Local Intermediate Inputs, Foreign Direct Investment and the Performance of Domestic Firms: When Firms Share Common Local Input Suppliers*

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Abstract

This paper uses a unique, representative garment firm sample of Bangladesh to study how the increased presence of FDI firms causes domestic firms in the same industry to gain access to better quality and new varieties of *local* intermediate inputs, which enhance their product scope and productivity. Results from reduced form and structural regressions, derived from a multi-product firm model with love of variety for inputs, show that increased presence of FDI firms explains a quarter of the product scope expansion and a third of the productivity gains within domestic firms, driven largely by better and newer local intermediate inputs.
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Keywords: Intermediate Inputs, Foreign direct investment, Product Scope, Multi-product Firms, Productivity, Local Suppliers

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"*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

While new intermediate inputs play a critical role in explaining productivity gains and growth in many endogenous growth models, empirical supporting evidence has been scant. At a macro level, Feenstra (1994) is the first to estimate substantial gains from trade derived from using new *import* variety as a measure of new intermediate inputs. Broda and Weinstein (2006) further find significant gains in GDP of a country due to increased import variety that pushes down the import price index. It is not until recently that we begin to see some micro level evidence linking new *imported* intermediate inputs to the gains in product scope and productivity of domestic firms. In the context of input tariff reduction due to trade liberalization, Goldberg, Khandelwal, Pavcnik and Topalova (2010) find Indian firms expanding their output variety due to increased access to new imported intermediate input variety. Also Amiti and Konings (2007) show how Indonesian firms gain in terms of total factor productivity (TFP) due to input tariff cuts, which allow them to import more intermediate inputs. However, new intermediate inputs can also be produced *locally* and not necessarily acquired through imports. In fact, there is seldom any distinction made between imported and local intermediate inputs in explaining productivity gains in most models (Either, 1982; Romer 1990; Grossman and Helpman, 1991). For many developing countries with problematic trading infrastructure, promoting a viable intermediate input industry that offers high quality and more variety of intermediate inputs may have significant benefits to domestic final goods producers.

This paper looks at how the product scope and productivity of domestic firms may improve due to increased access to new and better varieties of *local* intermediate inputs caused by the larger presence of foreign direct investment (FDI) firms in the same industry. The focus is on those FDI firms that have clear linkages with the domestic economy – these FDI firms have local input suppliers, and share these local suppliers with some domestic firms in the same industry. Through raising the industry demand for better and more specialized local intermediate inputs, these FDI firms cause local intermediate input industries to provide higher quality and more varieties of local intermediate inputs. Consequently, domestic firms can also have better access to these improved and newer varieties of local inputs, which in turn enable them to produce more output variety and gain in productivity.

Firm level data of the Bangladeshi garment sector is specifically collected to study this issue.[1,2] The data set consists of a stratified random sample of 10 percent of the domestic firms and 100 percent of the FDI firms in the apparel sector of Bangladesh.[3] Each of these firms is asked to identify its top three local input suppliers. It is therefore possible to link each domestic firm only to a subset of FDI firms within the same industry that share its local input suppliers. 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*. 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 product scope and productivity of domestic firms to their individual sibling foreign presence. While product scope is measurable in the data, firm productivity is unobservable. This

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[2] Demidova, Kee and Krishna (2006) and Cherkashin, Demidova, Kee and Krishna (2010) also use 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. Both these papers do not look at local intermediate inputs and other factors that would affect product scope and productivity of firms.

[3] There were 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 the information necessary for the regression analysis. After dropping firms that have incomplete data, I am left with 41 FDI firms.

paper looks at multiple firm productivity measures, which include sales per worker, output per worker, and estimated TFP (OLS and augmented Olley-Pakes due to Ackerberg, Benkerd, Berry and Pakes (forthcoming)). By looking at a wide 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 very similar and consistent results.

The positive impacts of FDI firms on the quality and productivity of their local suppliers have been found in Javorcik (2004) and Javorcik and Spatareanu (2009), based on evidence from Lithuania and Czech Republic. This paper is taking one step forward by suggesting that these better local suppliers will further benefit those downstream domestic firms that also buy from them. Anecdotal evidence based on some follow up interviews with the local garment input suppliers in Bangladesh also support this point. In these interviews, FDI garment firms are often described as being "pickier" who demand higher quality inputs. Thus in order to meet the higher standards of the FDI firms, these local intermediate input suppliers need to improve their quality and consistency, which inevitably benefits their other clients who are domestic garment firms.[4] On the other hand, to illustrate that FDI firms promote new local intermediate input varieties, Figure 1 plots the number of FDI firms in the garment industry alongside the number of local input suppliers in the upstream industries in Bangladesh, from 1984 to 2003.[5] The two series are closely correlated and 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 the number of local input suppliers to increase and not the reverse.[6] Thus, in a way, a liberal FDI regime may compensate for an environment with high trade costs, due to tariffs, exchange rates, transport and communication costs, through its impact

[4] Follow up interviews with these local intermediate input suppliers indicate that supplying FDI firms is an important factor for these firms to enter the market, and most of these firms only sell to the FDI and domestic garment firms in Bangladesh and are not themselves exporting. These local suppliers also agree that FDI firms are "pickier," so to satisfy the FDI firms, these suppliers will need to improve their quality and consistency as well as expand their product variety, which subsequently benefit the domestic garment firms that also buy from them. The interviews are still on going and the results will be made available once they are completed.

[5] 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.

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

$$\begin{aligned} FDI_t &= \beta_0 + \beta_1 FDI_{t-1} + \beta_2 Suppliers_{t-1} + \varepsilon_{1t} \\ Suppliers_t &= \gamma_0 + \gamma_1 FDI_{t-1} + \gamma_2 Suppliers_{t-1} + \varepsilon_{2t} \end{aligned} \quad (1)$$

on the upstream local intermediate good sectors in terms of quality and product variety. 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. Nevertheless, local intermediate inputs are often preferred as they are not subjected to tariff and exchange rate risks, and could avoid problems due to unreliable customs clearing and shipping delays, significantly cutting down lead time for downstream firms. Moreover, firms may have better control over the quality and specification of these intermediate inputs as they may inspect or supervise the production process of their local suppliers.

To address possible endogeneity issues associated with relating firm performance to their sibling foreign presence, this paper exploits a natural experiment due to 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 product scope and productivity of these domestic firms. In 2000, the EU unexpectedly announced that it will implement the "Everything-But-Arms" (EBA) Initiative in 2001 which formally provides duty free and quota free access for all products from the 48 Least Developed Countries (LDC), including Bangladesh. Garment products from Bangladesh may enjoy such trade preferences if the rules of origins (ROO) are satisfied, which require final products to be made up of mostly local intermediate inputs. Depending on the sub-industry and export destinations, different FDI firms in Bangladesh reacted very differently to such a policy announcement – those woven FDI firms that were already exporting to the EU took advantage of the initiative by increasing their investment and hence their market presence. Their reaction also caused 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 affected the sibling foreign presence for domestic firms – domestic firms that have FDI siblings exporting to the EU saw an increase in their sibling foreign presence, while domestic firms that have FDI siblings which do not export to the EU experienced a decrease in their sibling foreign presence. Results show that such exogenous increase in the sibling foreign presence led to an expansion of product scope and productivity of

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$$\begin{aligned} FDI_t &= \beta_0 + \beta_1 FDI_{t-1} + \beta_2 Suppliers_{t-1} + \beta_3 trend_t + \varepsilon_{1t} \\ Suppliers_t &= \gamma_0 + \gamma_1 FDI_{t-1} + \gamma_2 Suppliers_{t-1} + \gamma_3 trend_t + \varepsilon_{2t} \end{aligned} \tag{2}$$

In both versions, F-tests reject the null hypothesis that $\beta_2 = 0$, with a 95% confidence level, while fail to reject the null hypothesis that $\gamma_1 = 0$.

domestic firms, even when these domestic firms did not themselves export to the EU. At the sample mean, sibling foreign presence is shown to explain about a quarter of the product scope expansion and a third of the productivity gains within firms, over the 5 year sample period, a result that is significant both statistically and economically.

To further examine the hypothesis that FDI firms cause the local input variety to increase, which subsequently increases the product scope and productivity of domestic firms, we rely on structural regressions, derived directly out of a simple multi-product firm model when firms have love of variety for inputs similar to Ethier (1982) and Rodriguez-Clare (1996). The model shows that a firm's TFP can be decomposed into two terms, one depending positively on input variety and one depending on unobserved firm productivity. In addition, the product scope of the firm depends positively on input variety, unobserved productivity, and real input prices. Through instrumental variable regressions, we show that an exogenous increase in the number of FDI firms in the garment sector causes the number of local input variety to increase, which leads to statistically significant productivity and product scope gains for domestic firms.

Besides the information on local suppliers, there are other traits of this data set that makes it well suited for this study. There is information in the data that allows us to construct firm specific price indexes for output and materials, which significantly improve the measurement of firms' output and productivity. Without firm specific output prices, most papers in the literature use some industry price indexes to deflate revenue of all firms in order to obtain their output level. Given that more productive firms are 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 use 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 common local input suppliers. This would cause material costs for domestic firms to be higher. However, given that we have firm specific material prices, we deflate higher material costs with higher prices, which does not affect the quantity of material used, and therefore does not affect 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 use common input suppliers with the FDI firms. This also highlights that the results of this paper are not driven by pecuniary externalities due to the presence of FDI firms.

Furthermore, this data set contains product and destination specific sales information for 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 spillovers from FDI firms to those domestic firms that produce the same products or export to the 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.

Given the emphasis of FDI firms benefitting domestic firms in the same industry through their use of common local input suppliers, the findings of this paper are also relevant for another literature, which focuses on horizontal spillovers from FDI firms to domestic firms. Theoretical papers in this area tend to conclude positive spillovers that support the result of this paper. 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 spillovers may take place, that 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 industries through backward linkages, which further foster the downstream industries through forward linkages. However, empirical results in this area are mixed. 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 of developing countries have found the opposite (Aitken and Harrison, 1999; Haddad and Harrison, 1993; Djankov and Hoekman, 2000; Konings, 2001).[7] However, none of these papers focus on FDI firms with backward linkages, while the theoretical models such as Rodriguez-Clare (1996) clearly emphasizes on this. This is the main point of departure of this current paper where all firms in our sample have backward linkages, and we link FDI and domestic firms based on their common local suppliers, which thus enable the channel of spillovers to be clearly identified.

The rest of the paper is organized as follows: Section 2 provides some definitions for the main variables used in the empirical analysis. Section 3 describes the data set and the policy environment during the sample period. Reduced form regression results are presented in Section 4, followed by some robustness checks in Section 5. Section 6 presents a simple multiproduct firm model and the structural regressions that are derived from it. Section 7 concludes. The Appendix of the paper provides some details on the construction of the firm specific price index and the estimation of firm productivity.

2 Definitions

Definition 1 Foreign presence (FP_{it}) *of firm* i *in year* t *is the product of firm's foreign ownership share* (FS_i) *and its capital share in industry* j *in year* t*,*

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

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

The reason capital share is used to measure the influence of a firm in an industry is because, unlike employment or output, which is highly endogenous to contemporary changes in firm productivity, by construction, capital is predetermined by the investment in period $t-1$.[8]

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

[7] One exception is Haskel, Pereira, and Slaughter (2007), who found small but statistically significant evidence of positive spillovers in a study of UK manufacturing plants.

[8] see Appendix on construction of capital and productivity estimation.

presence across all firms in j, in t,

$$IFP_{jt} \equiv \sum_{i \in j} FP_{it} = \frac{\sum_{i \in j} K_{it} FS_i}{\sum_{i \in j} K_{it}}. \tag{4}$$

It is also equivalent to averaging the foreign ownership share of each firm in the industry, with weights equal to each firm's capital share in the industry.

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

$$S^s_{ikt} = \begin{cases} 1, & \textit{if } s \in \mathbf{S}_{it} \cap \mathbf{S}_{kt} \\ 0, & \textit{if } s \notin \mathbf{S}_{it} \cap \mathbf{S}_{kt} \end{cases}. \tag{5}$$

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,

$$NS_{ikt} \equiv \sum_{s \in \mathbf{S}_{it}} S^s_{ikt}. \tag{6}$$

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 on 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 these newer suppliers, their sets of local suppliers exhibit year to year variations. This is why $\mathbf{S}_{it}$ 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,*

$$SFP_{it} \equiv \sum_{s \in \mathbf{S}_{it}} \sum_{k \in j} FP_{kt} S^s_{ikt} = \frac{\sum\limits_{k \in j} \sum\limits_{s \in \mathbf{S}_{it}} K_{kt} FS_k S^s_{ikt}}{\sum\limits_{k \in j} K_{kt}} = \frac{\sum\limits_{k \in j} K_{kt} FS_k \sum\limits_{s \in \mathbf{S}_{it}} S^s_{ikt}}{\sum\limits_{k \in j} K_{kt}} = \frac{\sum\limits_{k \in j} K_{kt} NS_{ikt} FS_k}{\sum\limits_{k \in j} K_{kt}}. \quad (7)$$

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, $FDIS_{it}$:

$$FDIS_{it} = \begin{cases} 1, & \text{if } SFP_{it} > 0 \\ 0, & \text{if } SFP_{it} = 0 \end{cases} . \quad (8)$$

In other words, $FDIS_{it}$ indicates wether 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. 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 percent of the total population of the domestic firms and 100 percent of FDI firms currently operating in the Bangladeshi garment sector. Sample is stratified to reflect the population distribution of firms by size, by industry (woven garments versus 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 five 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 reflecting the population of firms in the garment sector. Among the sampled firms, 14 percent have positive foreign equity, while the remaining 86 percent 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, purchase more material inputs, including imported materials, hire more employees, and have more capital. All these presumably suggest that foreign firms are more productive.

Note that, 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), but not necessarily more productive. 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.

Table 2 presents the sample means of industry foreign presence and FDI sibling and sibling foreign presence of domestic firms in the sample by industries. On average, there is more foreign presence in the woven industry than in the non-woven industry, judging by their industry foreign presence, although 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 the woven industry has FDI siblings, while only 18 percent of domestic firms in the non-woven industry has FDI siblings. Furthermore, the average sibling foreign presence in the woven industry is 5.4 percent, nearly 10 times higher than that of the 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 the non-woven industry 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.

3.1 Everything-But-Arms Initiative of the EU

In 2000, the EU announced that it will implement the "Everything-But-Arms" (EBA) initiative in 2001, which provides duty-free, quota-free access to imports from all 48 Least Developed Countries, Bangladesh being one of them. However, to enjoy such trade preference, rules of origin (ROOs) requirements of the products must be met. There are two sub-industries within the garment sector of Bangladesh, one consisting of firms producing woven apparels and the other consisting of firms producing non-woven apparels, such as knitwear and sweaters. These two industries have very distinct production techniques, and while any of the nonwoven apparel producing firms can easily satisfy ROOs, only the larger woven firms, many of which are FDI firms, find it profitable to meet ROOs by using local inputs that are typically more expensive.[9] Thus, the announcement of EBA in 2000 prompted differential impacts on the investment and capital share of the firms, depending on the sub-industry they are in and whether they export to the EU. 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 the woven sub-industry. 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. Conversely, the share of those FDI firms in the woven sub-industry 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. On the other hand, market presence of FDI firms in the non-woven sub-industry did not follow this pattern. Such distinct movements of market shares among different FDI firms in different sub-industries were a result of an unanticipated exogenous policy change in the EU that may have affected sibling foreign presence of some domestic firms. We will use the impact of the EBA announcement on the market presence of those FDI firms in the woven industry 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

[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.

literature that, while the more productive firms may self select into exporting, further exporting may not have feedback effects on the productivity of exporters (Clerides, Lach and Tybout, 1998; Bernard and Jensen, 1999). However, some recent papers find that exporting may further promote productivity gains (Van Biesebroeck, 2006; De Loecker, 2007; Fernandes, 2007). As a robustness check, we 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 the EU should not directly affect the productivity and performance of these firms.

3.2 Foreign Investment Policy of Bangladesh

Foreign investment policy of Bangladesh is governed by its industrial policy. According to the Industrial Policy (1999) of Bangladesh, during the sample period, while foreign investment was welcome in all sectors,[10] it was discouraged in the following areas: garments, banks, insurance companies, and other financial institutions. Such restrictions were relaxed in the Industrial Policy (2005). In other words, during our sample period, 1999-2003, while existing FDI firms were allowed to expand and invest with no restrictions on their capital and machinery, entry of new FDI firms in Bangladesh was very rare (only 6 new FDI firms were established during the period), and were 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 foreign firm entry was restricted by the government.

4 Reduced Form Regression Results

As mentioned above, there are two industries in the garment sector of Bangladesh, namely woven and non-woven. These two industries are characterized by very different production structures and techniques. The Appendix discusses how two separate industry specific production functions are estimated using Ackerberg et al (forthcoming) in a three step procedure that take into account endogeneity of labor and material inputs, and how input and investment decisions may depend on

[10] With the exception of (a) manufacturing of arms and ammunition or other defense equipment, (b) forest plantation and mechanized extraction of reserved forests, (c) the production of nuclear energy, and (d) security printing (currency notes) and minting.

the FDI status of firms. This technique is similar to De Loecker (2007), to allow production function to depend on exporter status. Here we focus on relating sibling foreign presence to product scope and sales per worker, output per worker and the estimated firm productivity. The appendix also contains a discussion on the construction of the very crucial firm specific price indexes. Output and material 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) describe as a "*pervasive problem in the literature on micro panels*" that uses industry prices in place of the often missing firm level prices.

4.1 Do FDI firms increase the demand for local intermediate inputs?

The main of this paper is about how the presence of foreign firms significantly increases 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 other comparable domestic firms in the same industry. The following regression is fitted:

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

The dependent variable of this table is the log of the value of domestic materials 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. The right-hand side variables may include industry-location-year fixed effects, α_{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 includes dummy variables for firms that export to the EU and the US. 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 α_{FDI} would suggest that, all else equal, a typical FDI firm uses more domestic materials than a domestic firm.

Due to space constraint, results of the regression are not reported in this paper, but is available upon request. Overall, the hypothesis that FDI firms typically demand more local inputs than other comparable domestic firms in the same industry cannot be rejected. Controlling for industry-local-year fixed effects and the export markets, the estimated α_{FDI} suggests that on average FDI firms demand 50 percent more domestic intermediate inputs than domestic firms, mainly driven by their larger 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. This result is also consistent with the sample averages listed in Table 1.

4.2 Do FDI firms improve the performance of 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:

$$\ln y_{it} = \alpha_i + \alpha_{jkt} + \alpha_{SFP} SFP_{it} + \mathbf{X}_{it}\boldsymbol{\beta} + \beta_i Trend_{it} + \upsilon_{it}, \tag{10}$$

where the dependent variable (y_{it}) includes the product scope, 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 α_{SFP} suggests the performance of domestic garment firms is enhanced due to the increased presence of their FDI siblings. We control for firm fixed effects, α_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 the market toughens due to the increased presence of FDI firms, while may be important, should not affect or explain the within coefficient on sibling foreign presence.

4.2.1 Omitted variable bias

Equation (10) controls for industry-location-year specific effects, α_{jkt}, to wipe out any macro omitted variables which are common among all firms within the same industry, location, and year and which 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. Equation (10) 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, $\mathbf{X}_{it}$, 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 practices are typical among firms that export to the US and these firms could be more productive as the US market is 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 sib-ling presence to be smaller and in turn inducing a downward bias on the coefficient for sibling foreign presence. To control for this, the share of imported materials in total materials of firms is included. Another possible omitted variable pertains to production techniques. Inefficient firms tend to waste material, which leads to a high material-to-sales ratio. The more materials a firm uses, the more likely it is that this firm has more FDI , as they may demand more domestic materials. This leads to larger within-firm year to year change in sibling foreign presence among unproductive firms that have high materials-to-sales ratio, which in turn leads to a downward bias on the coefficient on sibling foreign presence. Equation (10) also controls for materials-to-sales ratio in the regression. Finally, the age of a firm may also bias the estimate. Specifically older firms tend to be more productive, and older firms tend to work with the more established local suppliers which could be also preferred by FDI firms. This causes an upward bias on the coefficient of sibling foreign presence.

Finally, firm specific time trend, $Trend_{it}$, is also included to soak up any time movement of the variables on both sides of (10) that is specific to each firm. This would include some firm specific exogeneous shock that move $\ln y_{it}$ and SFP_{it} up simulteneously.

4.2.2 Selection bias, endogeneity and reverse causality

While the beauty of using sibling foreign presence is that SFP_{it} 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 reverse causality. One 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 α_{SFP}. There is also a concern that if a local supplier becomes exogenously better, it improves the performance of all its clients, and some FDI firms may expand their market presence as a result. Such simultaneity problems will also cause an upward bias in the least squares estimate of α_{SFP}. Finally, as a domestic firm becomes better over time, it may expand its own market share, causing the market share 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 reverse causality will result in a downward bias in the least squares estimate of α_{SFP}. Another source of downward bias in the least squares estimate of α_{SFP} is measurement errors. The overall bias in least squares estimate of α_{SFP} is not clear, it depends on whether reverse causality and measurement errors dominate selection and endogeneity biases.

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 the "Everything-But-Arms" (EBA) Initiative in 2001, which would formally grant duty-free and quota-free access to the EU market for products from the 48 Least Developed Countries, including Bangladesh. Table 3 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, $FDIS\_EU_{it}$, and the triple interaction term between $FDIS\_EU_{it}$, an EBA dummy that equals to one for 2000 onwards and a woven industry dummy variable:

$$SFP_{it} = \gamma_1 FDIS\_EU_{it} + \gamma_2 FDIS\_EU_{it} * woven_i * EBA_t + \mathbf{Z}_{it}\boldsymbol{\gamma} + \zeta_{it}, \tag{11}$$

where $\mathbf{Z}_{it}$ has all the right-hand side variables of (10). We expect γ_1 and γ_2 to be positive, which would suggest that conditional on 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 the years following the announcement of EBA. Column (1) of Table 3 presents the results based on a subset of domestic firms that do not export to the EU, and Column (3) shows the first stage regression based on the full sample of domestic firms who may or may not export to the EU. 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 γ_1 and γ_2 are positive and statistically significant, with F-statistics that are greater than 10, suggesting that these instrumental variables have explanatory power on SFP_{it}.

Tables 4 and 5 present the second stage regressions according to (10), for the restricted sample of domestic firms that do not export to the EU and for the full sample of domestic firms that may or may not export to the EU. These tables also present the least square estimations and compare them to the IV estimates. In both the tables, the IV estimates for α_{SFP} are larger than the LS estimates, suggesting that the downward biases due to measurement errors and reverse 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, an exogenous increase in sibling foreign presence due to EBA causes these domestic firms to have better performance in terms of a higher product scope, sales per worker, output per worker, and TFP (estimated with OLS and the augmented Olley Pakes procedure). This is the sample of firms whose performance EBA should not have had a direct impact on other than through their FDI siblings that export to the EU, thus satisfying the exclusion restriction. These results are very similar in the full sample of domestic firms.

In summary, by exploiting exogenous changes in sibling foreign presence due to EBA, we show that domestic firms benefitted from the increased presence of their FDI siblings, a result that is driven by the improved access to better and new local input variety as the FDI garment firms push up their demand for local inputs. Based on the estimates in Columns (2) and (10) of Table 5, a one percent increase in sibling foreign presence is associated with a 1 percent gain in product scope and 3 percent gain in productivity for domestic firms on average. From 1999 to 2003, the average within firm gain in product scope and productivity among domestic firms is about 4 and 8 percent, respectively, while the average change in sibling foreign presence is 1 percent. A back of an envelope calculation would then suggest that the increase in sibling foreign presence throughout the sample period could explain about a quarter of the within firm product scope expansion and a third of the within firm productivity gains. These results are important statistically and economically.[11]

[11] 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 reverse 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.

5 Robustness Checks

5.1 Alternative Interpretations

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, and not necessarily due to access to better and new variety of local intermediate inputs? To study these other channels, we construct two variables to capture the market presence of those FDI firms that share 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:

$$PFP_{it} \equiv \sum_{p \in \mathbf{P}_i} \sum_{k \in j} \frac{K_{kt}}{K_{jt}} FS_k R_{ik}^p = \sum_{k \in j} \frac{K_{kt}}{K_{jt}} FS_k \sum_{p \in \mathbf{P}_i} R_{ik}^p, \tag{12}$$

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

$$MFP_{it} = \sum_{m \in \mathbf{M}_{it}} \sum_{k \in j} \frac{E_{kt}^m}{E_{jt}^m} FS_k R_{ikt}^m, \tag{13}$$

where $\mathbf{M}_{it}$ is the set of export markets for i in t, E_{kt}^m 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 which 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 that 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, 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 gains over the sample period.

Alternatively, could domestic firms benefitting from sharing common local input suppliers with other domestic firms? To understand this, we construct the following domestic sibling presence variable (DSP_{it}) for each domestic firm i in year t :

$$DSP_{it} \equiv \sum_{s \in \mathbf{S}_{it}} \sum_{k \in j} (1 - FP_{kt}) S^{s}_{ikt}. \tag{14}$$

Table 6 presents the regression results when we relate product foreign presence, market foreign presence, and domestic sibling presence to product scope and TFP of domestic firms. In all cases, these other possible channels are not statistically significant, suggesting that the performance of domestic firms do not improve simply because they share common product or market with FDI firms, or when they share common local suppliers with other domestic firms.

5.2 Placebo experiment – random siblings

Another concern could be that the sibling relationship is somehow random and the previous result is just coincidental. Columns (4) and (8) of Table 6 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 a consistent pattern in affecting firm performance – while it is positive and significant in explaining product scope, it is 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 may not have been a fluke.

5.3 Evidence based on industry foreign presence

If the finding that domestic firms perform better due to the increased presence of their FDI siblings 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 an omitted variable bias that needs to be dealt with more carefully. In addition, industry foreign presence by construction does not have variation across firms within 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). Due to space constraints, the regression results based on industry foreign presence are not reported in this paper but are available upon request. Overall we found that only for those domestic firms that have FDI siblings that increases in industry foreign presence has a positive effect on their productivity. Other domestic firms that do not have FDI siblings, but may share common products or common export market with FDI firms do not seem to benefit from the increased industry foreign presence. This result is consistent with our previous findings.

6 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) and Rodriguez-Clare (1996). 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 goods 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 goods 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 goods sector has the following production function (year subscript omitted),

$$Y_i = \phi_i \left[\sum_{n=1}^{N} m_{ni}^{\frac{\sigma-1}{\sigma}} \right]^{\frac{\sigma}{\sigma-1}\alpha_M} L_i^{\alpha_L} K_i^{\alpha_K}. \tag{15}$$

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

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

where $M_i = Nm_i$, is the total amount of intermediate inputs used in the production of Y_i. Holding M_i fixed, (16) shows that an increase in N raises Y_i. Taking logs on both sides of (16) , and defining 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 $\sigma > 1$:

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

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

$$N \equiv N^D + N^I,$$

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

$$\ln TFP_i = \ln \phi_i + \frac{\alpha_M}{\sigma - 1} \ln \left(N^D + N^I\right). \tag{18}$$

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

$$N^D = f\left(FDI\right). \tag{19}$$

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 N^I based on the number of imported intermediate inputs variety.[12] 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

[12] 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 imports from 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.

and the number of imported input variety probably measure N^D and N^I with errors, we expect the least square estimates to have a downward bias.

Columns (1) and (2) of Table 7 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 biased given that N^D and N are measured with errors.

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.[13] Here, the exclusion restriction is that the number of FDI firms in the Bangladeshi garment sector is exogenous and has 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 was discouraged under the Bangladesh Investment Policy (1999). While existing FDI firms may invest and expand their capacity, new FDI firm entry was highly regulated by the government which makes the total number of FDI firms de facto exogenous during the sample period. On the other hand, the world price of cotton fabrics clearly should not affect the productivity of domestic garment firms other than through its negative impact on imported fabrics variety.

Columns (3) and (4) of Table 7 present 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.

[13] 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.

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

$$Y_i = \left[\sum_{v_i=1}^{V_i} y_{v_i}^{\frac{\lambda-1}{\lambda}} \right]^{\frac{\lambda}{\lambda-1}}, \lambda < 0. \tag{20}$$

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 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 ensuring that the quantity produced for each variety is also the same,

$$p_{v_i} = p_i, \text{ and } y_{v_i} = y_i. \tag{21}$$

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

$$Y_i = V_i^{\frac{\lambda}{\lambda-1}} y_i.$$

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

$$y_i = V_i^{\frac{-\lambda}{\lambda-1}} \phi_i N^{\frac{\alpha_M}{\sigma-1}} M_i^{\alpha_M} L_i^{\alpha_L} K_i^{\alpha_K}, \tag{22}$$

which shows that given the same amount of inputs, if firm i produces more varieties 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 $\alpha_M + \alpha_L + \alpha_K = 1$),

$$c_i = \kappa V_i^{\frac{\lambda}{\lambda-1}} \left[\phi_i N^{\frac{\alpha_M}{\sigma-1}}\right]^{-1} P_M^{\alpha_M} P_L^{\alpha_L} P_K^{\alpha_K}, \tag{23}$$

where $P_j, \forall j = \{M, L, K\}$, is the price of intermediate input, labor and capital, and κ is a constant which depends on the $\alpha's$. Equation (23)) implies that an increase in the variety of intermediate inputs pushes down the unit cost of producing y_i. In contrast, given input prices and variety, an increase in output variety raises 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 $c_{i,}$

$$p_i = \mu c_i = \mu\kappa V_i^{\frac{\lambda}{\lambda-1}} \left[\phi_i N^{\frac{\alpha_M}{\sigma-1}}\right]^{-1} P_M^{\alpha_M} P_L^{\alpha_L} P_K^{\alpha_K} \tag{24}$$

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

$$\begin{aligned} V_i^{\frac{\lambda}{\lambda-1}} &= \left[\phi_i N^{\frac{\alpha_M}{\sigma-1}}\right] \frac{p_i}{P_M^{\alpha_M} P_L^{\alpha_L} P_K^{\alpha_K}} \frac{1}{\mu\kappa} \Rightarrow \\ \ln V_i &= \frac{\lambda-1}{\lambda}\left[\theta + \ln\phi_i + \frac{\alpha_M}{\sigma-1}\ln N + \ln p_i - \sum_{j=\{M,L,K\}} \alpha_j \ln P_j\right]. \end{aligned} \tag{25}$$

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 increases the productivity a firm. Recalling 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 varieties. 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 (2010). In their paper the authors show that trade liberalization in India in the 1990s caused an explosion in the variety of imported intermediate inputs and a reduction in the prices of these inputs, which led to an expansion in product scope within firms. 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 easily be estimated using the following log linear specification (time subscript is reintroduced for clarity):

$$\ln V_{it} = \beta_i + \beta_N \ln N_t + \beta_{TFP} \ln \phi_{it} + \beta_p \ln p_{it} + \beta_M \ln P_{Mt} + \beta_L \ln P_{Lt} + u_{it}, \tag{26}$$

where we expect β_N, β_{TFP} and β_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 ϕ_{it}, the average firm specific input price index for P_{Mt}, and wages for P_{Lt}. However, it is clear that in addition to 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 the following instrumental variables: average productivity of the industry for ϕ_{it}, and the 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 7 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 N are positive and significant, the majority of the remaining coefficients either has wrong signs or are insignificant. Columns (11) and (12) show the second stage of the IV estimates. Now all the coefficients have the correct signs and are mostly significant. Most importantly, the results confirm that an increase in the number of FDI firms leads to increases in local input variety and total input variety, which raise the product scope of domestic firms. The IV estimates for β_N are smaller than the least squares estimates due to 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 cause the number of local input variety to increase, which leads to significant gains for domestic firms in terms of productivity and product scope.

7 Conclusion

This paper studies how product scope and productivity of domestic firms improve due to the increased presence of FDI firms within the same industry that share common local input suppliers. This effect is primarily driven by increased firm access to new local input varieties as the expanding FDI firms push up industry demand for local intermediate inputs. 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. We then present a simple theoretical model of a multi-product firm with a love of variety for intermediate inputs. The model predicts that productivity and product scope of the firm rise with the expansion of 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.

Thus, the results of this paper provide support to endogenous growth models which emphasize the importance of new intermediate inputs in explaining productivity growth. Moreover, our findings may shed light in another literature, as to why researchers have not found evidence of horizontal spillovers 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 for the Bangladeshi garment sector, but may not apply to other countries, particularly developing countries. A policy message derived from the results of this paper could be that, to reap the potential spillovers 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 spillovers, but domestic firms in the same industry may also benefit from the booming local input industries via horizontal spillovers.

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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 value 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 information on prices at the firm level, which allows us to construct firm specific price indexes 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 firms 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 reflecting 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 for 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.[14]

[14] 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.

A.2 The Production Function

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

$$Y_{it} = \phi_{it} L_{it}^{\alpha_L} M_{it}^{\alpha_M} K_{it}^{\alpha_K}, \tag{27}$$

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. The total factor productivity (TFP) of firm i in year t is ϕ_{it}. Let's assume that in log, ϕ_{it} can be decomposed linearly into the following,

$$\ln \phi_{it} \equiv \omega_{it} + \alpha_t + \alpha_A a_{it} + \alpha_F FDI_{it} + \eta_{it}, \tag{28}$$

where ω_{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, α_t, may capture the effects of time and others factors that are common to all firms during a year (within an industry) and $\alpha_A a_{it}$, is the effect of (log of) age on productivity.[15] We further allow FDI firms to have a different productivity than 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 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 scenarios cause α_A and α_F to have ambiguous signs a priory. We will be able to test the effect of age and FDI status on productivity in the empirical section. The last term, η_{it}, is the truly unobserved classical error term.

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

$$y_{it} = \alpha_t + \alpha_A a_{it} + \alpha_F FDI_i + \alpha_L l_{it} + \alpha_M m_{it} + \alpha_K k_{it} + \omega_{it} + \eta_{it}, \tag{29}$$

[15] Given that all firms are exporters in our data set, $a_A a_{it}$, may also capture the effect of export experience on productivity due to possibly learning-by-exporting.

where 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 ω_{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 α_L and α_M to be biased upward. However, for the woven industry, ω_{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 α_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 α_A and α_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 input decisions. The productivity, ω_{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, ω_{it}. This is possible because, given k_{it} and a_{it}, i_{it} is an increasing function of ω_{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 investment 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.[16] 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,[17]

$$i_{it} = i_{FDI,t}\left(k_{it}, a_{it}, \omega_{it}\right).$$

This allows FDI firms to react differently than domestic firms when it comes to investment decision, as capital, age, or productivity of the firms change. 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.[18]

$$\omega_{it} = i_{FDI,t}^{-1}\left(k_{it}, a_{it}, i_{it}\right) = h_{FDI,t}\left(k_{it}, a_{it}, i_{it}\right). \tag{30}$$

In other words, we can proxy the unobserved firm productivity parsimoniously with a polynomial function $h_{FDI,t}\left(k_{it}, a_{it}, i_{it}\right)$. In addition to the FDI status, we also allow the polynomial function to be different in different time periods, 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 tariffs on Bangladeshi garment exports. Such policies may significantly alter the market struc-

[16] 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 to either have no foreign ownership for the whole sample period, or have the same FDI status throughout the sample period. Without the evolution of FDI status, it is not possible to model it as a state variable.

[17] FDI dummy equals one when the firms have any foreign equity. In our sample, the minimum foreign ownership is 25 percent.

[18] 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 endogenously through the spillover channels.

ture 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 ω_{it} in order to estimate the α coefficients on the variable inputs, l_{it} and m_{it}, which are decided after ω_{it} are observed.

$$\begin{aligned} y_{it} &= \alpha_t + \alpha_L l_{it} + \alpha_M m_{it} + \alpha_K k_{it} + \alpha_A a_{it} + \alpha_F FDI_i + h_{FDI,t}(k_{it}, a_{it}, i_{it}) + \eta_{it} && (31) \\ &= \alpha_L l_{it} + \alpha_M m_{it} + \nu_{FDI,t}(k_{it}, a_{it}, i_{it}) + \eta_{it}, \text{ where} && (32) \\ \nu_{FDI,t}(k_{it}, a_{it}, i_{it}) &= \alpha_t + \alpha_K k_{it} + \alpha_A a_{it} + \alpha_F FDI_i + \omega_{it}, && (33) \end{aligned}$$

combines α_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 ω_{it}, the least squares estimates for α_L and α_M are consistent, and we denote them as $\hat{\alpha}_L$ and $\hat{\alpha}_M$.

To estimate α_K and α_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 ω_{it} is

$$\chi_{it} = \begin{cases} 1 \text{ (continue)} \\ 0 \text{ (exit)} \end{cases} \text{if } \omega_{it} \gtrless \bar{\omega}_{FDI,t}(k_{it}, a_{it}), \qquad (34)$$

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

$$\begin{aligned} \Pr(\chi_{it+1} = 1 | J_t) &= \Pr(\omega_{it+1} > \bar{\omega}_{FDI,t+1}(k_{it+1}, a_{it+1}) | J_t) \\ &= \tilde{\varphi}_t(\omega_{it}, \bar{\omega}_{FDI,t+1}(k_{it+1}, a_{it+1})) \\ &= \tilde{\tilde{\varphi}}_{FDI,t}(\omega_{it}, k_{it+1}, a_{it+1}) \\ &= \varphi_{FDI,t}(k_{it}, a_{it}, i_{it}) = \mathbf{P}_{it+1} && (35) \end{aligned}$$

where the first equality holds because of the exit rule (34), the second and third equalities hold due to the assumption of the exogenous Markov process of ω_{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 ω_{it} conditional on (k_{it}, a_{it}), and k_{it+1} and a_{jt+1} can be inferred from k_{it}, i_{it} and a_{it}, from their laws of motion,

$$K_{it+1} = K_{it}(1-\delta) + I_{it+1}, \text{ and } A_{it+1} = A_{it} + 1. \tag{36}$$

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 $\hat{\mathbf{P}}_{it+1}$.

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

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

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, ω_{it+1} only depends on ω_{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 $g'(\nu_t - \alpha_t - \alpha_K k_{it} - \alpha_A a_{it} - \alpha_F FDI_i, \mathbf{P}_{it+1})$ being approximated parsimoniously with a polynomial function, to obtain α_t, α_A, α_F and α_K,

$$\begin{aligned}
y_{it+1} - \hat{\alpha}_L l_{it+1} - \hat{\alpha}_M m_{it+1} = \; & (\alpha_L - \hat{\alpha}_L) l_{it+1} + (\alpha_M - \hat{\alpha}_M) m_{it+1} + \alpha_{t+1} + \alpha_A a_{it+1} + \alpha_F FDI_i + \alpha_K k_{it+1} \qquad (38) \\
& + g'\left(\hat{\nu}_t - \alpha_t - \alpha_K k_{it} - \alpha_A a_{it} - \alpha_F FDI_i, \hat{\mathbf{P}}_{it+1}\right) + \zeta_{it} + \eta_{it}, \qquad (39)
\end{aligned}$$

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, $h_{FDI,t}(k_{it}, a_{it}, i_{it})$, is successful in controlling for ω_{it}, and thus $\hat{\alpha}_L$ and $\hat{\alpha}_M$ are consistent, then there should be no variation of l_{it+1} and m_{it+1} left in (38) and the estimated coefficients should be zero.[19] 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.

Due to space constraint, the detailed results of the industry specific regressions are available upon request. Overall we find that the augmented OP procedure works well in correcting for input endogeneity and selection bias. Over-identification test also confirm that $\hat{\nu}_{FDI,t}(k_{it}, a_{it}, i_{it})$ are sufficient in controlling for ω_{it} and that there is no further correlation between these variable inputs and the unobserved productivity. Firm productivity is constructed based on the following results which forms the basis of our empirical exercise,[20]

$$\text{Non-Woven:} \qquad \ln \text{TFP\_AOP}_{it} = y_{it} - 0.156 m_{it} - 0.283 l_{it} - 0.303 k_{it}, \tag{40}$$

$$\text{Woven:} \qquad \ln \text{TFP\_AOP}_{it} = y_{it} - 0.549 m_{it} - 0.357 l_{it} - 0.122 k_{it}. \tag{41}$$

Note that since the production functions are estimated separately for the two industries, we restrict our empirical exercises only to within industry comparisons of firm productivity, in order to avoid questionable cross regression comparisons.[21] For comparison, without any correction, the TFP

[19] In fact when we do not use x_{it}^E and x_{it}^U as controls for market specific demand shocks, μ_{it}^E and μ_{it}^U, the one of over-identifying restriction tests was negative indicating that the ω_{it} cannot be proxied by the polynomial of i_{it}, k_{it}, and a_{it}, suggesting the inversion of Υ_t was not valid.

[20] How different are these estimates compared 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 α_L, α_M, and α_K are slightly different between the two versions, simple t-tests reveal that the differences are not statistically significant with 95% confidence level.

[21] There may be a concern that the non-woven industry appears to have decreasing returns to scale, 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 scale:

$$H_0 : \alpha_M + \alpha_L + \alpha_K = 1.$$

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.

estimates from OLS are constructed as the following:

$$\text{Non-Woven} \quad : \quad \ln \text{TFP\_OLS}_{it} = y_{it} - 0.177 m_{it} - 0.416 l_{it} - 0.121 k_{it} \tag{42}$$

$$\text{Woven} \quad : \quad \ln \text{TFP\_OLS}_{it} = y_{it} - 0.524 m_{it} - 0.396 l_{it} + 0.013 k_{it}. \tag{43}$$

Figure 1: Numbers of Garment FDI firms and Local Suppliers In Bangladesh (1984=1)

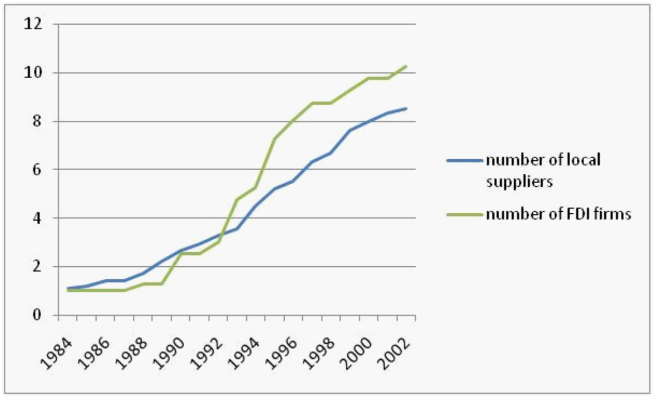

Table 1: Sample Averages

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

Note: All values are in US$000, except where otherwise specified.

Figure 2: The Share of FDI Firms in Bangladesh's Apparel Sector, 1999-2003

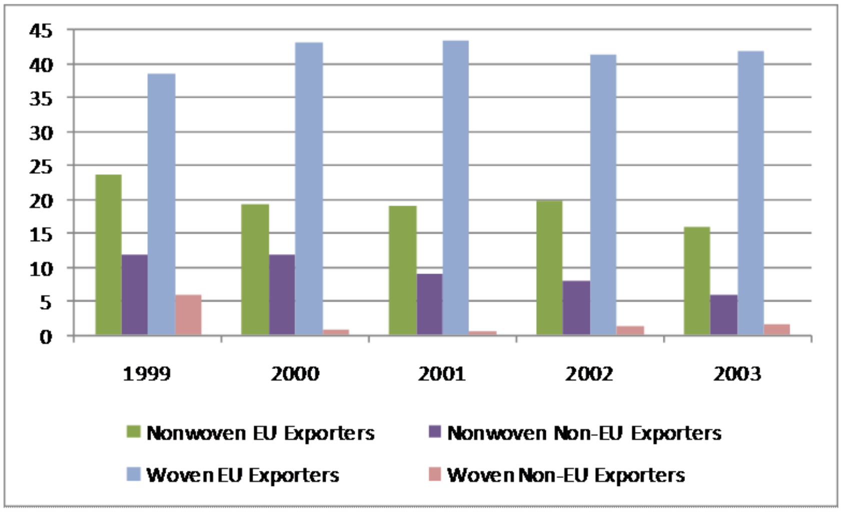

Figure 3: An Example on the Calculations of Industry Foreign Presence vs. Sibling Foreign Presence

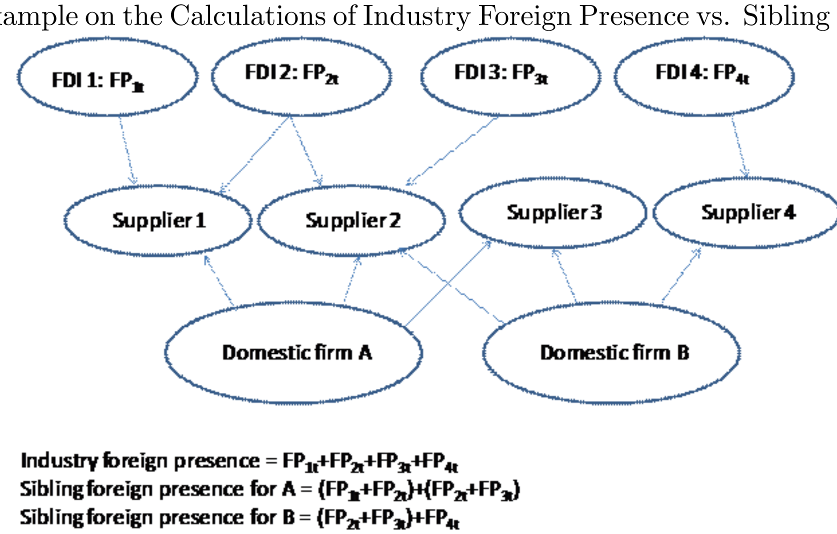

Figure 4: Output variety increases as PPF shifts out due to an increase in input variety

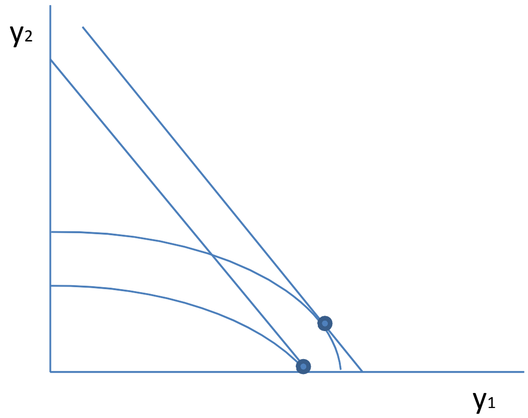

Table 2: Sample Averages for Domestic firms

	Non-woven	Woven
Industry foreign presence	28.68	36.43
FDI sibling	15.57	51.91
Sibling foreign presence	0.48	6.08
FDI product rival	89.52	92.93
Product rival foreign presence	13.48	36.61
FDI market rival	97.60	97.31
Market rival foreign presence	2.12	10.58

Note: All values are in percent.

Table 3: First Stage Regressions: Dependent variable – Sibling Foreign Presence

	(1)	(2)
FDI siblings that export to EU	0.09***	0.04***
	(0.01)	(0.01)
FDI siblings that export to EU* Woven*EBA	0.04***	0.01***
	(0.01)	(0.00)
Observations	104	1000
F-stat	202.79***	13.46***

Notes: All columns include firm fixed effects, industry-region-year fixed effects, firm age, share of imported materials, share of material in sales, and firm specific time trends. Standard errors are clustered by industry-year.
*, **, *** indicate statistical significance at 90%, 95%, and 99% confidence levels.

Table 4: Restricted Sample of Domestic Firms with Firm specific Time Trends

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Dependent Variables	Product Scope		Sales per Worker		Output per Worker		TFP_OLS		TFP_AOP	
Estimation Methods	LS	IV	LS	IV	LS	IV	LS	IV	LS	IV
Sibling Foreign Presence	2.21*	7.30***	4.85*	18.43***	4.92*	18.40***	2.47**	9.05***	2.53**	8.33***
	(1.07)	(0.52)	(2.23)	(1.07)	(2.27)	(1.15)	(1.03)	(0.55)	(1.00)	(0.55)
Age	1.52	0.59***	1.43	-1.06	1.51	-0.96	0.57	-0.63**	0.45	-0.62*
	(1.08)	(0.23)	(3.28)	(0.67)	(3.23)	(0.71)	(1.45)	(0.28)	(1.43)	(0.34)
Imported Materials/Materials	0.17	-0.06	-0.21	-0.81***	-0.22	-0.81***	-0.21	-0.50***	-0.19	-0.45***
	(0.36)	(0.16)	(0.85)	(0.15)	(0.84)	(0.16)	(0.43)	(0.10)	(0.43)	(0.11)
Material/Sales	-0.17	-0.01	0.92	1.34***	0.73	1.14***	-0.41	-0.21	-0.44	-0.29*
	(0.64)	(0.31)	(0.59)	(0.22)	(0.56)	(0.18)	(0.36)	(0.18)	(0.28)	(0.16)
Observations	116	113	116	113	116	113	108	104	104	100

Notes: All dependent variables are in logs. TFP_OLS is from (42) and (43) ; TFP_AOP is from (40) and (41).
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 trends.

Table 5: Full Sample of Domestic Firms with Firm Specific Time Trends

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Dependent Variables	Product Scope		Sales per Worker		Output per Worker		TFP_OLS		TFP_AOP	
Estimation Methods	LS	IV	LS	IV	LS	IV	LS	IV	LS	IV
Sibling Foreign Presence	0.94**	1.19***	2.15***	5.30***	1.97***	5.32***	1.08***	2.76***	1.09***	2.64***
	(0.32)	(0.20)	(0.20)	(0.39)	(0.17)	(0.38)	(0.09)	(0.12)	(0.09)	(0.08)
Age	0.06	0.06*	0.52***	0.49***	0.61***	0.58***	0.44***	0.42***	0.27**	0.26**
	(0.05)	(0.03)	(0.15)	(0.10)	(0.13)	(0.09)	(0.11)	(0.07)	(0.11)	(0.07)
Import Materials/Materials	-0.07**	-0.07***	0.39	0.39***	0.33	0.33**	0.16	0.16**	0.06	0.06
	(0.03)	(0.02)	(0.21)	(0.14)	(0.21)	(0.14)	(0.11)	(0.08)	(0.08)	(0.06)
Material/Sales	-0.00	-0.00	0.43	0.43**	0.23	0.23	-0.78**	-0.79***	-1.00**	-1.01***
	(0.08)	(0.05)	(0.26)	(0.18)	(0.24)	(0.16)	(0.30)	(0.20)	(0.34)	(0.23)
Observations	1034	1034	1034	1034	1034	1034	1013	1013	1000	1000

Notes: All dependent variables are in logs. TFP_OLS is from (42) and (43) ; TFP_AOP is from (40) and (41).
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 trends.

Table 6: Robustness Checks – Other Sources of Spillovers

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dependent Variables	Product Scope				TFP_AOP			
Product Foreign Presence	0.61				0.26			
	(1.03)				(0.46)			
Market Foreign Presence		-0.06				-0.58		
		(0.76)				(0.42)		
Domestic Sibling Presence			-0.89				-0.93	
			(0.68)				(1.35)	
Randomized Sibling Foreign Presence				1.51**				-0.74
				(0.64)				(0.80)
Age	-0.21*	-0.20*	-0.18	-0.20*	0.28**	0.28**	0.31**	0.28**
	(0.10)	(0.10)	(0.11)	(0.11)	(0.11)	(0.11)	(0.11)	(0.11)
Imported Materials/Materials	-0.04	-0.04	-0.05	-0.04	-0.06	0.07	0.06	0.06
	(0.12)	(0.12)	(0.11)	(0.12)	(0.09)	(0.09)	(0.07)	(0.09)
Material/Sales	-0.21	-0.20	-0.21	-0.20	-1.00**	-0.99**	-1.01**	-1.00**
	(0.18)	(0.18)	(0.18)	(0.18)	(0.35)	(0.35)	(0.35)	(0.35)
Observations	1034	1034	1034	1034	1000	1000	1000	1000

Notes: All dependent variables are in logs. TFP_AOP is from (40) and (41).

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 trends.

Table 7: Structural Estimations

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Dependent Variables	TFP_AOP				Product Scope							
Estimation Methods	LS	LS	IV	IV	LS	LS	IV	IV	LS	LS	IV	IV
Number of local input suppliers	0.27*		0.36***		0.20***		0.20**		0.26***		0.09**	
	(0.12)		(0.14)		(0.01)		(0.01)		(0.01)		(0.04)	
Number of total intermediate inputs		0.10*		0.12***		0.11***		0.11**		0.15***		0.04*
		(0.05)		(0.05)		(0.01)		(0.02)		(0.01)		(0.02)
TFP									0.06	0.06	0.47***	0.64**
									(0.03)	(0.03)	(0.16)	(0.30)
Price of output									0.16**	0.16**	0.04	0.36
									(0.05)	(0.05)	(0.70)	(1.06)
Price of intermediate inputs									0.02	0.14	-0.18***	-0.19***
									(0 .04)	(0.07)	(0.04)	(0.05)
Wages									0.04	0.04	-0.14***	-0.20***
									(0.05)	(0.05)	(0.05)	(0.07)
F-Statistics			29.27	13.48			29.11	13.01			158.66	158.66
Observations	1041	1041	1041	1041	1165	1165	1165	1165	1041	1041	1041	1041

Notes: Full sets of firm fixed effects are included in all columns. Standard errors in parentheses are clustered by year. TFP_AOP is from (40) and (41). 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.