0.03)</td>
<td>(0.02)</td>
<td>(0.21)</td>
<td>(0.14)</td>
<td>(0.21)</td>
<td>(0.14)</td>
<td>(0.11)</td>
<td>(0.08)</td>
<td>(0.08)</td>
<td>(0.06)</td>
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<td></td>
</tr>
<tr>
<td>Material/Sales</td>
<td>-0.00</td>
<td>-0.00</td>
<td>0.43</td>
<td>0.43**</td>
<td>0.23</td>
<td>0.23</td>
<td>-0.78**</td>
<td>-0.79***</td>
<td>-1.00**</td>
<td>-1.01***</td>
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<tr>
<td>(0.08)</td>
<td>(0.05)</td>
<td>(0.26)</td>
<td>(0.18)</td>
<td>(0.24)</td>
<td>(0.16)</td>
<td>(0.30)</td>
<td>(0.20)</td>
<td>(0.34)</td>
<td>(0.23)</td>
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<tr>
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</tbody>
</table>

Notes: All dependent variables are in log. TFP_OLS is from (1) and (4) of Table 12; TFP_AOP is from (3) and (6) of the same table. Firm fixed effects and industry-region-year fixed effects are included in all columns. Robust standard errors in parentheses are clustered by industry-year, with degree of freedom adjustment for small sample. *, **, *** indicate statistical significance at 90%, 95% and 99% confidence levels. Sample consists of Bangladeshi firms that may or may not export to the EU. All columns include firm specific time trend.
### Table 9: Robustness Checks – Other Sources of Spillovers

<table>
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<th>Dependent Variables</th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
<th>(6)</th>
<th>(7)</th>
<th>(8)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Product Foreign Presence</td>
<td>0.61</td>
<td>0.26</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
|                                              | (1.03)| (0.46) &nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&n...
Table 10: Robustness check based on industry foreign presence – Dependent variable: Log of TFP of Domestic Firms

<table>
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<tr>
<th>Estimation Methods</th>
<th>(1)</th>
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<th>(3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Industry foreign presence</td>
<td>-0.50**</td>
<td>0.37</td>
<td>-0.79</td>
</tr>
<tr>
<td></td>
<td>(0.18)</td>
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<td>(0.98)</td>
</tr>
<tr>
<td>Industry foreign presence*</td>
<td>0.23***</td>
<td>0.22***</td>
<td></td>
</tr>
<tr>
<td>FDI siblings</td>
<td>(0.06)</td>
<td>(0.06)</td>
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</tr>
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<td>Industry foreign presence*</td>
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<td>0.54</td>
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</tr>
<tr>
<td>FDI product rival</td>
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<td>(0.40)</td>
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<td>Industry foreign presence*</td>
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<td>-1.14</td>
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</tr>
<tr>
<td>FDI market rival</td>
<td>(0.79)</td>
<td>(0.79)</td>
<td></td>
</tr>
<tr>
<td>Total industry export to EU &amp; US</td>
<td>-0.25*</td>
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<td>(0.13)</td>
</tr>
<tr>
<td>Average productivity of industry</td>
<td>1.16**</td>
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<td>(0.49)</td>
</tr>
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</table>

Observations: 1041 1041 1041

Notes: Full sets of firm fixed effects and year fixed effects are included in all columns. Standard errors in parentheses are clustered by industry-year in (1)-(3). *, **, *** indicate statistical significance at 90%, 95% and 99% confidence levels.
<table>
<thead>
<tr>
<th>Dependent Variables</th>
<th>(1)</th>
<th>(2)</th>
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<th>(4)</th>
<th>(5)</th>
<th>(6)</th>
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<th>(8)</th>
<th>(9)</th>
<th>(10)</th>
<th>(11)</th>
<th>(12)</th>
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</thead>
<tbody>
<tr>
<td>Number of local input suppliers</td>
<td>0.27*</td>
<td>0.36***</td>
<td>0.20***</td>
<td>0.20**</td>
<td>0.26***</td>
<td>0.09**</td>
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<tr>
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<td>(0.12)</td>
<td>(0.14)</td>
<td>(0.01)</td>
<td>(0.01)</td>
<td>(0.01)</td>
<td>(0.01)</td>
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<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Number of total intermediate inputs</td>
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<td>0.12***</td>
<td>0.11***</td>
<td>0.11**</td>
<td>0.15***</td>
<td>0.04*</td>
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<tr>
<td></td>
<td>(0.05)</td>
<td>(0.05)</td>
<td>(0.01)</td>
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<td>(0.01)</td>
<td>(0.02)</td>
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<td>0.16**</td>
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<td>(0.05)</td>
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</tr>
<tr>
<td>Price of output</td>
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<td>-0.18***</td>
<td>-0.19***</td>
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<td></td>
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<tr>
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<td>(0.04)</td>
<td>(0.07)</td>
<td>(0.04)</td>
<td>(0.05)</td>
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</tr>
<tr>
<td>Price of intermediate inputs</td>
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<td>0.04</td>
<td>-0.14***</td>
<td>-0.20***</td>
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<td>(0.05)</td>
<td>(0.05)</td>
<td>(0.05)</td>
<td>(0.07)</td>
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<td></td>
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<td></td>
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<tr>
<td>Wages</td>
<td>29.27</td>
<td>13.48</td>
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</tr>
</tbody>
</table>

Notes: Full sets of firm fixed effects are included in all columns. Standard errors in parentheses are clustered by year. All variables are in logs. Excluded instruments for IV estimations are: number of FDI firms, international cotton fabrics price (in (4), (8) and (12) only), industry average TFP (in (11) and (12) only), and international cotton price (in (11) and (12) only). For (11) and (12), F-statistics are the lowest among the first stage regressions. First stage results are available upon request. *, **, *** indicate statistical significance at 90%, 95% and 99% confidence levels.
Table 12: Dependent variable: Log of output

<table>
<thead>
<tr>
<th>Industry</th>
<th>Dependent Variable</th>
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<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
<th>(6)</th>
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<tr>
<td></td>
<td></td>
<td>$y_{it}$</td>
<td>$y_{it}$</td>
<td>$y_{it+1} - 0.156m_{it+1}$</td>
<td>$y_{it+1} - 0.283l_{it+1}$</td>
<td>$y_{it+1}$</td>
<td>$y_{it+1} - 0.549m_{it+1} - 0.357l_{it+1}$</td>
</tr>
<tr>
<td>Non-woven</td>
<td>Materials</td>
<td>0.177***</td>
<td>0.156***</td>
<td>-0.004</td>
<td>0.524***</td>
<td>0.549***</td>
<td>0.013</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.051)</td>
<td>(0.046)</td>
<td>(0.040)</td>
<td>(0.044)</td>
<td>(0.045)</td>
<td>(0.028)</td>
</tr>
<tr>
<td>Non-woven</td>
<td>Labor</td>
<td>0.416***</td>
<td>0.283***</td>
<td>-0.019</td>
<td>0.396***</td>
<td>0.357***</td>
<td>-0.012</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.086)</td>
<td>(0.099)</td>
<td>(0.085)</td>
<td>(0.076)</td>
<td>(0.085)</td>
<td>(0.056)</td>
</tr>
<tr>
<td>Non-woven</td>
<td>Capital</td>
<td>0.121***</td>
<td></td>
<td>-0.013</td>
<td></td>
<td></td>
<td>0.122***</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.048)</td>
<td></td>
<td>(0.081)</td>
<td></td>
<td></td>
<td>(0.053)</td>
</tr>
<tr>
<td>Woven</td>
<td>Age</td>
<td>-0.085</td>
<td></td>
<td>-0.226</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.281)</td>
<td></td>
<td>(0.162)</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Woven</td>
<td>FDI</td>
<td>-0.370</td>
<td></td>
<td>-0.421</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.555)</td>
<td></td>
<td>(0.305)</td>
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</tr>
</tbody>
</table>

Endogeneity correction: 1
Selectivity correction: 2
Year fixed effects: 3
Observations: 4

Notes: Heteroscedasticity corrected white robust standard errors in parentheses.

1 A 2nd order polynomial function of age, capital, investment, FDI status are included.
2 A 3rd order polynomial function of propensity to stay in business and the fitted output net of labor and capital are included.
3 Columns (2) and (5) are for observations with positive investments.
4 Columns (3) and (6) lose one year of observations due to the lead variables.
5 *, **, *** indicate statistical significance at 90%, 95% and 99% confidence levels.