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FDI and export spillovers using Heckman's two step approach: Evidence from Turkish manufacturing data

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Abstract. *This paper examines the impact of horizontal and vertical spillovers from foreign direct investment on a firm's decision to export, and on export share. Using Heckman selection models, the export spillover hypothesis is tested using firm-level data from Turkish manufacturing firms. The empirical evidence reveals that domestic firms seem to benefit only in a limited way from export spillovers. Except for backward spillovers to exporters with adequate absorptive capacity, there is no evidence of forward and horizontal spillovers to domestic exporting firms, even when they increase their absorptive capacity. However, the findings also suggest that increases in absorptive capacity will first increase but eventually reduce the export share of domestic firms. Furthermore, the results reveal negative horizontal spillovers and no evidence of vertical spillovers to non-exporters. This may well indicate negative competition effects resulting from entry of foreign firms into domestic markets, and high sunk entry costs to export markets.*

Keywords: Foreign Direct Investment (FDI), export spillovers, absorptive capacity, horizontal linkage, vertical linkage.

JEL Classification: F13, F21, F23.

1. Introduction

Foreign direct investment (FDI) is viewed as a powerful force for the integration of developing countries into the global economy (UNCTAD, 2000). This is due to the argument that FDI has a significant effect on the host country's macroeconomic performance, and is an important form of technology transfer from developed countries to developing countries. Therefore policymakers and governments across the world design policies to stimulate inward flows (see e.g. Aitken et al. 1997; Gorg and Greenaway, 2004; Bwalya, 2006; Girma and Wakelin, 2007; Bitzer et al. 2008). Compared to domestic firms, foreign firms have more advanced technology, employ higher numbers of highly skilled workers, and spend more on R&D, and it is possible that such assets may leak out to domestic firms (so-called spillover effects), which in turn has a beneficial effect on domestic firms' productivity (Caves, 1996). Spillover effects arise from a number of sources including the horizontal (intra-industry) and vertical (inter-industry) production linkages formed between domestic and foreign-owned firms. Following this line of reasoning, since the pioneering study of Caves (1974), the productivity spillovers from FDI have been widely investigated in the literature, although the empirical evidence is mixed **(**see Meyer, 2003 and Greenaway et al., 2004 for the literature survey**).**

However, a new strand of literature suggests that the interaction of domestic firms with foreign firms can also affect the export decision (export participation) and export share (export intensity) of domestic firms, i.e. create export spillovers resulting from information, imitation and competition effects (see Blomstrom and Kokko, 2003; Gorg and Greenaway, 2004; Greenaway and Kneller, 2004; Ruane and Sutherland, 2004; Kneller and Pisu, 2007; Bajgar and Javorcik, 2013 among others).

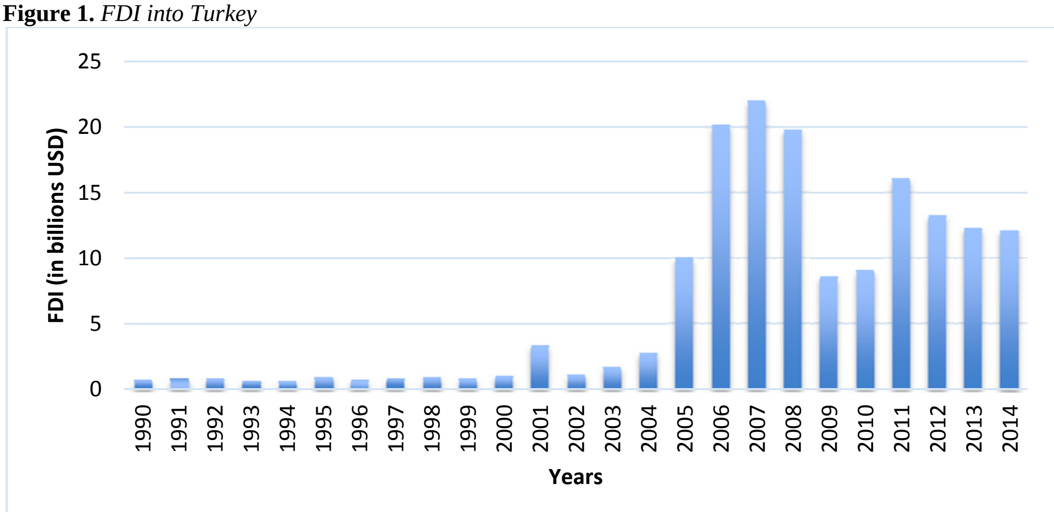
The issue of export spillovers is important, because strong export performance is widely believed to be one of the crucial factors in enhancing economic growth. Since exporting firms must improve their productivity in order to overcome trade barriers, and the higher levels of competition in international markets, and have to address different consumer tastes, exports are generally regarded as boosting a firm's productivity. Furthermore, exporting firms might be alerted to potential innovations abroad, which they may adapt in order to improve their position in foreign markets (Barrios et al. 2003, Greenaway and Kneller 2007). This would encourage firms to obtain the appropriate knowledge and advance their technological capability **(**Jongwanich and Kohpaiboon, 2008).

This paper contributes to this debate by focusing on Turkey, a country that has attracted significant FDI since the early 1990s, but especially in the last decade. Until 1980, the total foreign investment allowed into Turkey was less than $250m. With the switch to an export-oriented trade policy, the history of FDI in Turkey accelerated in the early 1980s (Mercul, 2001). Following reforms to the existing investment law, Turkey experienced a considerable increase in foreign capital investments. Particularly, thanks to economic and political stability, over the past decade, Turkey made notable progress and sustained a confident economic environment, and in this context, FDI inflows to the country increased dramatically.

As shown in Figure 1, in 2001, FDI reached the highest level up to then, at $3.35 billion (with an increase of 240% compared to 2000, in which FDI was about $980 million) due to the second installment payment made by an Italian company that bought a GSM license in Turkey in 2000. Although FDI decreased substantially to $1 billion in 2002 and $1.7 billion in 2003, $2.8 billion foreign capital entered the country in 2004, and this amount jumped remarkably to $20 billion in 2006 and $22 billion in 2007, as a result of privatization rather than new investments. However, with the arrival of the global crisis, FDI dropped to $19.9 billion in 2008 and the real impact was felt the following year, when FDI dropped sharply to $8.6 billion. The figure rose to $9 billion in 2010 and then *soared to $16 billion* in 2011. This upward movement, however, did not last: *FDI declined* to $13.3 billion in 2012, $12.4 billion in 2013 and $12.1 in 2014.

Overall, while the country attracted only about USD 15bn. in FDI through 2002, FDI inflows totalled to USD 155bn. in the period 2003-2015. The number of companies with foreign capital, which was only 6700 in 2003, rose to 44000 by 2015. According to the 2015 World Investment Report of the United Nations Conference of Trade and Development (UNCTAD), FDI inflows into Turkey were $12.1 billion in 2014, making the country the 22nd most popular spot for investors in the world, 12th among emerging countries, and first in the Western Asia region.

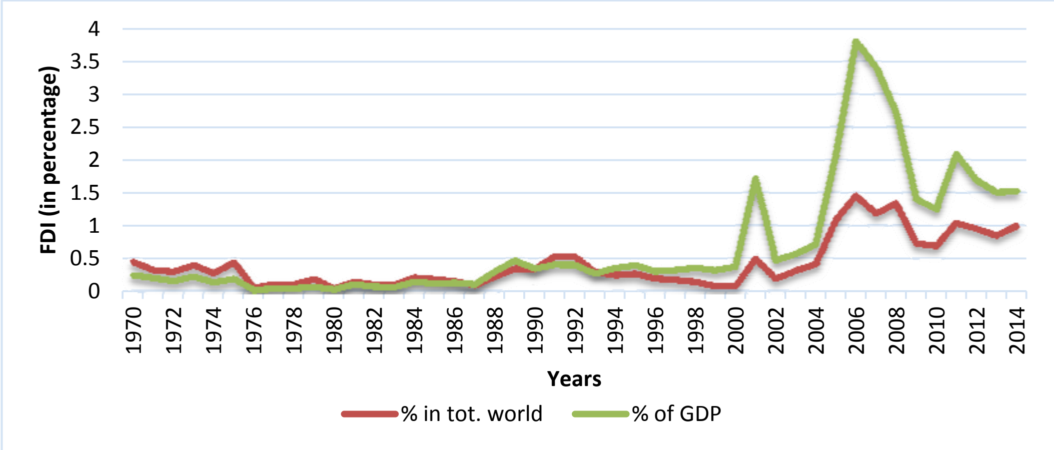
Figure 1. *FDI into Turkey*



Source: UNCTAD.

Turkey's performance at attracting FDI can also be evaluated by examining FDI shares with respect to GDP, and by comparing FDI inflows to the world total. As Figure 2 shows, FDI, as a percentage of GDP and world total, increased dramatically after 2000, while the highest shares are recorded in years after 2004. Although the financial crisis of 2008 slowed down the country's performance, the figures in the following years indicate recovery.

Figure 2. *FDI in percentage of World Total and GDP*



Source: UNCTAD.

While some existing studies have considered the impact of FDI on productivity, economic growth and exports (see, Aslanoglu, 2000; Yılmaz and Ozler, 2004; Lenger and Taymaz, 2006; Pamukcu and Taymaz, 2009 among others), to the best of our knowledge, none of the available studies has considered the impact of FDI-related industrial linkages on export spillovers in Turkey. Therefore, in the present paper, considering a firm's ability to absorb spillovers, we try to provide some empirical evidence for the impact of horizontal and vertical linkages between domestic and foreign firms on (i) the decision of domestic firms to export (export participation) and (b) the export share of domestic firms (export intensity). By means of Heckman selection models, we test for the export spillover hypothesis using a firm-level dataset of manufacturing industries.

The rest of the paper is organized as follows. Section two contains a review of the literature pertaining to the impact of FDI on export performance. Section three presents the research methodology, including data collection and model specification, and a list of variables. Section four presents the results, and finally section five concludes the paper.

2. Literature Review

The literature on export spillovers from foreign multinationals is limited, while there is a large amount of empirical literature that investigates the impact of FDI and FDI-linked spillovers on productivity, and on technology transfer to domestic firms (Gorg and Greenaway, 2004; Kneller and Pisu, 2007). Furthermore, the studies that have considered the effect of FDI on export performance have mainly focused on horizontal linkages (see Blomstrom, 1986; Blomstrom and Kokko, 2001; Liu and Wang, 2003; Gorg and Hijzen, 2004; Girma, Gorg, and Pisu, 2008; Liu, 2008; and Blalock and Simon, 2009 among others). This is despite the fact that foreign presence might clearly affect the export activities of domestic firms through horizontal and vertical linkages (Rodriguez-Clare, 1996; Aitken et al., 1997).

The evidence on export spillovers is mixed. While Aitken et al. (1997), Greenaway et al. (2004), Kneller and Pisu (2007), Greenaway and Kneller (2008), and Koenig et al. (2010) find relatively positive export spillovers, Barrios et al. (2003), Bernard and Jensen (2004), and Ruane and Sutherland (2005) find insignificant or even negative results. The contradictory results are not surprising, since the impact of FDI-related industrial linkages on export performance depends on the characteristics of domestic firms, industries and indeed the host country, i.e. size of a country's stock of human capital, financial market development, and technology gap between domestic and foreign firms (Anwar and Nguyen, 2011; Kneller and Pisu, 2007). However, there are only a few studies, such as Keller (2004), Girma and Gorg (2005), and Girma (2005), that examine the role of the absorptive capacity of domestic firms, which enable them to capture spillovers from FDI, but these studies mostly focus on the spillovers from FDI to productivity growth rather than to export performance (Kim, 2013).

Furthermore, Alvarez and Lopez (2008) argue that the sunk-entry costs to export markets tend to lower the overall size of the export spillover effect, meaning that the net effect on export performance will be positive only if the export spillover effects can more than compensate for the sunk-entry cost (Anwar and Nguyen, 2011). Before beginning to export, domestic firms must face significant sunk costs, which might include setting up international networks, development of new products for global markets, and establishment of distribution channels (Kneller and Pisu, 2007). On the one hand, foreign firms can act as a natural source of such information that would reduce sunk costs associated with export market participation and facilitate export market participation of domestic firms (Aitken et al., 1997) since, as Ruane and Sutherland (2004) discuss, such information can have public-good characteristics, and domestic firms are able to obtain new information associated with exporting activity from foreign enterprises, i.e. knowledge spillovers. These knowledge spillovers can occur between firms in the same industry (intra-industry or horizontal spillovers) and between firms in different industries (inter-industry or vertical spillovers).

On the other hand, the entry of foreign multinationals boosts the level of competition, which forces domestic firms to become more productive in order to remain in the market, which in turn can positively influence the likelihood of entering export markets. This is due to the fact that, as discussed in Kneller and Pisu (2007), only highly productive firms that can meet the sunk costs associated with export activity, gain positive profit from export market participation, and continue to export (see also Melitz, 2003; Helpman, Melitz, and Yeaple, 2004; and Bernard et al., 2003). Furthermore, the presence of foreign firms can affect the productivity of domestic firms through industrial production linkages (horizontal and vertical) (see Gorg and Greenaway, 2004; and Javorcik, 2004 for rationales for production linkage spillovers), and therefore affect the export behavior of domestic firms. However, Aitken et al. (1999) argue that there is a possibility of productivity reductions due to lower production and higher average cost of production, since foreign firms are more competitive and may steal market demand from domestic firms. This tends to decrease the export intensity of domestic firms and force some domestic firms, which are not able to compete with foreign firms, to exit the market (Kim, 2013).

One of the first and key empirical studies on the issue of export spillovers (Aitken et al. 1997) investigates the role of geographic and multinational spillovers on the export decisions of local firms, using plant-level data from the Mexican manufacturing industry between 1986 and 1990. They find evidence of export spillovers from multinational enterprises (MNEs), and they conclude that proximity to multinational activity reduces the cost of access to foreign markets, and the probability of domestically-owned firms being exporters is positively associated with a high concentration of exporting activity by MNEs in the same industry and region.

Kokko et al. (2001), employing cross section data from Uruguayan manufacturing in 1998, investigate the existence of spillovers from foreign firms on the export decisions of domestic firms. The empirical evidence suggests that the likelihood of exporting of domestic firms is positively associated with a relatively high presence of foreign firms established in the outward-oriented period in Uruguay (after 1973), whereas there is no evidence of export spillovers from multinationals established in the inward-oriented period (before 1973) (Kneller and Pisu, 2007). "This suggests that the type of trade regime within which multinationals operate may determine their potential for generating positive export spillovers" (Gorg and Greenaway, 2004).

Barrios at al. (2003), using firm-level panel data for Spanish manufacturing for 1990-98, emphasize the importance of export spillovers from R&D expenditure and export activity of both domestic firms and MNEs. They estimate a probit model to explain why firms export, and a Tobit model to estimate what determines the firm's export ratio. Their results do not provide any significant evidence for export spillovers from either R&D or export activities of MNEs in the same industry, although they find spillovers from both types of activity on other foreign-owned firms. However, the Tobit estimations suggest that the R&D expenditures of MNEs have positive spillover effects on the export ratio of domestic firms.

Utilizing firm-level panel data for the United Kingdom for 1992-96, Greenaway et al. (2004) extend the model utilized by Aitken et al. (1997) by introducing demonstration and competition effects in addition to information spillovers. They identify possible transmission mechanisms for export spillovers and test for their existence. They show that the presence of foreign firms has a positive effect on both the likelihood of exporting, and the export share of domestic firms.

Ruane and Sutherland (2005), using data from Irish manufacturing industry during the period 1991-1998, investigate export spillovers from foreign firms on the export decision and export intensity of domestic firms in an export platform economy. The empirical evidence suggests that the export decision and export intensity of domestic firms is positively associated with the presence of foreign enterprises, whereas the export share of foreign-owned firms is negatively associated with the export decision and export intensity of domestic firms. The negative effect is explained by the concentration of US-owned firms in Ireland using the country as an export platform to produce and distribute products to the EU. They argue that export spillovers are unlikely where the country is an export platform, in which competition with domestic firms in local markets is limited.

Using a firm-level dataset of the United Kingdom manufacturing industries from 1992 to 1999, Kneller and Pisu (2007) assess the extent of both horizontal and vertical spillovers from FDI towards domestic firms. Utilizing a Heckman selection process, they show that there are significant export spillovers from foreign firms. They also find positive and significant horizontal and regional export spillovers on the export decision of firms, which results from the fact that, as they argue, foreign presence leads to information spillovers which reduces the sunk costs of exporting of domestic firms. With regard to vertical spillovers, they find significant backward spillovers on the export intensity only.

Anwar and Nguyen (2011), using a Heckman sample selection model estimated over firm-level data in Vietnam, examine the effect of the horizontal and vertical linkages on the export decision and export intensity of domestic firms. The empirical results suggest that the presence of foreign firms in Vietnam, through horizontal and forward linkages, significantly affects the export decision and export share of domestic firms. This result continues to hold when (a) level of technology of domestic firms, (b) ownership structure of domestic firms, (c) orientation of foreign firms and (d) geographical proximity to foreign firms are taken into account.

Nguyen and Sun (2012), utilizing firm-level data from Vietnam in 2003 and 2004, investigate the export behavior of manufacturing firms in Vietnam. Their empirical analysis is based on a Heckman selection model and their results reveal that firm-specific characteristics have a significant effect on the export behavior of firms, and they find significant evidence of export spillovers from FDI to domestic firms. On the other hand, their results suggest that spillovers are heterogeneous and depend on firm characteristics.

In the context of Turkey, the literature mainly focuses on the impact of FDI and FDI-linked spillovers on productivity of domestic firms, and the empirical evidence provides contradictory results. Aslanoglu (2000), using survey data from 1993 on the largest 500 firms collected by the Istanbul Chamber of Commerce (ISO), finds no evidence of horizontal spillover effects from FDI to the average labor productivity of domestic firms. Similarly, Lenger and Taymaz (2006) find that there is no contribution of FDI on the productivity of Turkish firms.

Pamukçu & Taymaz (2009) use Turkish plant-level data over the period of 1983-2001 and show that there are negative horizontal spillovers from foreign-owned firms. Koymen and Sayek (2010) use unbalanced panel data of Turkish manufacturing firms over the period of 1990-2001 and focus on the role of human capital in horizontal and vertical spillovers from FDI. Their results indicate that only the firms that have a share of skilled employees above a certain threshold are able to benefit from horizontal spillovers. They also show that firms' human capital does not play any role as a limiting absorptive capacity when it comes to the realization of vertical linkages.

3. Data and Estimation Strategy

For our purpose in this study, we use a recent enterprise-level dataset on Turkish manufacturing firms over the period of 2003-2013. In the database, "enterprise" is the statistical unit and defined as “the smallest combination of legal units that is an organizational unit producing goods and services, which benefits from a certain degree of autonomy in decision making, especially for the allocation of its current resources. An enterprise carries out one or more activities at one or more locations” (We will use the terms “firm” and “enterprise” interchangeably in this paper). This unbalanced panel dataset is based on two different sources of data collected by the Turkish State Institute of Statistics (TURKSTAT): The Annual Industry and Service Statistics (AISS) and the Foreign Trade Statistics (FTS). The datasets are available under a confidential agreement by which all the computations can only be conducted at the Microdata Research Centre of TURKSTAT.

AISS contains data on output, revenues, value added, intermediate input costs, and employment, along with capital ownership structure over the period 2003-2013. It is a census for the whole population of firms with more than 19 employees whereas it is a representative survey for firms with less than 20 employees. FTS, on the other hand, relies on customs declarations and provides information on the export and import activities of the entire population of firms engaged in export/import activities together with the information on the origin/destination countries and physical quantity of trade flows for the period 2002-2013.

In 2010, economic industry classification was changed from NACE Rev.1.1 to NACE Rev.2 and accordingly the dataset was reclassified using NACE Rev.2, so that NACE Rev.1.1 standard codes are not available after 2009, while NACE Rev.2 standard codes are available for most of the firms over the whole period. However, for the sake of employing I-O table (2002), in which firms are classified by NACE Rev.1.1, in order to calculate spillover variables, we opted to convert the industry codes of firms over the period 2010-2013, for which we only observe a NACE Rev.2 code, to NACE Rev.1.1. To do so, we simply used the most recent code. Although a 4-digit code is available, we mostly rely on 2-digit (or slightly more aggregated) industry classifications for practical implementation (spillover variables estimation for example). The list of the industries by NACE Rev.1.1 can be found in Table 1 in the appendix. We should note that, industries 16, 30, and 37 are excluded from the analysis due to very small number of observations in these industries.

Our estimation sample is limited to firms operating in the manufacturing industry with more than 19 employees. This is motivated by the fact that, as we mentioned above, AISS is a census for the whole population of firms with more than 19 employees whereas it is a representative survey for firms with less than 20 employees. Furthermore, we also impose the restriction of at least 4 consecutive time-series observations for each firm, with the number of years of observations on each firm varying between 4 and 11. This is mainly motivated by the initial capital stock estimation method we employ in this paper, which is based on Harberger (1978), who uses three-year growth averages to construct a more stable initial capital stock for firms (see the appendix for the calculation of capital stock series). Therefore, this produces an unbalanced sample of manufacturing firms, which mitigates possible selection and survivor bias, as Levinsohn and Petrin (1999) argue, by allowing for both entry and exit. All nominal values are deflated using 2-digit NACE price indices with the base year of 2010. For capital goods, we use an aggregate investment deflator provided by the Ministry of Development. In this study, foreign firms are defined as those firms in which the equity share held by a foreign investor is at least 10 per cent in accordance with the definitions of the OECD and the IMF.

In this paper, for our purposes, we investigate two aspects of export spillovers, which are i) the decision to export (export participation) and ii) how much to export (export intensity). Therefore, the econometric analysis involves a two-stage decision process, as at the first stage, firms decide whether to export or not, and at the second stage, firms decide how much to export (Kneller and Pisu, 2007). The export intensity is restricted to the subset of firms that do export, since not every firm exports. If functions of export participation decision and export intensity decision of a firm are estimated separately, the problem of selection bias arises. The reasoning behind this is that, as Greenaway et al. (2004) discuss, the presence of foreign firms affects the export decision of all domestic firms, not only domestic exporting firms. The sample selection bias can be avoided using a Heckman selection model, which jointly estimates the export participation and export intensity functions. The model consists of two equations as follows:

$$\mathrm{EXD_{ijt}} = \alpha + \beta_1 \mathrm{EXP_{ijt-1}} + \beta_2 \mathrm{X_{ijt}} + \beta_3 \mathrm{Y_{jt}} + \beta_4 \mathrm{Z_{jt}} + \mathrm{u_{ijt}} \quad (1)$$

$$\mathrm{EXI_{ijt}} = \mu + \delta_1 \mathrm{X_{ijt}} + \delta_2 \mathrm{Y_{jt}} + \delta_3 \mathrm{Z_{jt}} + \mathrm{v_{ijt}} \quad (2)$$

where Equations (3.1) and (3.2) are export market participation decision and export share decision (export intensity) equations, respectively. Here, i represents firm i, while j represents industry j, and time is represented by t. EXD_{ijt} is a binary variable equal to 1 if the firm was exporting at time t and zero otherwise. EXI_{ijt} is a firm's export intensity and is defined as the ratio of exports to total sales. EXP_{ijt-1} is the lagged export status of the firm and it is 1 if the firm was exporting at time t-1 and zero otherwise. This variable is considered to be relevant for current export decisions. Kneller and Pisu (2007) argue that, as discussed in Bernard and Jensen (2004), this variable captures the importance of past experience in export markets, and if it is positive and significant, it is usually interpreted as evidence of fixed costs of entry to export market.

$\mathrm{X_{ijt}}$ and $\mathrm{Y_{jt}}$ capture the characteristics of firm i and industry j at time t, respectively. Meanwhile, $\mathrm{Z_{jt}}$ captures the channels of export spillover from foreign firms.

We estimate our equations using a Heckman model with a maximum likelihood estimation method, since it is more efficient and more appropriate than the two-step estimation method (Kneller and Pisu, 2007). The method involves estimation of the inverse Mill's ratio, and the coefficients in the two equations, by using a full maximum likelihood procedure.

3.1. Variables

As discussed earlier, FDI spillovers can occur through both horizontal and vertical linkages between domestic and foreign firms. Following Javorcik (2004), Kneller and Pisu (2007) among others, we construct spillover variables using the firm-level panel and Turkish input/output table (I/O table) for 2002 prepared by TURKSTAT. Specifically, the horizontal spillover variable (H_{jt}) is the share of total output of foreign-affiliated plants operating in Turkey (Y^f_{jt}) in industry j at time t in total output of industry *j* (Y_{jt}), and captures the intra-industry spillovers from foreign multinationals to domestic firms in the same industry. H_{jt} is calculated as:

$$H_{jt} = \frac{\sum_{i\epsilon j}(f_{ijt} * Q_{ijt})}{\sum_{i\epsilon j} Q_{ijt}} = \frac{Y^f_{jt}}{Y_{jt}} \quad (3)$$

where f_{jt} denotes the foreign ownership share of firm *i* in industry *j* at time t and is represented by a variable whose value is either 0 or 1, where zero implies a fully-domestically-owned firm, and 1 depicts a fully-foreign-owned firm. Plants with at least 10% foreign ownership shares are defined as foreign-affiliated firms. Q_{ijt} is the total output of firm *i* in industry *j* at time *t*.

Vertical linkages can be divided into forward or backward categories. The variable for backward spillovers (B_{jt}) captures the spillovers from foreign firm operating in downstream industry to domestic firm operating in upstream industry (the domestic firm is an input supplier of the foreign firm). B_{jt} is calculated as:

$$B_{jt} = \sum_{m\ if\ m\neq j} \alpha_{jm} H_{mt} \quad (4)$$

where α_{jm} is the share of industry j's output supplied to industry m in total output of industry j.

The forward variable (F_{jt}) captures the spillovers from foreign firm operating in upstream industry to domestic firm operating in downstream industry (the foreign firm is an input supplier of the domestic firm). F_{jt} is calculated as:

$$F_{jt} = \sum_{n\ if\ n\neq j} \beta_{jn} H_{nt} \quad (5)$$

where β_{jn} denotes the share of material inputs purchased by industry *j* from industry *n* in total inputs sourced by industry *j*.

We derive both the coefficients α_{jm} and β_{jn} following Javorcik (2004). The calculation of these coefficients require an integration with the Input-Output (I/O) table, which is available only for 2002 and at the 2-digit International Industrial Classification (ISIC) level.

The Herfindahl index captures the concentration level in an industry. Blomstrom and Kokko (1998), as referred to by Javorcik (2004), argue that the entry of multinational firms results in more severe competition and forces domestic firms to use their resources more efficiently or to search for new technologies, which may both the probability of exporting, and export intensity. The Herfindahl index is defined as the squared sum of the market shares of the largest 50 firms, and may be written as follows, where x_{ijt} is the sales of the firm i in industry j at time t and X_{jt} is the total sales of industry j.

$$HERF_{jt} = \sum_{i=1}^{50} (\frac{x_{ijt}}{X_{jt}})^2 = \sum_{i\epsilon j} s_i^{\,2} \qquad i = 1,2,\dots,50 \quad (6)$$

where s_i is a market share of a firm *i* in industry *j* and $X_{jt} = \sum x_{ijt}$

Based on the arguments of Roberts and Tybout (1997), and Bernard and Jensen (2004), affirmed in most of the evolutionary economics literature, firms with better quality labor are expected to produce better quality products and higher levels of efficiency and, hence, the quality of workers may affect export performance. Following Bernard and Jensen (2004), and Kneller and Pisu (2007) among others, we use the average level of wages of the firm as a proxy for this export-performance- enhancing effect of quality workers.

In our specification, we also control for the export experience of firms. Export experience is represented by a dummy variable set to 1 if a domestic firm has already engaged in exporting in the past, and 0 otherwise. As in Kneller and Pisu (2007), Sun (2009), Nyugen and Sun (2012), this variable is included only in the export participation equation, due to the fact that the selection equation should contain at least one variable that is not in the outcome equation (see Baum, 2006 and De Luca and Perotti, 2011). Furthermore, Kneller and Pisu (2007) argue that, as discussed in Bernard and Jensen (2004), this variable captures the importance of past experience in export markets, and if it is positive and significant, it is usually interpreted as evidence of sunk costs of exporting. As Sun (2009) discusses, it is reasonable to exclude the export dummy from the export intensity equation since any fixed export cost should not affect the export share of firm, as it has been already paid.

Similar to Franco and Sasidharan (2009), who proxy the firm size by the ratio of each firm's sales to average sales in the industry, firm size is proxied by the share of each firm’s output in average output in the industry. Although Narjoko (2009) points out that the variables, such as output, sales or profits, are not appropriate because they tend to be more sensitive to the changes in the business cycle, the term, relative output, should mitigate this type of concern.

Capital intensity is defined as a firm’s fixed assets per employee, which is used to control for the impact of comparative advantage disparity across firms on their export performance (Chen et al., 2013). The capital intensity is considered to be positively related both to the decision to export and to the export intensity in developed countries, because it embodies accumulated technological knowledge (Wakelin, 1998). However, the capital intensity coefficient may turn out to be negative or insignificant in the case of developing countries because they are capital scarce (Franco and Sasidharan, 2010). Since the capital stock series of firms are not available from the database, the series are calculated using a perpetual inventory method (See Appendix B for the details of the capital stock estimation method).

Industry export share is defined as the share of exports in each industry in total manufacturing exports. This variable is included in the specification due to the fact that it captures the importance of each industry in the export structure of the manufacturing industry and controls for the possibility that firms operating in more export-oriented industries are more likely to export. On the other hand, it also controls for the fact that foreign affiliates may tend to locate in industries with higher export ratios, which if not controlled for may lead to an endogeneity problem (Nguyen and Sun, 2012).

Total factor productivity (TFP) is a measurement of efficiency in the production process and is often considered to be a proxy for the quality of management. According to Melitz (2003), more productive groups of firms can cover the sunk costs associated with trade, so that they are more likely to export. On the other hand, Greenaway and Kneller (2004), among others, find that productivity increases the probability of exporting, and export intensity. TFP is estimated by using a semi-parametric regression method constructed by Levinsohn and Petrin (2003), which takes account of unobserved firm-specific productivity.

The earlier literature investigating the spillover effects from FDI estimated the production function using traditional methods, i.e. by applying ordinary least squares (OLS) to a panel of (continuing) firms. However, OLS estimation of TFP create several methodological issues. The OLS technique assumes that production inputs are uncorrelated with omitted unobservable variables even though productivity and input choices are likely to be correlated. Hence, OLS estimation of firm-level production functions introduces a simultaneity or endogeneity problem and thereby results in inconsistent and biased estimates of production function. Moreover, selection bias will emerge if no allowance is made for entry and exit (Van Beveren, 2010).

In response to these methodological issues, several estimators have been proposed in the literature. The main contributions to measuring firm level TFP are by Olley and Pakes (1996) and Levinsohn and Petrin (2003). The key difference between the two methods is that Olley and Pakes (1996) use investment whereas Levinsohn and Petrin (2003) introduce material inputs as a proxy into the estimation procedure.

Levinsohn and Petrin (2003) point to the evidence from firm-level datasets that there are substantial adjustment costs related to investment. They argue that it is less costly to adjust material inputs than to adjust investment in response to the productivity shocks. If this is the case, the investment proxy may not smoothly respond to the productivity shock, violating the consistency condition. Moreover, firms generally report positive material inputs whereas large number of zero observations in investment series are observed (Petrin et al., 2004).

In this paper we use the Levinsohn and Petrin (2003) methodology to estimate firm level production functions. Specifically, we estimate a Cobb-Douglas production function by expressing value added as a function of capital and labor costs, using materials and energy usage as proxies for unobserved productivity shocks:

$$y_{it} = \beta_0 + \beta_l l_{it} + \beta_k k_{it} + \beta_m m_{it} + \beta_e e_{it} + \omega_{it} + \eta_{it} \quad (7)$$

where y_t is the logarithm of value added; l_{it}, m_{it} and e_{it} are the logarithm of labor, materials and energy usage respectively; k_t is the logarithm of the state variable, capital, ω_{it} denotes the productivity of the firm, and η_{it} stands for measurement error in output, which is uncorrelated with input choices. Levinsohn and Petrin (2003) give a detailed description of the estimation procedure and the derivation of the TFP.

We also control for industry size, defined as the share of revenues of each industry in total manufacturing revenues. Including industry size into the specifications allows for possible general spillovers not directly associated with export activity (Franco and Sasidharan, 2010).

Year and industry dummy variables are also included in both specifications to account for macroeconomic shocks and cross-industry disparities that are not captured by other control variables. The definition of the variables can also be found in Table 4 presented below.

As discussed earlier, spillover effects have also been shown to depend on the absorptive capacity of the firm. In our alternative estimation, we account for this fact, and we add interaction terms between the absorptive capacity variable and spillover variables into our specification. We define absorptive capacity as the technology gap between firms and the industry leaders, which are predominantly foreign firms (Griffith, Redding, and Simpson, 2002; Girma, 2005):

$$abs\_cap_{it} = {TFP_{it}} \Big/ {max_{industry}(TFP_{jt})} \qquad (8)$$

that is, firm i's TFP relative to the maximum TFP in the two-digit industry (the "industry leader").

In the literature, the technology gap between foreign and domestic firms has been identified as one of the key mediating factors for FDI spillovers (Kokko 1994; Kokko, Tansini, and Zejan 1996). However, regarding its role for spillovers from FDI, empirical research provides conflicting results. While some studies such as Findlay (1978), Wang and Blomstrom (1992), and Smeets (2008) find that a large technology gap is beneficial for local firms since their catching-up potential increases, others such as Blalock and Gertler (2009) argue that, if the technology gap between the multinational and local producers is too big or too small, local firms might not be able to absorb positive FDI spillovers (Farole and Winkler, 2012).

Table 1 presents the definition of the variables, whereas the descriptive and summary statistics of domestic firms and foreign multinationals are presented in Tables 2 and 3. Foreign firms are, not surprisingly, on average, superior to domestic firms in all aspects. For example, they are larger, more productive, more capital intensive, and pay higher wages.

The distribution of firms by NACE Rev.1.1 is presented in Table 4. Foreign firms are, not surprisingly, mostly concentrated in high-tech and capital intensive industries, such as 24 (chemicals), 23 (coke and refined petroleum), 34 (motor vehicles, trailers and half trailers), and 33 (medical, precision, optical instruments). On the other hand, they appear less in low-tech and labor intensive industries, such as 17 (textile products), 18 (wearing apparel), and 19 (dressing of leather).

Table 1. *Definition of Variables*

Variables	Definition
Export Intensity	the ratio of exports to total revenue
Export Participation	expar=1 if the firm has exported during the year; 0 otherwise
Capital Intensity	a firm's fixed assets per employee
Industry Size	the share of revenues of each industry in total manufacturing revenues
Firm Size	the share of each firm's output in average output in the industry.
Herfindahl Index	the concentration level in an industry (the squared sum of the market shares of the largest 50 firms)
Average Wage	wage per employee per year in Turkish Lira
TFP	estimated by using the semi-parametric regression method constructed by Levinsohn and Petrin (2003)
Industry Export Share	the share of exports in each industry in total manufacturing exports
Horizontal Linkage	the linkage between domestic firm and foreign firm when both are in the same industry
Backward Linkage	the linkage between domestic firm and foreign firm when the domestic firm is the input supplier of the foreign firm
Forward Linkage	the linkage between domestic firm and foreign firm when the foreign firm is the input supplier of the domestic firm
Export Experience	a dummy variable taking 1 if a domestic firm has already engaged in exporting in the past and 0 otherwise

Sources: TURKSTAT (The Annual Industry and Service Statistics and the Foreign Trade Statistics).

Table 2. *Descriptive Statistics of Key Variables (All Firms)*

Variables	Obs.	Mean	Min	Max
Export Intensity	146830	0.105	0	1
Export Participation	146830	0.535	0	1
Capital Intensity	146830	424384	26.260	150000000
ln(CAP_INT)	146830	11.796	3.268	18.824
Industry Size	146830	0.068	0.002	0.170
Firm Size	146830	0.372	0.062	11.990
Herfindahl Index	146830	0.022	0.002	0.959
Average Wage	146830	12543.9	84.621	237327.8
ln(wage)	146830	9.272	4.438	12.377
TFP	146830	694	1.066	28135.68
ln(TFP)	146830	6.180	0.064	10.245
Industry Export Share	146830	0.062	0.0001	0.766
Horizontal Linkage	146830	0.179	0.0000	0.966
Backward Linkage	146830	0.107	0.0110	0.361
Forward Linkage	146830	0.138	0.0003	0.848
Export Experience	128297	0.556	0	1

Sources: TURKSTAT (AISS and FTS).

Table 3. *Summary Statistics of Key Variables (Foreign vs. Domestic)*

	Foreign Firms		Domestic Firms	
Variables	Obs.	Mean	Obs.	Mean
Export Intensity	6333	0.225	140497	0.100
Export Participation	6333	0.849	140497	0.521
ln(CAP_INT)	6333	11.990	140497	11.788
Industry Size	6333	0.070	140497	0.068
Firm Size	6333	0.495	140497	0.367
Herfindahl Index	6333	0.029	140497	0.022
ln(wage)	6333	10.105	140497	9.235
ln(TFP)	6333	6.987	140497	6.143
Industry Export Share	6333	0.075	140497	0.061
Horizontal Linkage	6333	0.279	140497	0.175
Backward Linkage	6333	0.118	140497	0.107
Forward Linkage	6333	0.192	140497	0.135
Export Experience	5670	0.880	122627	0.541

Sources: TURKSTAT (AISS and FTS).

Table 4. *Distribution of Firms by Industry*

NACE	INDUSTRY	Domestic	Foreign	All	% Foreign
15	Food products and beverages	1835	113	1948	0.058
17	Textile products	2884	69	2953	0.023
18	Wearing apparel	2883	77	2960	0.026
19	Dressing of leather	484	3	487	0.006
20	Wood products, excepts furniture	303	6	309	0.019
21	Paper and paper products	384	43	427	0.101
22	Publishing and printing	415	15	430	0.035
23	Coke and refined petroleum	47	9	56	0.161
24	Chemicals	518	128	646	0.198
25	Rubber and plastic products	1098	83	1181	0.07
26	Non-metalic products	1277	67	1344	0.05
27	Basic metal industry	653	25	678	0.037
28	Metal products, except machinery	1581	79	1660	0.048
29	Machinery and equipment, n.e.c.	1716	79	1795	0.044
31	Elect. machinery and apparatus, n.e.c.	546	50	596	0.084
32	Radio, tv, communication eq. and app.	93	10	103	0.097
33	Medical, precision, optical instruments	170	19	189	0.101
34	Motor vehicles, trailers and half trailers	712	86	798	0.108
35	Other transport equipment	419	25	444	0.056
36	Furniture, n.e.c.	1097	37	1134	0.033
Total		19115	1023	20138	0.051

Note: Sector 16, 30 and 37 are not included in the study.

4. Empirical Results

The two export equations of the Heckman selection model are estimated jointly by the maximum likelihood technique, and Tables 5 - 7 report the estimation results. The Wald tests for overall significance of the models indicate the coefficients of the regressors are highly jointly significant. On the other hand, the null hypothesis of no correlation between the error terms (i.e. $\rho = 0$) is rejected at the 1% level by the LR test, which suggests the interdependence between the export participation and export intensity equations, and hence validates the choice of the Heckman selection model.

Table 5 shows the estimation results without considering absorptive capacity of domestic firms, whereas Table 6 presents the results of estimation for domestic firms with the full set of explanatory variables including the interaction terms between each spillover variable and absorptive capacity variable. Table 7 shows the results from the model with a quadratic specification, in which we allow for a non-linear relationship between spillover variables and the absorptive capacity of domestic firms. The results of each specification for all countries are also reported in the appendix. We note that the results are very similar across both samples.

As shown in Table 5, when absorptive capacity is not taken into account in the model, there exist no spillover effects from horizontal and backward linkages, while the export decision and export intensity of domestic firms seem to be (although only at the 10 per cent significance levels) associated with the presence of foreign firms in downstream industries. The effect is positive in the export intensity equation, whereas it is negative in the export decision equation. If we suppose that exporting firms are more productive, and the access to quality intermediate inputs less costly, which eventually reduces the production costs of domestic firms and improves the quality of their products, this may enable domestic firms to increase their export share. On the other hand, domestic firms with low absorptive capacity may not able to use complex intermediate inputs supplied by multinationals, and are unlikely to capture positive spillovers from foreign firms. Therefore, they are unlikely to start exporting due to high sunk costs of exporting. On the other hand, the intermediate inputs supplied by foreign firms may be mostly international-market-oriented, which favors already exporting firms, but not non-exporting firms.

Furthermore, the export participation decision of domestic firms appears to depend on a firm's previous export experience, confirming the proposition that firms involved in exporting in the past are more likely to continue exporting, since they have already incurred the sunk costs of market entry (Kneller and Pisu, 2007; Sun, 2009; Nguyen and Sun, 2012). The degree of industry concentration (HHI), as we expect, has a negative and significant effect on the export intensity of firms, but a positive but insignificant effect on the export decision of firms.

Table 5. *Estimation Results w/out Considering Absorptive Capacity of Firms (Domestic Firms)*

		Export Participation		Export Intensity	
VARIABLES		Coeff.	Std. Err.	Coeff.	Std. Err.
Capital Intensity		0.040***	0.004	-0.002***	0.001
Industry Size		0.112	0.940	-0.264	0.189
Firm Size		-0.008	0.047	-0.009	0.009
Herfindahl Index		0.543	0.567	-0.355***	0.106
Average Wage		0.088***	0.013	0.002	0.002
TFP		0.192***	0.008	-0.008***	0.002
Industry Export Share		-0.467***	0.149	0.108***	0.034
Horizontal Linkage		0.234	0.179	-0.042	0.034
Backward Linkage		1.235	0.785	-0.114	0.156
Forward Linkage		-0.548*	0.326	0.095*	0.057
Export Experience		2.201***	0.009	Not included	Not included
Constant		-3.607***	0.188	0.352***	0.037
No. of Observations	122627				
Rho	-0.393				
Sigma	0.233				
Lambda	-0.092				
LR test of indep. Eqns. (rho=0)	2593.9				
Wald's Test for the Overall Significance of the Model	3776				
Log pseudo-likelihood	-41577				

Notes: * significant at 10%; ** significant at 5%; *** significant at 1%; regressions include time and industry dummies.

The results in Table 5 also indicate that capital intensity is significant and negative in the export intensity equation, while it is positive and significant with regard to the export decision of firms. Franco and Sasidharan (2009) find a negative effect of capital intensity for both equations and argue that in an emerging country the role played by capital is secondary in favouring exporting activities. However, our results show that, although the effect is negative for the export intensity of domestic firms, capital intensity favors the likelihood of exporting of domestic firms. This supports the idea that an increase in capital intensity increases the scale of production and increases the likelihood that domestic firms will enter the export market (Anwar and Nguyen, 2011).

Furthermore, Table 5 shows that the likelihood of exporting increases in the wage per employee. Kneller and Pisu (2007) argues that this may reflect the fact that firms with high skilled workers (and therefore higher wages) are more likely to be able to compete successfully in international markets. The coefficient for the productivity variable (TFP) is, surprisingly, negative and significant in the export intensity equation but positive and significant in export participation equation. This implies that more productive firms are more likely to enter international markets, but they export less. This may be due to the fact that, in the case of Turkey, local firms are more domestic-oriented; even as they export and as they become more productive, they interact and compete with foreign firms more intensely in domestic market, which makes them to cut their exports and to be more oriented in domestic market. The result, on the other hand, may be related to the export destinations of domestic firms. If domestic firms mostly export to low-income destinations, increasing productivity may lower the export intensity. In a representative sample of Italian manufacturing firms, Crino and Epifani (2009) find a negative correlation between productivity (however measured) and sales to low-income destinations.

Industry export share has a positive and significant effect on the export intensity equation; however, the coefficient turns out to be negative in the export participation equation. This suggests that firms operating in more export-intensive industries are more likely to export a larger share of their output, while they are less likely to participate in the export market, which may result from high fixed costs of entry to export markets. Moreover, as Table 5 indicates, the size of the industries and firms do not play any roles in the export volume and export decisions of domestic firms, as the coefficients are insignificant. This is in contrast with the literature (see Wakelin, 1998; Bleaney and Wakelin, 1999; Barrios et al., 2003; Greenaway and Kneller, 2004 among others), who argue that larger firms may be more financially capable of competing successfully in the international market.

When the absorptive capacity of firms is considered in the model, the results in Table 6 show that the interaction terms between absorptive capacity and backward spillover variables become significant and positive in the export intensity equation. It is negative but insignificant in the export participation decision equation. This result signifies backward spillovers on the decision about how much to export; as Kneller and Pisu (2007) discuss, these are likely to capture general information externalities that improve the firm's ability to compete in international markets as domestic firms improve their productivity. However, these general information externalities do not affect the firms' likelihood of exporting.

With regard to horizontal spillovers, Table 6 shows that, as the firms become more productive and close the technology gap, the likelihood of exporting decreases (albeit the coefficient is significant at a 10 per cent significance level). This may be due to the fact that horizontal linkages are more likely to result in both information and competition effects (Kneller and Pisu, 2007). Girma and Gorg (2005) argue that domestic firms with low absorptive capacity levels are unlikely to be in direct competition with foreign firms due to their relative backwardness, and are not able to benefit from positive spillovers. As they improve their productivity and close the technology gap, they start competing with foreign firms and thus begin to be exposed to the negative competition effect in the domestic market. Therefore, they may be less willingly to start exporting.

Table 6. *Estimation Results Accounting for Absorptive Capacity of Firms (Domestic Firms)*

		Export Participation		Export Intensity	
VARIABLES		Coeff.	Std. Err.	Coeff.	Std. Err.
Capital Intensity		0.041***	0.004	-0.003***	0.001
Industry Size		0.116	0.940	-0.244	0.189
Firm Size		-0.011	0.047	-0.008	0.009
Herfindahl Index		0.468	0.567	-0.341***	0.106
Average Wage		0.095***	0.013	0.0001	0.002
TFP		0.213***	0.009	-0.015***	0.106
Industry Export Share		-0.466***	0.149	0.112***	0.034
Horizontal Linkage		0.299	0.184	-0.040	0.035
Horizontal_abs.cap		-1.379*	0.824	-0.002	0.137
Backward Linkage		1.376*	0.787	-0.195	0.156
Backward_abs.cap		-2.229	1.378	1.430***	0.244
Forward Linkage		-0.534	0.327	0.097*	0.058
Forward_abs.cap		-0.525	0.868	-0.074	0.135
Export Experience		2.201***	0.009	Not included	Not included
Constant		-3.823***	0.195	0.415***	0.038
Number of Observations	122627				
Rho	-0.394				
Sigma	0.233				
Lambda	-0.092				
LR test of indep. Eqns. (rho=0)	2603.4				
Wald's Test for the Overall Significance of the Model	3830.3				
Log pseudo-likelihood	-41544				

Notes: * significant at 10%; ** significant at 5%; *** significant at 1%; regressions include time and industry dummies.

We find no evidence of export spillovers from forward linkages, resulting from increasing absorptive capacity of domestic firms. This implies that as the firms become more productive, the foreign presence in upstream industries does not affect the export activity of domestic firms. This may be due to the fact that intermediate supplier foreign firms may be mostly export oriented. Regarding the other control variables, the results are similar to the one without the interaction terms of absorptive capacity with spillover variables.

Finally, Table 7 shows the results from the model with a quadratic specification, in which we allow for a non-linear relationship between spillover variables and the absorptive capacity of domestic firms. The results for domestic firms, as shown in Table 7, indicate a concave (inverted u-shape) relationship for the interaction of absorptive capacity with backward linkages in the export intensity equation. Hence, an increase in absorptive capacity will first increase, but eventually reduce the export share of the firms. This implies that, if technology gap between domestic firms and multinationals is too small, there is a negative effect of backward linkage on the export share of the domestic firm.

Table 7. *Estimation Results Accounting for Nonlinearity between FDI and abs_cap Term (Domestic Firms)*

		Export Participation		Export Intensity	
VARIABLES		Coeff.	Std. Err.	Coeff.	Std. Err.
Capital Intensity		0.042***	0.004	-0.003***	0.001
Industry Size		0.069	0.940	-0.256	0.189
Firm Size		-0.009	0.047	-0.008	0.009
Herfindahl Index		0.515	0.568	-0.334***	0.106
Average Wage		0.090***	0.013	-0.002	0.002
TFP		0.204***	0.010	-0.019***	0.002
Industry Export Share		-0.476***	0.150	0.111***	0.034
Horizontal Linkage		0.223	0.187	-0.062*	0.035
Horizontal_abs.cap		0.610	1.269	0.485**	0.228
Horizontal_(abs.cap2)		-4.283	2.826	-0.896	0.575
Backward Linkage		1.301*	0.789	-0.241	0.157
Backward_abs.cap		-0.240	2.164	2.449***	0.413
Backward_(abs.cap2)		-4.888	5.073	-2.910***	1.123
Forward Linkage		-0.536	0.328	0.093	0.058
Forward_abs.cap		-0.803	1.329	-0.026	0.222
Forward_(abs.cap2)		0.888	2.856	-0.092	0.556
Export Experience		2.200***	0.009	Not included	Not included
Constant		-3.711***	0.199	0.466***	0.039
Number of Observations	122627				
Rho	-0.394				
Sigma	0.233				
Lambda	-0.092				
LR test of indep. Eqns. (rho=0)	2603.1				
Wald's Test for the Overall Significance of the Model	3876.1				
Log pseudo-likelihood	-41515				

Notes: * significant at 10%; ** significant at 5%; *** significant at 1%; regressions include time and industry dummies.

5. Conclusion

This paper examines the impact of horizontal and vertical spillovers from FDI on i) the export participation decision and ii) the export intensity of domestic firms utilizing firm level data of Turkey's manufacturing industries for the period of 2003 – 2013. The empirical analysis is based on Heckman's maximum likelihood estimation strategy to control for selection bias.

The empirical evidence reveals that, when absorptive capacity is not considered in the model, there exists no spillover effects from FDI through horizontal and backward linkages on the export intensity and the export participation decision of domestic firms. On the other hand, the export decision of firms is weakly significantly and negatively associated with the presence of foreign firms in the upstream industries whereas there is a little evidence of positive forward effects on the export share of domestic firms.

When the absorptive capacity of firms is accounted for, domestic firms seem to benefit only in a limited way from export spillovers. With reference to horizontal spillovers, we found negative export spillovers to non-exporters. This may result from the negative competition effects of foreign firms. Domestic firms with low absorptive capacity levels are unlikely to be in direct competition with foreign firms due to their relative backwardness. As they increase their absorptive capacity and close the technology gap, they begin to be exposed to the negative competition effect in the domestic market. Therefore, they may be less willingly to start exporting (Girma and Gorg, 2005).

With regard to vertical spillovers, the results reveals an evidence of backward spillovers to only exporters, we find no evidence of backward spillovers to non-exporters and no evidence of forward spillovers to both exporters and non-exporters. These findings suggest that, even if domestic firms increase their absorptive capacity, they are not be able to benefit from export spillovers through forward linkages. This might due to that foreign firms that are input suppliers are mostly export-oriented firms and they do not affect export behavior of domestic firms. On the other hand, domestic exporters may benefit from backward spillovers as they improve their capacity. This may suggest general information externalities that improve the firm's ability to compete in international markets and increase their export share, as domestic firms improve their productivity. However, our findings also imply that increases in absorptive capacity will first increase but eventually reduce the export share of exporters.

Overall, domestic firms seem to benefit only in a limited way from export spillovers. The export participation and export intensity decision of domestic firms does not seem to be affected by contacts they may have with multinational enterprises. Except for backward spillovers to exporters with adequate absorptive capacity, we did not find any evidence of forward and horizontal spillovers to domestic exporting firms even they increase their absorptive capacity. However, our findings also suggest that that increases in absorptive capacity will first increase but eventually reduce the export share of domestic firms. Furthermore, our results reveal negative horizontal spillovers and no evidence of vertical spillovers to non-exporters. This may well indicate negative competition effects resulting from entry of foreign firms into domestic markets and high sunk entry costs to export markets.

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Appendix A. Tables

Table 8. *Estimation Results without Considering Absorptive Capacity of Firms (All Firms)*

		Export Participation		Export Intensity	
VARIABLES		Coeff.	Std. Err.	Coeff.	Std. Err.
Capital Intensity		0.038***	0.004	-0.004***	0.001
Industry Size		0.116	0.923	-0.240	0.185
Firm Size		-0.011	0.046	-0.009	0.009
Herfindahl Index		0.414	0.560	-0.364***	0.104
Average Wage		0.118***	0.012	0.008***	0.002
TFP		0.188***	0.008	-0.011***	0.002
Industry Export Share		-0.627***	0.138	0.102***	0.032
Horizontal Linkage		0.210	0.175	-0.041	0.033
Backward Linkage		1.546**	0.765	-0.114	0.152
Forward Linkage		-0.537*	0.317	0.090	0.055
Export Experience		2.215***	0.009	Not included	Not included
Constant		-3.797***	0.182	0.346***	0.035
Number of Observations	128297				
Rho	-0.395				
Sigma	0.238				
Lambda	-0.094				
LR test of indep. Eqns. (rho=0)	2716.42				
Wald's Test for the Overall Significance of the Model	3910				
Log pseudo-likelihood	-43963.53				

Notes: * significant at 10%; ** significant at 5%; *** significant at 1%; regressions include time and industry dummies.

Table 9. *Estimation Results Accounting for Absorptive Capacity of Firms (All Firms)*

		Export Participation		Export Intensity	
VARIABLES		Coeff.	Std. Err.	Coeff.	Std. Err.
Capital Intensity		0.039***	0.004	-0.004***	0.001
Industry Size		0.124	0.923	-0.224	0.185
Firm Size		-0.012	0.046	-0.008	0.009
Herfindahl Index		0.361	0.560	-0.354***	0.104
Average Wage		0.124***	0.013	0.006***	0.002
TFP		0.204***	0.009	-0.017***	0.002
Industry Export Share		-0.629***	0.139	0.105***	0.032
Horizontal Linkage		0.245	0.179	-0.035	0.033
Horizontal_abs.cap		-0.731	0.746	-0.082	0.114
Backward Linkage		1.668**	0.767	-0.191	0.152
Backward_abs.cap		-1.803	1.279	1.250873	0.206
Forward Linkage		-0.519	0.318	0.093*	0.055
Forward_abs.cap		-0.522	0.792	-0.071	0.116
Export Experience		2.215***	0.009	Not included	Not included
Constant		-3.967***	0.190	0.398***	0.037
Number of Observations	128297				
Rho	-0.396				
Sigma	0.238				
Lambda	-0.094				
LR test of indep. Eqns. (rho=0)	2724.21				
Wald's Test for the Overall Significance of the Model	3959.88				
Log pseudo-likelihood	-43935.21				

Notes: * significant at 10%; ** significant at 5%; *** significant at 1%; regressions include time and industry dummies.

Table 10. *Estimation Results Accounting for Non-linearity between FDI and abs_cap Term (All Firms)*

		Export Participation		Export Intensity	
VARIABLES		Coeff.	Std. Err.	Coeff.	Std. Err.
Capital Intensity		0.039***	0.004	-0.004***	0.001
Industry Size		0.070	0.924	-0.236	0.185
Firm Size		-0.010	0.046	-0.008	0.009
Herfindahl Index		0.410	0.561	-0.346***	0.104
Average Wage		0.118***	0.013	0.004	0.002
TFP		0.194***	0.009	-0.022***	0.002
Industry Export Share		-0.645***	0.139	0.106***	0.032
Horizontal Linkage		0.159	0.182	-0.055	0.034
Horizontal_abs.cap		1.571	1.162	0.338*	0.198
Horizontal_abs.cap2		-5.385**	2.648	-0.730	0.503
Backward Linkage		1.598**	0.768	-0.251*	0.153
Backward_abs.cap		0.191	1.989	2.609***	0.356
Backward_abs.cap2		-4.308	4.389	-3.516***	0.876
Forward Linkage		-0.516	0.319	0.095*	0.056
Forward_abs.cap		-0.960	1.213	-0.167	0.194
Forward_abs.cap2		1.397	2.523	0.324	0.456
Export Experience		2.213***	0.009	Not included	Not included
Constant		-3.839***	0.193	0.454***	0.038
Number of Observations	128297				
Rho	-0.396				
Sigma	0.238				
Lambda	-0.094				
LR test of indep. Eqns. (rho=0)	2725.25				
Wald's Test for the Overall Significance of the Model	4019.33				
Log pseudo-likelihood	-43896.21				

Notes: * significant at 10%; ** significant at 5%; *** significant at 1%; regressions include time and industry dummies.

Appendix B. Capital Stock Estimation

Capital Stock Estimation

The perpetual inventory method is a simple method of producing a capital stock series from data on investment flows. The capital stock in period t is equal to the capital stock in the previous period after accounting for depreciation plus new additions to the capital stock in terms of net-investment.

$$K_t = (1-\delta)K_{t-1} + I_t \quad (A.1)$$

where K_t represents the capital stock at time t, δ the geometric depreciation rate, and I_t is investment.

In order to be able to apply the Perpetual Inventory Method to calculate the current capital stock, we need (i) a time series of investment data, (ii) information on the initial capital stock at the time when the investment time series starts, and (iii) information on the rate of depreciation of the existing capital stock.

(i) time series of investment data

The basic ingredient to the perpetual inventory method is the investment information provided in the AISS. The AISS distinguishes between 4 types of investment:
1. Machinery and equipment
2. Buildings and civil engineering structures
3. Other tangible goods
4. Computer software

After calculating capital stock series for each one of these asset types, these series are aggregated to obtain the total capital stock series of the firm.

(ii) initial capital stock

The implementation of the perpetual inventory method varies with respect to the way the initial capital stock is constructed. In this paper we employ the steady state approach to estimate the initial capital stock, which is based on the neoclassical growth theory whereby the economy is assumed to be at its balanced growth path (Harberger, 1978). This translates into firms operating at their steady state at a micro level. Hence, output grows at the same rate as the capital stock which implies constant capital-output over the long run. Therefore, denoting the initial year of the firm with "0", considering K_0 as initial capital stock of firm i and δ as depreciation rate, initial capital stock is constructed as follows:

$$K_{i1} = (1-\delta)K_{i0} + I_{i0} \quad (A.2)$$

Dividing both sides of equation with K_{i0}, we get

$$\frac{K_{i1}}{K_{i0}} = (1-\delta) + \frac{I_{i0}}{K_{i0}} \quad (A.3)$$

Since we assume that firms are at their balanced growth path

$$\frac{K_{i1}}{K_{i0}} = \frac{Y_{i1}}{Y_{i0}} = 1 + g_i \qquad \text{(A.4)}$$

so

$$1 + g_i = (1 - \delta) + \frac{I_{i0}}{K_{i0}} \qquad \text{(A.5)}$$

then

$$K_0 = \frac{I_0}{g_i + \delta} \qquad \text{(A.6)}$$

where g is the growth rate of the firm and calculated as growth of deflated production value.

An obvious problem of the Steady State Approach is that the estimate of the initial capital stock depends crucially on the investments and the growth rate of output in a single year. While this is unproblematic if the economy under consideration is in fact in equilibrium, a short-term investment shock in the first period of the available time-series of investments would lead to a strongly biased initial capital stock estimate. To counter this problem, Harberger (1978) uses three year averages to construct a more stable and reliable initial capital stock for firms (Berlemann and Wesselhoft, 2012). As a rendition to this, we use average investment and average growth rate of output of firms that appear in at least four years to construct our initial capital stock.

The steady state approach can generate negative value for initial capital stock if the average growth rate in output is negative and greater than the depreciation rate. This method can also generate zero value for initial capital stock in case the firms report zero investment for the first year they appear in the dataset. For firms that report zero investment at their initial year, it is assumed that they cannot be producing without capital. Therefore, initial capital stock is calculated at the year that they report positive investment and this amount is iterated back to the beginning year by dividing each type of capital stock by (1-δ) for each former year.

(iii) the rate of depreciation of the existing capital stock.

Ozler & Yılmaz (2007), utilizing Turkish micro level data from 1983-1996, assumed depreciation rates of 5%, 10%, 20% and 30% for building and structure, machinery and equipment, transportation equipment and computer and programming respectively. However, these depreciation rates are quite high compared to those in the literature. Furthermore, the methodology of the data covering the period 2003-2013 is quite different from the previous years. Therefore, motivating from the literature, we assume the following depreciation rates: 2.5 percent for building and civil engineering structures; 5 percent for transportation vehicle, machinery and equipment, and computers; 10 percent for other tangible goods; and 15 percent for computer software.

Given the initial capital and depreciation rates, perpetual inventory method is used for following years where we assume that capital stock is predetermined and evolves according to,

$$K_t = (1 - \delta)K_{t-1} + I_t \qquad \text{(A.7)}$$