

# Vertical and Horizontal FDI Spillovers in Transition Economies: Do Institutions Matter?

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## Abstract

This paper tests a number of hypotheses regarding the impact of foreign direct investment (FDI) on the competitiveness (productivity) of domestic firms in the host country. Using BEEPS data we are able to test traditional and new hypotheses with a larger number of countries (15 transition economies), on small firms as well as large firms, on firms in the service sector as well as firms in the manufacturing sector, and with a wider array of institutional variables than any other study. We find horizontal spillovers are consistently positive for large firms, and estimated with a negative (but not significant) sign for small firms. There is a clear pattern that supplying a foreign firm, whether in the host country or outside of the country, through exports, has positive productivity spillovers whereas purchasing from foreign firms has no effect. We found no support for the hypotheses that wholly owned foreign firms provide greater spillovers than joint ventures for either vertical or horizontal relationship. Similarly, there is no evidence that the quality of FDI from OECD countries is better than that of Non-OECD. There is some evidence that for large firms backward and horizontal spillovers are greater from Non-OECD countries. We tested whether the strength of spillovers varied if the environment was more or less corrupt, bureaucratic or open to trade and found these factors did not seem to play a role. Finally, we tested whether the strength of spillovers varied by the ‘absorptive capacity’ of the firm using two measures: technological gap and levels of education. We find that distance from the technological frontier dampens only horizontal spillovers only in the service industry; large firms with a higher educated workforce gain from the presence of foreign firms in their industry.

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## 1. Introduction and Literature Review

Since the early 1990s private capital flows have exceeded official foreign assistance to developing countries and most of it is in the form of foreign direct investment (FDI). At the same time, governments in emerging market economies have tended to make numerous concessions to attract FDI in order to spur economic development. There is an expectation that FDI increases productivity, both directly through investment in a Greenfield venture or acquisition of a domestic firm and indirectly through positive productivity spillovers on other domestic firms. Whereas there is a great deal of evidence that foreign owned firms are more productive than domestic firms,<sup>1</sup> the evidence on the productivity enhancing effects of foreign firms on domestic firms (spillovers) is mixed. This paper uses the rich Business Environment and Enterprise Performance Survey (BEEPS) data on firms in 26 transition economies to increase our understanding as to when, where and under what conditions FDI has positive spillover effects on domestic firms, and hence improves national welfare.

Foreign firms can have productivity “spillover” effects on local competitors (horizontal spillovers) as well as on upstream and downstream domestic firms (vertical spillovers).<sup>2</sup> The transfer of technology (broadly defined as managerial practices, production methods, marketing techniques or any other knowledge embodied in a product or service) can occur through a number of channels. For example, local firms may learn to imitate a new process or improve the quality of their product through observation, interaction with foreign managers in business chambers, and from former employees of foreign multinational corporations (MNEs).<sup>3</sup> Local

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<sup>1</sup> There is an extensive literature on this, from the seminal work of Caves (1974) to more recent work of Haskell, Pereira and Slaughter (2002) and Sabirianova, Svejnar and Terrell (2005a).

<sup>2</sup> Foreign firms can have other spillover effects on domestic firms, such as wage spillovers, but we focus on total factor productivity.

<sup>3</sup> In this paper the term MNEs will refer to foreign owned multinationals although we recognize that domestically owned firms can also be multinational in their production and sourcing.

firms may also benefit from the entry of new professional services or suppliers as a result of the MNE entry. Foreign firms may act as catalyze domestic suppliers to improve the quality or time efficiency of their good or service by demanding higher standards.<sup>4</sup> On the other hand, foreign firms may have a negative effect on domestic firms' output and productivity, especially in the short run, if they compete with domestic firms and "steal" their market or their best human capital. As domestic firms cut back production they may experience a higher average cost as fixed costs are spread over a smaller scale of production (Aitken and Harrison, 1998).

Most studies have examined "horizontal spillovers" and do so with a production function framework. The effect of foreign presence on the productivity of domestic firms in the same industry is captured by the coefficient on the share of foreign firms' output or employment in an industry. The evidence from this research is very mixed although there appears to be a sobering pattern. Most studies suggest that the effect in developing countries is null or negative (see for e.g., studies of Morocco by Haddad and Harrison, 1993; Venezuela by Aitken and Harrison, 1999; Bulgaria and Romania by Konings, 2000; the Czech Republic by Kosova, 2004; and Russia by Yudaeva et al., 2003). On the other hand, several studies find positive horizontal spillovers in the more developed economies such as the UK (e.g., Haskel et al., 2002) and the US (e.g., Keller and Yeaple, 2003).

The negative effect found in the less developed countries is usually attributed to the low "absorptive capacity" of the domestic firms. It is argued that the larger the technology and human capital gap between the domestic and foreign firms, the less likely the domestic firms will be able to gain from the spillovers and the implication is that positive spillovers should be found in more technologically advanced sectors or in the more industrialized countries.<sup>5</sup>

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<sup>4</sup> Domestic firms may again learn to achieve this on their own or be trained directly by the foreign firm.

<sup>5</sup> The reverse hypothesis -- that spillovers increase with a larger technology gap -- was put forth by Findlay (1978).

There is some evidence supporting the human capital gap hypothesis but the evidence with respect to the technology gap is mixed. Using data on FDI flows from industrial countries to 69 developing countries, Borensztein, De Gregorio and Lee (1998) show that FDI is an important vehicle for the transfer of technology and economic growth, but only in countries which have the minimum threshold stock of human capital. This was based on a variable indicating the share of the population with high school education or more. Using plant level data in one country, Blalock and Gertler (2002) have found that plants in Indonesia that have more highly educated employees benefit more from the presence of MNEs.

With respect to the empirical evidence on the effects of technology gaps, Kokko (1994) and Takii (2001) find a negative effect on spillovers from the technology gap between local and foreign-owned plants whereas Sjöholm (1999) and Blalock and Gertler (2002) find a positive relation, all using data for Indonesia. Girma, Greeaway and Wakelin (2001) find that local firms that are 'technologically comparable' to foreign firms have greater spillovers, using U.S. plant-level data for 1987-1996. The findings may differ because of different measures of the technology: some use labor productivity and others total factor productivity. On the other hand, studies that proxy technology through level of R&D tends to find positive horizontal spillovers in the R&D sector (see Kinoshita (2000) using data from the Czech Republic).

Sabirianova, Svejnar and Terrell (2005b) find that in the manufacturing sector in both the Czech Republic and Russia the productivity gap between domestic and foreign firms is increasing in industries with a greater foreign presence. However, in the Czech Republic this negative spillover effect is diminished and eventually reversed over time, whereas in Russia it continues to be associated with domestic firms falling further behind the technology frontier. The changing pattern in these two countries is intriguing and raises questions as to whether they are

driven by changing domestic policies over time with respect to competition, rule of law, openness to foreign investment and international trade.

A recent stream in the literature argues that FDI is more likely to have a positive effect on the host country's growth and development if the economy is open (in terms of trade and FDI) and competitive (see e.g., Moran, Graham and Blomstrom, 2005). Conversely, in protected and distorted economies, FDI is likely to worsen economic welfare of the host country:

“Foreign investors in countries with domestic content, joint venture and technology sharing requirements deploy production technique lagging far behind the frontier in international industry. Foreign affiliates with older technology and less efficient plants are not good candidates to develop from an infant industry to a robust world competitor. Local firms that sell to foreign affiliates in protected market are often subscale in size and inefficient in operation...” (Moran, Graham and Blomstrom, 2005, p. 376)

Supporting evidence on the impact of competition has been found by Blalock and Gertler (2004), using Indonesian data in that they show spillovers are highest in sectors with more competition. However, the relationship may be more complicated. Sembenelli and Siotis (2002) using Spanish data find that only firms in the R&D have positive spillovers when there is more competition. Aghion, Burgess, Redding, and Zilibotti (2005) develop a model showing that firm responses to liberalization are likely to be heterogeneous, with technologically more advanced firms being more likely to respond by investing in new technologies and production processes, and find supporting evidence with Indian data. Hence, the impact of openness and competition may have different spillover effects depending on where the firm is relative to the technological frontier, again referring to ‘absorptive capacity.’

In other words, foreign affiliates in better business environments tend to bring with better technology with them and hence there is “more to spill.” They also argue that foreign affiliates that have higher level of technology tend to be wholly owned, rather than joint-ventures. One might therefore see high more positive spillovers from wholly-owned foreign firms than from partially-owned foreign firms.

While there are numerous studies on horizontal (intra-industry) spillovers, there are relatively few empirical studies on vertical spillovers, which is surprising given the early analysis by Lall (1980) of the positive backward linkage effects of foreign firms on the Indian trucking industry.<sup>6</sup> Moreover, vertical spillovers are more likely to be positive than horizontal spillovers since MNEs have an incentive to improve the productivity of their suppliers (and not their competitors).<sup>7</sup> The few empirical papers that have appeared recently do indeed find evidence that is consistent with of technology transfer through backward linkages in the manufacturing sectors of Indonesia (Blalock and Gertler, 2005), Hungary (Schoors and van der Tol, 2001) and Lithuania (Javorcik, 2004). However, these studies rely only on a variable that is constructed from input-output tables at the industry level, rather than a direct firm-specific variable.

This study advances our understanding of the effects of vertical and horizontal spillovers in several dimensions. With respect to data, we provide incomparably larger comparative evidence than has been possible to date with information on 15 transition economies.<sup>8</sup> Moreover the evidence is for firms in the service sector as well as the manufacturing sector. Since most of

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<sup>6</sup> On the other hand, there are numerous case studies which provide specific examples of how MNEs provide training and assistance to their suppliers. See for example, Moran, 2001.

<sup>7</sup>Blalock and Gertler (2005) point out that MNEs may establish a relationship with multiple suppliers to reduce dependency on a single supplier and that this will then benefit all firms that purchase these vendors’ output. Consistent with this view, Lin and Saggi (2005) show theoretically how exclusivity in the contractual relationship between a multinational and its local supplier reduces the competition among local suppliers and can lower backward linkages and local welfare relative to autarky.

<sup>8</sup> We will potentially be able to provide results all 26 transition economies once data limitations are overcome. At the moment the analysis includes firm level data from: Albania, Bulgaria, Croatia, Czech Republic, Estonia, Hungary, Kazakhstan, Latvia, Lithuania, Poland, Romania, Russia, Slovakia, Slovenia and Ukraine.

the recent FDI is in acquisitions in services, this is an important phenomenon that has not been captured to date. Much of the existing evidence is for medium and large firms and we are also able to parse out the effects on small firms, with less than 30 employees, which tend to be the new entrepreneurs and engines of growth in the transition economies. Finally our data is very recent: for the years 2002 and 2005.

We are able to address the question of whether forward and backward linkages (vertical spillovers) with MNEs with a direct firm-specific variable and compare this with the results using the more indirect industry-specific variable based on input-output tables. We extend the analysis of forward and backward spillovers to include the concept of selling or buying from firms outside of the country, i.e., importing and exporting. There is no reason to believe that vertical spillovers are constrained to linkages with foreign firms within the host country alone (although the magnitude of effect may be stronger given proximity).

This study also advances the literature by shedding light on the impact of a country's institutions on the strength of vertical and horizontal spillovers. First, we explore whether spillovers vary by proxies for quality of FDI and then we explore the effect of various measures of the business environment (eg., corruption, bureaucracy, hold-up at customs) on the strength of spillovers.

Finally we address the question of whether the absorptive capacity of the firm, i.e., the technology or human capital gap, affects the strength of spillovers by asking: How does a domestic firm's distance from the business practice frontier affect spillovers? To what extent does the level of schooling in a firm impact the degree of spillovers?

## 2. Data<sup>9</sup>

We use data from the Business Environment and Enterprise Performance Survey (BEEPS) is a joint initiative of the European Bank for Reconstruction and Development (EBRD) and the World Bank Group. The survey was first undertaken in 1999–2000, when it was administered to approximately 4,000 enterprises in 26 countries of Central and Eastern Europe (CEE) (including Turkey) and the Commonwealth of Independent States (CIS) to assess the environment for private enterprise and business development. In the second round of the BEEPS, in 2002, the survey instrument was administered to approximately 6,500 enterprises in 27 countries (including Turkey). In the third round, in 2005, the BEEPS instrument was administered to approximately 7,900 enterprises in the same 27 countries covered by the second round of the BEEPS.<sup>10</sup>

This paper relies on the 2002 and 2005 survey data (BEEPS II and BEEPS III). The sampling frames of the last two BEEPS are very similar. Both were designed to have the following general targeted distributional criteria:

- Coverage of countries: Both were to be administered to 28 transition economies: 16 from CEE (Albania, Bosnia and Herzegovina, Bulgaria, Croatia, Czech Republic, Estonia, FR Yugoslavia, FYROM, Hungary, Latvia, Lithuania, Poland, Romania, Slovak Republic, Slovenia and Turkey) and 12 from the CIS (Armenia, Azerbaijan, Belarus, Georgia, Kazakhstan, Kyrgyzstan, Moldova, Russia, Tajikistan, Turkmenistan, Ukraine and Uzbekistan). In neither year could the survey be administered in Turkmenistan.
- Sector: In each country, the sectoral composition of the sample in terms of manufacturing<sup>11</sup> versus services<sup>12</sup> was to be determined by their relative contribution to GDP. Firms that operate in sectors subject to government price regulation and prudential supervision, such as

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<sup>9</sup>The information in the section draws heavily from Synovate (2005). (Synovate implemented the BEEPS instrument and provided the EBRD with electronic data sets.)

<sup>10</sup> Turkmenistan did not allow the members of Synovate into its country for either the second or third rounds of the BEEPS survey.

<sup>11</sup> Manufacturing includes mining and quarrying, construction, manufacturing and agro-processing

<sup>12</sup> Services includes: Transportation, storage and communications; Wholesale, retail, repairs; Real estate, business services; Hotels and restaurants; Other community, social and personal activities; and Commerce.

banking, electric power, rail transport, and water and waste water, were to be excluded from the design of the sample

- Size: At least 10% of the sample was to be in the small and 10% in the large size categories.<sup>13</sup> Firms with only one employee or more than 10,000 employees were to be excluded.
- Ownership: At least 10% of the firms were to have foreign control and 10% state control, based on more than 50% shareholding.
- Exporters: At least 10% of the firms were to be exporters, meaning that 20% or more of total sales is exported.
- Location: At least 10% of firms were to be in the category “small city/countryside” (Population under 50,000 inhabitants).

In 2005, the survey instrument was administered to an additional 1,700 manufacturing enterprises in seven countries: Kazakhstan, Armenia, Azerbaijan, Poland, Hungary, Romania and Moldova. This sample was to be distributed between at least two major industrial regions within each country and distributed evenly among manufacturing enterprises operating within three sectors: garments, food processing and metal and machinery. The aim was to keep the sectoral composition as similar as possible across countries.<sup>14</sup>

Table A1 in the appendix summarizes the total number of interviews as well as the quotas achieved in each country for the main BEEPS III. The percentages given in the table are calculated based on the completed (and not the targeted) interviews.<sup>15</sup> As can be seen in the table, the data base is comprised of a total of 7,942 firms, with between 200 and 600 firms per

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<sup>13</sup> Small=2-49 employees, Medium=50-249, Large=250-9,999.

<sup>14</sup> Specifically, the sectors were to be constant at the 3-digit ISIC code. However, if it was not possible to obtain enough observations to complete the sampling overlay while limiting it to the 3-digit ISIC code, then firms could be selected from the sectors defined at the 2-digit level.

<sup>15</sup> 17,083 eligible enterprises were contacted and for an interview completion rate of 37.7%. Respondents who either refused outright (i.e. not interested) or were unavailable to be interviewed (i.e. on holiday, etc.) accounted for 34.6% of all contacts. Enterprises which were contacted but were non-eligible (i.e. business activity, year of establishment, etc) or quotas were already met (i.e. size, ownership, etc.) or to which “blind calls” were made to meet quotas (i.e. foreign ownership, exporters, etc.) accounted for 27.7% of the total number of eligible enterprises contacted.

country. The share of firms in services ranged from 50% to 65% across the 27 countries. Between two-thirds and three-quarters of the firms are small (less than 50 employees). Approximately 10% of the firms are foreign owned and another 10% are state owned. The share of firms that export more than 20% of their output varies tremendously across these countries: from 5% in Kazakhstan to 30% in Slovenia.

This study relies primarily on the 2005 BEEPS survey and to a lesser extent on the 2002 BEEPS because data are made available on the rates of change from 2002 to 2005 in most of the variables of interest in the 2005 BEEPS. In those cases when we cannot construct rates of change from the 2005 BEEPS, we construct them by combining information from the two, 2002 and 2005, BEEPS data sets.

In addition to the BEEPS data, we rely on data from input-output tables to construct some of the spillover variables. To date, we have only been able to obtain recent input-output tables for 15 of the 26 countries, which limits our analysis at this stage. We attempted to impute values for countries with missing input-output tables by using the average values from the two closest neighboring countries but we found this introduced too much noise in the data. See Table A2 in the appendix for the year and source of our input-output tables.

### 3. Baseline Specification for Vertical and Horizontal Spillovers

To answer the posed questions regarding the existence of vertical and horizontal spillovers, we estimate the following baseline regression using pooled data for all 15 countries:

$$\Delta \ln Y_{ij} = \alpha_1 \Delta F_j + \alpha_2 \Delta B_j + \alpha_3 \Delta FP_j + \alpha_4 \Phi_i + \alpha_5 \text{Import}_i + \alpha_6 \Delta \text{Export}_i + \alpha_7 \Delta \text{HHI}_j + \beta_{1j} \Delta \ln K_i + \beta_{2j} \Delta \ln L_i + \beta_{3j} \Delta \ln M_i + X_{ij} \gamma + \varepsilon_{ij} \quad (1)$$

where  $\Delta$  refers to change from 2002 to 2005,  $i$  and  $j$  index firms and industries (at the two-digit NACE level),  $\ln Y$  is the log of sales revenues. The three industry-specific spillover variables are:  $F$  and  $B$ , forward and backward linkages, respectively, and  $FP$ , foreign presence (all described below). The firm-specific spillover variables include  $\Phi$ , which is the share of sales to MNEs<sup>16</sup> (only available for 2005); Exports, share of sales exported; Imports, share of inputs imported (only available for 2005). The inputs include:  $K$ , capital stock (at replacement value and utilization adjusted);  $L$ , labor (number of employees) and  $M$ , intermediate material input (including electricity).  $X$  is a set of country and industry dummies. The industry dummies are also interacted with the inputs in order allow for flexible industry specific production functions. We include  $\Delta \text{HHI}$ , which is the change in the Herfindahl index (computed at the two-digit level) as a proxy for the level of industry concentration. Multinational entry decreases industry concentration leading to more competition which forces domestic firms to improve their efficiency. Since we want to distinguish between the competition effect and the knowledge spillover effect, we follow Javorcik (2005) and include this variable to help separate out the two phenomena.

The foreign presence for industry  $j$  is constructed as is typically found in the literature:

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<sup>16</sup> MNEs is defined here as a firm with 50% or more foreign ownership.

$$FP_j = \frac{\sum_i Y_i \cdot s_i \cdot \mathbf{1}(i \in \text{industry } j)}{\sum_i Y_i \cdot \mathbf{1}(i \in \text{industry } j)}, \quad (2)$$

where  $Y_i$  is sales of firm  $i$  and  $s_i$  is the share of foreign ownership in firm  $i$ . In our econometric specifications, we exclude own output of the firm in computing  $FP$ . Since the number of firms per industry can be small, the estimate of the foreign presence can be sensitive to inclusion of very large firms of either domestic or foreign ownership. To attenuate this problem, we censor the size of sales at the median plus/minus three times the interquartile range for a given industry and country.<sup>17</sup> Finally, we note that the variable is constructed with the share of foreign ownership rather than whether the foreign firm is foreign owned or not foreign owned.

The linkage variables can be interpreted as follows:  $F_j$  is the average share of domestic firms' inputs in industry  $j$  purchased from foreign firms in industry  $h$ ;  $B_j$  is the average share of domestic firms' sales in industry  $j$  supplied to foreign firms in industry  $h$ . To clarify any confusion, the concept of forward and backward linkages is derived from the perspective of the foreign firm. Specifically, foreign owned firms provide backward spillovers to domestic firms when they buy from them and forward spillovers as they sell to them. We follow the methodology used by Blalock and Gertler (2002), Schoors and van der Tol (2001) and Javorcik, 2004 and denote  $s_{jh}$  as the share of sales sold by industry  $j$  to industry  $h$ . The shares, taken from the latest input/output table available for each country, are only for *domestic intermediate* consumption of goods.<sup>18</sup> They exclude "own" purchases or sales from industry  $j$ .<sup>19</sup> The forward and backward linkages are computed using the previously defined foreign presence ( $FP$ ) variable as follows:

$$F_j = \sum_{h \neq j} FP_h \cdot s_{hj} / \sum_{h \neq j} s_{hj} \quad (3)$$

<sup>17</sup> Given the size of our sample in each country, it was not possible to entertain the idea of constructing a foreign presence variable at the sub-national level.

<sup>18</sup> See Appendix Table A2 for the year and source of each input-output table.

<sup>19</sup> We note that, Blalock and Gertler's (2002) linkage variable includes purchases from its own sector.

$$B_j = \sum_{h \neq j} FP_h \cdot s_{jh} / \sum_{h \neq j} S_{jh} \quad (4)$$

We rely on the firm level data in the 2005 BEEPS to estimate equation (1) since this survey provides information on the growth from 2002 to 2005 in sales, exports, and each of the inputs. We use industry level data from the 2002 and 2005 BEEPS to construct changes in the three linkage variables,  $B_j$ ,  $F_j$  and  $FP_j$  over time. However, the 2005 BEEPS does not collect information on the change in Sales to MNEs ( $\Phi$ ) and *Imports* and hence these are included as their levels in 2005. This clearly creates an issue of how to interpret the coefficients on these variables, given that 2005 levels are being regressed on 2002-2005 changes. We can at least assert that the endogeneity problem of these two variables is not affecting the other coefficients since estimation of the regression excluding the two variables does not lead to a change in the coefficients or standard errors on the other variables of interest ( $B_j$ ,  $F_j$ ,  $FP_j$ , and *Export*). We obviously cannot attribute causality to  $\Phi$  and *Imports* with this specification. In order to test for a causal relation, we re-estimate equation (1) with first-differenced  $\Phi$  and *Imports* from a smaller panel of data that are available for about 700 firms in 2002 and 2005.

Two other econometric issues need to be addressed at this point. One is the concern about potential endogeneity of foreign presence and domestic firm productivity. For example, foreign firms may choose to locate in a given country because there is better telecommunications or other infrastructure which is also improving the efficiency of domestic firms. Or foreign firms may select to enter a given industry because of opportunities that we the econometricians do not observe but which also improve the efficiency of firms in that industry. We are able to control for this endogeneity by first differencing and adding fixed effects for country and industry. First-differencing removes any fixed firm-specific unobservable variation such as infrastructure. The

Industry and time dummies will control for unobservables that may be driving changes in, for e.g., the attractiveness of a given country or industry.

The second econometric issue has to do with endogeneity of inputs. It has been argued that the inputs should be considered as endogenous since they are chosen by the firm based on its productivity. Not taking this into account may bias the estimated coefficients. Hence, we also estimate a specification that uses the Solow residual as the measure of total factor productivity:

$$\begin{aligned} \Delta Solow_{ij} = & \alpha_1 \Delta F_j + \alpha_2 \Delta B_j + \alpha_3 \Delta FP_j + \alpha_4 \Phi_i + \alpha_5 Import_i + \alpha_6 \Delta Export_i + \\ & + \alpha_7 \Delta HHI_j + X_{ij} \gamma + \varepsilon_{ij}, \end{aligned} \quad (5)$$

where  $Solow_{ij} = \ln Y_{ij} - \alpha_j^K \ln K_{ij} - \alpha_j^L \ln L_{ij} - \alpha_j^M \ln M_{ij}$ , we allow cost shares to vary by industry and country. This approach improves on the Cobb-Douglas production function in equation (1) as it controls for the endogeneity of inputs. However, to the extent that the assumptions of competition, constant-returns to scale and cost-minimization are not met, the cost shares may not reflect the marginal cost and marginal revenue of the firm and may bias our results.

Given the large sample size of about 4,600 domestic firms (with zero FDI), we are able to estimate equation (1) and (5) separately for firms in the manufacturing and service sectors and for firms with less than 30 employees (small) and more than 30 employees (medium and large). The descriptive statistics of these variables are presented in appendix Tables A3-A7, for all domestic firms by industry and by country.

The key results from estimating equations (1) and (5) are presented in Tables 1a and 1b, respectively. The findings for both total factor productivity in the Cobb-Douglas estimation and the Solow residuals are very similar in terms of signs and significance.

*Backward spillover:* We find that the coefficient estimates are similar in magnitude in the two specifications and indicate large positive spillovers from supplying to MNEs. The estimates

signify that a 1% increase in sales to foreign firms in industry  $h$  raises the efficiency of domestic firms in industry  $j$  by about 11%. The coefficient appears to be larger for large firms (15-16%) than for small firms (9-10%), but not significantly different for firms in the manufacturing and service sector.

*Forward Spillover:* The point estimates for these coefficients are all much smaller than those for backward spillovers and none are statistically significant, leading us to conclude that purchasing from foreign firms (or industries with a higher share of foreign firms) does not provide any knowledge enhancing element in the production process of domestic firms.

*Horizontal Spillovers:* The coefficients on the foreign presence variables are small, changing in signs but generally not significant, except for the coefficient for large enterprises, which is identical in both specifications. It indicates that a 1% increase in the share of foreign firms' output in an industry will raise productivity of domestic large firms in the same industry by 0.5% but has no impact on the productivity of small firms or firms in manufacturing or services.

*Exports:* The coefficient on share of sales exported is robust with very similar point estimates for all firm-types across both specifications. A one percent increase in exports is correlated with about a 22-28% increase in the productivity of local firms, with a potentially higher effect on service sector and large firms.

*Herfindahl:* Changes in the concentration of firms in an industry does not seem to impact the changes in efficiency over this period, but we still think it is necessary to control for the level of concentration to be sure that the impact of the other variables can be attributed to knowledge spillovers rather than the result of competition.

*Sales to MNEs in 2005*: the coefficient on sales to MNEs is positive for all categories of firms and the point estimate is similar for each firm type across the two specifications. For example, a 1% increase in sales to MNEs as a share of output in 2005, (0.22-0.25) is correlated with a 6% increase in the growth of efficiency in both the Cobb-Douglas and Solow specifications. The coefficients are highest for small firms in both specifications (0.07-0.09) and smallest for large firms – 0.02-0.03 – with the coefficient not being significantly different from zero in the Solow residual specification.

*Imports in 2005* are not significant for any of the firm categories in either specification.

In order to test whether these last two firm level variables cause the growth in efficiency over time, we re-estimate equation (1) with panel data on 680 firms, as this allows us to first difference both the sales to MNEs and the imports variables. The results from this estimation, presented in Table 3 indicate that the change in either imports or sales are not significantly correlated with the change in efficiency over time. We tested various other specifications, which we do not show here. We found that the result holds when the industry-level variables ( $F_j$ ,  $B_j$ ,  $FP_j$ ) are eliminated from the regression. They also hold when a 2002 levels and 2002-2005 difference specification of all six linkage variables ( $F_j$ ,  $B_j$ ,  $FP_j$ ,  $\Phi_i$ ,  $Import_i$ ,  $Export_i$ ) is run with data on the 15 countries, however we found the coefficient on  $\Phi_i$  to be positive both on its 2002 level and 2002-2005 difference when this specification was estimated with data on all 26 countries.<sup>20</sup> The findings for imports continue to be not significant in all these specifications. We do not believe the non-significant finding for  $\Phi_i$  could be the result of the small sample size when using the panel data for 15 countries since we note that the findings for the backward linkage and exports continue to be robust with this small sample of firms. We believe it may

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<sup>20</sup> The  $F_j$ ,  $B_j$ , and  $FP_j$  variables in this regression were calculated with imputed values for shares using neighboring country's input-output tables' share values.

have to do with the mix of countries and hope to learn what may be driving this result in future research. Nevertheless, we do not use the panel specification for the remainder of this analysis because its size limits us in further analysis.

To sum up, the findings from Tables 1 and 2 indicate that there is an increase in the efficiency of domestic firms that supply industries in their country with higher concentrations of foreign firms or which export a higher share of their output (sell more to foreign firms outside of the country) but that domestic firms that buy from foreign firms (either domestically or out of the country, i.e., import) do not gain knowledge spillovers. Finally, only large firms gain from the presence of foreign firms in their industries. The firm level variable for share of sales to MNEs is not significant when estimated in first difference.

#### **4. Institutional Factors and the Business Environment**

As noted above, differences between countries' spillovers gains (losses) may be caused by differences in institutional factors and the business environmental. In this section we provide a preliminary exploration into some of these issues.

Moran, Graham and Blomstrom (2005) and others argue that a country with better property rights and more openness to market competition and FDI will attract better quality FDI (higher level technology) because, by being unconstrained these foreign firms will be able to optimize. Conversely, countries that impose restrictions on ownership or require technology sharing will attract FDI with a lower level of technology. Moreover, several studies have shown that foreign investors tend to transfer technology within wholly owned networks of multinationals subsidiaries than to joint ventures or licensees (see. e.g., Ramachandran, 1993 and Mansfield and Romero, 1980). Others have shown that in countries with limited rule of law, MNEs tend to shy away from joint-ownership and choose to invest in wholly-owned ventures

(see for example, Smarzynska and Wei, 2002 who study the impact of corruption on mode of entry). Hence, this evidence seems to point to potentially stronger positive spillovers from wholly-owned foreign firms than from partially-owned foreign firms since they bring with them a higher level of technology, and that the positive spillovers should be even greater in better business environments, i.e. more open economies with better rule of law.

Another characteristic that may affect spillovers is the nationality of foreign investors. Javorcik, Saggi and Spatarenu (2004) argue that there are two reasons why we might see nationality matters: 1) Since the share of intermediate inputs sourced by multinationals in a host country is positively correlated with the distance between the multinational's headquarters and the production plant in the host country, FDI from countries further away will have lower spillovers. 2) Preferential trading agreements will cover some host countries and not others. A third reason one might see that nationality of the FDI matters is that the quality of FDI (level of technology) may vary by origin: i.e., FDI from more developed countries may have a higher level of technology than FDI from less advanced countries. Hence we conjecture that FDI from the OECD countries may have higher technology than FDI from non-OECD countries and hence we would see greater spillovers from FDI from OECD countries.

Equation (1) is re-estimated with new variables for the backward, forward, and horizontal linkages where the foreign presence variable,  $FP_j$ , is recalculated for share of output by wholly-owned foreign firms v. partially-owned and for share of output produced by FDI from OECD countries v. non-OECD countries. The findings for these proxies for the "quality of FDI" are presented in Tables 3 and 4. They indicate that there appears to be no difference in the productivity spillovers from wholly v. partially owned foreign firms or from FDI from OECD v. Non-OECD countries.

Hence, neither the conjecture from the literature that wholly-owned foreign firms have higher levels of technology than partially-owned, nor our conjecture that the quality of FDI from OECD countries is better from Non-OECD seem to be born out in terms of spillover effects. This could be due to a number of reasons;<sup>21</sup> we test whether spillovers are higher for wholly-owned firms in better business environments, following the hypothesis put forth by Moran, Graham and Blomstrom (2005). However, we begin by testing whether vertical and horizontal spillovers (without taking degree of ownership into account) vary systematically with different institutions. By institutions and business environment, we refer to openness of the economy, bureaucratic red tape, and corruption. We hypothesize that spillovers more likely to be positive when there is less bureaucratic tape or corruption and more openness to trade, both because this will attract better quality FDI and because domestic firms in these environments will be more competitive and able to absorb technology spillovers.

BEEPS offers a unique opportunity to examine factors determining the strength of horizontal and vertical spillovers. Not only does it have a rich set of variables that capture institutions/business environment, but importantly, this information is collected at the firm level. Second, BEEPS has large cross-country variation so that we do not have to rely on time-series variation to identify the effect the institutions. We test for the importance the effect of institutions on the strength of spillovers as follows. Our baseline specification can be rewritten as

$$\Delta \ln Y_{ij} = \alpha \Lambda_{ij} + \beta Z_i + \gamma X_{ij} + \varepsilon_{ij} \quad (6)$$

where  $\Delta \ln Y_{ij}$  is growth rate of sales from 2002 to 2005,  $\Lambda$  is the vector of linkage variables (e.g., share of exports, share of sales to MNEs, forward linkage, etc.),  $Z$  is a vector of inputs and

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<sup>21</sup> One argument in the literature is that horizontal spillovers will be less likely if the wholly owned firms are better able than joint-ventures to protect their proprietary assets. We have no way to test for this.

X is a set of other controls such as industry and country dummies. Coefficient  $\alpha$  measures the strength of linkages. **YURIY – THIS AND FOLLOWING EQUATIONS ALSO NEED TO HAVE THE DELTA PUT INTO THE  $\Lambda$ , Z AND X VARIABLES**

Suppose that  $\alpha = \alpha(G)$  is a function of  $G$ , a vector of variables that captures institutions/business environment. Using first-order Taylor expansion, one can approximate (6) with

$$\Delta \ln Y_{ij} = \alpha \Lambda_{ij} + \theta G_{ij} \Lambda_{ij} + \beta Z_i + \gamma X_{ij} + \varepsilon_{ij} \quad (7)$$

where  $\theta = \alpha'(\bar{G})$  and  $\alpha = \alpha(\bar{G})$ . We generalize (7) to allow a direct effect of variable Z on outcome variable the outcome variable so that the specification is

$$\Delta \ln Y_{ij} = \alpha \Lambda_{ij} + \theta G_{ij} \Lambda_{ij} + \psi G_{ij} + \beta Z_i + \gamma X_{ij} + \varepsilon_{ij}. \quad (8)$$

Among the many variables in the BEEPS that measure institutions/business environment, we consider the following.<sup>22</sup>

- Corruption measured as *Bribe*, the percentage of total annual sales typically pay in unofficial payments/gifts to public officials and expenditures on contract enforcement;
- Red tape is proxied by the percentage of *management's time spent with officials*.
- Openness of the economy is proxied with a variable that captures hold-up in trade (*wait-time*) by the number of days waiting at customs to get imports and exports out.

These three variables were constructed by averaging firms' responses for the industry and country in which the firm resided. The results from interacting the 2002-2005 rate of change in these institutional variables with the rate of change in the forward, backward and horizontal spillover variables do not reveal any systematic patterns. Corruption (bribe) does not have a

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<sup>22</sup> In the next version of this paper we will consider other possible dimensions such as trade barriers, degree of competition, infrastructure, legal system, and government regulation.

direct or indirect effect on the efficiency of domestic firms (Table 5). The longer managers spend with bureaucrats has a significantly positive effect on efficiency of firms in the manufacturing sector but has no effect on the strength of vertical or horizontal spillovers (Table 6). On the other hand, hold-up in customs reduces the spillover effect from backward and forward linkages for certain groups: for manufacturing firms, backward spillovers, which are positive and significant at 0.131, are reduced by 0.215 for every unit of wait time. For the service sector, hold-up reduces the strength of forward spillovers but increases backward spillovers. This finding clearly needs further exploration (Table 7).

We ask ourselves whether it is the rate of change in the amount of corruption that matters or the actual level of corruption that is more important. Equation (8) was revised to include the 2002 level of the institution as follows: **YURIY CAN YOU CANGE THE FOLLOWING EQUATION TO INCLUDE  $G_{2002}$  – thanks!**

$$\Delta \ln Y_{ij} = \alpha \Lambda_{ij} + \theta G_{ij} \Lambda_{ij} + \psi G_{ij} + \beta Z_i + \gamma X_{ij} + \varepsilon_{ij}. \quad (9)$$

The estimates of  $\theta$  and  $\psi$  (not reported here) were not significantly different from zero for 2002 levels of corruption, manager's time and hold up in customs.

We then ask whether these environmental variables should not be measured at the country level rather than at the industry and country level, as we have been doing. It would seem that the effect of corruption or waiting time at customs would be more nation-specific than industry specific. We calculate a new measure of corruption in 2002 (wait-time and manager's time) as the average response rate for all firms in a country; we then rank and divide the 15 countries into three groups by level of corruption in 2002. We estimate a specification that

interacts this categorical variable of corruption with the three linkage variables. The results (not reported here) indicate there is no systematic affect.<sup>23</sup>

Finally we ask whether spillovers vary systematically for wholly and partially foreign owned by environment. We use the country level variable for corruption, manager's time and wait-time and rank countries in the top v bottom half of the distribution of each of these. We interact this variable with the spillover and wholly v partially owned variables as follows:

**YURIY CAN YOU CANGE THE FOLLOWING EQUATION TO REFLECT WHAT YOU DID IN OUTPTU 'TOP\_WHOLE-Partial.doc' of 2/2/06– thanks!**

$$\Delta \ln Y_{ij} = \alpha \Lambda_{ij} + \theta G_{ij} \Lambda_{ij} + \psi G_{ij} + \beta Z_i + \gamma X_{ij} + \varepsilon_{ij}. \quad (10)$$

Again, we did not find anything coming out as significant.

## 5. Technology Gap or Distance to the Frontier

Differences between plants' or firms' technology or level of human capital may also help explain the extent to which they can benefit from spillovers. In a series of papers, Acemoglu, Aghion et al. (2005) argue that the effect of foreign presence on domestic firms is heterogeneous. Specifically, firms that are close to the technological frontier benefit more from foreign presence than firms that are far from the technological frontier. Melitz (2003) obtains similar results although in his model foreign presence has only general equilibrium effects.

The empirical problem for testing the hypothesis with respect to the 'technology gap' is that the level of technology is not observed and, thus, it is hard to compute the distance to the technological frontier at the firm level.<sup>24</sup> We resolve this problem in the following way. Since

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<sup>23</sup> The only significant finding is that corruption affects only backward spillovers and in a U shaped pattern: i.e., firms in countries with the most or the least corruption fair worse in terms of backward spillovers compared to firms in countries with the middle level of corruption. **WHAT TO SAY?**

<sup>24</sup> We cannot use stochastic frontier analysis because the distance from the frontier interacted with other variables is correlated with the residual, which includes the level of technology.

there is substantial anecdotal and other evidence that foreign firms are more advanced than domestic firms in the developing countries, we assume that foreign firms embody the technological frontier. Firms that are similar to foreign firms along observed characteristics are likely to have a technology close to the technology of the foreign-owned counterparts. If observed characteristics of domestic firms are different from observed characteristic of the foreign-owned firms, the domestic firms are likely to use a technology different from the technology used by foreign-owned firms. At the minimum, one can interpret this difference as the distance from the business practice of foreign-owned firms.

To construct such a metric of discrepancy, we use standard tools from the literature on matching (e.g., Rosembaum 2002). Specifically, we use Mahalanobis distance, i.e., the distance of domestic firm  $i$  to a foreign firm is equal to  $d_i = \min_{j \in F} \{(x_i^D - x_j^F)' S_x^{-1} (x_i^D - x_j^F)\}^{1/2}$  where  $F$  and  $D$  are sets of foreign-owned and domestic companies,  $S_x$  is the covariance matrix of the vector of observed characteristics  $x$ . We take the minimum over all possible distances since technology (business practices and models) can vary across foreign-owned firms.

The vector of observed characteristics is size of capital stock (in logs), the number of employees (in logs), structure of the employment (educational attainment: primary school, vocational school, secondary school, college; skill level: management, skilled workers, unskilled workers, professional workers), type of location (capital, large city, mediums-size city, town), industry (NACE 2-digit level), export status (Yes/No), country. We match firms by industry and country exactly, i.e., domestic firms can be matched only to foreign-owned firms in the same industry and country. Since the distance is skewed, we take  $\log(1+\text{distance})$  as the distance from the frontier in our specification.

In the following we describe our test of the hypothesis that distance to the frontier determines the effect of foreign presence (and in the future work, other linkages). We modify the baseline specification to accommodate a possibility of the heterogeneous response to foreign presence. We assume that  $\alpha = \alpha(D)$  is a function of  $D$ , the distance from the frontier. Using first-order Taylor expansion, one can approximate  $\alpha = \alpha(D)$  in (?) with

$$\Delta \ln Y_{ij} = \alpha \Lambda_{ij} + \theta D_{ij} \Lambda_{ij} + \beta Z_i + \gamma X_{ij} + \varepsilon_{ij} \quad (9)$$

where  $\theta = \alpha'(\bar{D})$  and  $\alpha = \alpha(\bar{D})$ . The effect of distance on the strength of foreign presence is captured by the coefficient on the interaction of  $D$  with  $\Lambda$ .

The key findings on the technology gap are reported in Table 8. They show that only in the service sector does distance have a significant effect, indicating domestic firms whose technology is further away from the foreign firms are less efficient and also have smaller horizontal spillovers than those that are closer.<sup>25</sup>

Finally, the effect of education measured as the share of workers with a university education or higher, indicates that large firms with more educated workers do indeed tend to gain positive spillovers from foreign firms in their industries. Otherwise the effect is not significant.

## 6. Summary and Conclusions

This paper has set out to establish whether some patterns found in the literature with individual country data can be confirmed with a data on 15 transition economies. It also explores an area that has not been examined in the literature: the effect of institutions on the strength of spillovers.

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<sup>25</sup> Kathuria (2001) has measured technical efficiency as the distance between the local firm and the most efficient firm in the industry using data from 1975/76 to 1988/89 in India; he finds that foreign presence leads to increased dispersion of efficiency in the industry over time. Whereas the independent variable is similar the Mahalanobis distance, the outcome variable (dispersion in efficiency) differs. One can interpret this as a negative spillover.

We do confirm the findings by Blalock and Gertler (2005) and Javorcik (2005), with respect to the positive impact of *backward spillovers* and zero *forward spillovers* (using the same industry specific variables) that are robust to estimations with both the Solow Residual and Cobb Douglas. We find that both large and small firms that supply industries with a higher share of foreign firms experience higher efficiency gains on the order of 0.10 for small firms and 0.16 for large firms. We could not confirm this finding with the firm level variable on sales to MNEs. We conjecture that there is a lot of noise in this variable. *Horizontal spillovers* turned to be null, but are positive for large firms. Whereas *Growth in Imports* do not appear to improve growth of efficiency (never significant), *Growth in Exports* consistently increase efficiency by 22%. This is a very robust finding in all specifications. Hence there is a clear pattern that supplying a foreign firm, whether in the host country or outside of the country, has knowledge spillover effects whereas purchasing from foreign firms does not.

Our exploratory analysis of the institutional variables is disappointing and we do not at this stage understand whether it is due to noise in the data or to poor theoretical framework or indeed that red tape (e.g., proxied by the share of the manager's time spent with government officials, hold up in customs and bribery do not have an effect either directly or indirectly on the productivity of firms in developing countries. We are waiting until we obtain input-output data from other country's and re-estimate the equation before we draw final conclusions.

Finally, we find that *Distance* from the technological frontier in the service industry dampens the positive horizontal spillovers found there and large firms with a higher educated workforce gain from the presence of foreign firms in their industry.



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**Table 1a. Spillover Effects on Total Factor Productivity Using the Cobb-Douglas Production Function**

	(1)	(2)	(3)	(4)	(5)
	ALL	LARGE	SMALL	MNFG	SERV
Δ Backward	0.109*** (0.041)	0.155** (0.070)	0.090* (0.050)	0.090 (0.062)	0.095 (0.068)
Δ Forward	0.018 (0.036)	0.050 (0.052)	-0.002 (0.048)	0.036 (0.051)	0.047 (0.077)
Δ Horizontal	0.010 (0.016)	0.047** (0.022)	-0.012 (0.021)	-0.003 (0.026)	0.049 (0.033)
Δ Share Exports	0.224*** (0.029)	0.238*** (0.043)	0.205*** (0.036)	0.217*** (0.036)	0.245*** (0.053)
Δ HHI	-0.019 (0.014)	-0.009 (0.023)	-0.025 (0.017)	-0.009 (0.023)	-0.031 (0.024)
Sales to MNEs in 2005	0.057*** (0.013)	0.034* (0.018)	0.073*** (0.020)	0.049*** (0.019)	0.053** (0.024)
Share imports in 2005	-0.007 (0.008)	0.002 (0.013)	-0.011 (0.010)	-0.015 (0.012)	-0.005 (0.012)
Observations	4620	1580	3040	1879	2081
R-squared	0.61	0.63	0.60	0.64	0.57

Note: The table reports the estimated effects on total factor productivity using a Cobb-Douglas production function, where the dependent variables is growth rate of sales revenues; the independent variables include three inputs (utilization adjusted capital, number of employees, materials), country and industry fixed effects, and the reported variables. See text for definition of variables. Large firms are defined as firms with more than 30 employees. MNFG = manufacturing firms according to NACE classification. Robust clustered standard errors in parentheses; \* significant at 10%; \*\* significant at 5%; \*\*\* significant at 1%

**Table 1b. Spillover Effects on Total Factor Productivity Using the Solow Residual**

	(1)	(2)	(3)	(4)	(5)
	ALL	LARGE	SMALL	MNFG	SERV
Δ Backward	0.111**	0.156*	0.096*	0.070	0.136*
	(0.046)	(0.081)	(0.057)	(0.074)	(0.078)
Δ Forward	0.020	0.035	-0.001	0.064	0.075
	(0.043)	(0.069)	(0.055)	(0.064)	(0.088)
Δ Horizontal	-0.006	0.050*	-0.035	0.008	0.028
	(0.018)	(0.027)	(0.024)	(0.031)	(0.037)
Δ Share Exports	0.254***	0.256***	0.242***	0.239***	0.283***
	(0.032)	(0.046)	(0.043)	(0.039)	(0.058)
Δ HHI	-0.004	0.036	-0.023	0.013	-0.017
	(0.016)	(0.027)	(0.020)	(0.028)	(0.026)
Sales to MNEs in 2005	0.059***	0.024	0.090***	0.035	0.058**
	(0.017)	(0.023)	(0.024)	(0.023)	(0.029)
Share imports in 2005	-0.007	-0.000	-0.009	-0.010	-0.009
	(0.009)	(0.016)	(0.012)	(0.014)	(0.014)
Observations	4635	1585	3050	1883	2088
R-squared	0.04	0.06	0.05	0.04	0.06

Note: The table reports the estimated effects on total factor productivity using the Solow Residual where the dependent variables is growth rate of sales revenues; the independent variables include three inputs (utilization adjusted capital, number of employees, materials) whose cost shares are allowed to vary by industry, as well as country and industry fixed effects, and the reported variables. See text for definition of variables. Large firms are defined as firms with more than 30 employees. MNFG = manufacturing firms according to NACE classification. Robust clustered standard errors in parentheses; \* significant at 10%; \*\* significant at 5%; \*\*\* significant at 1%

**Table 2. Spillover Effects on Total Factor Productivity Using the Cobb-Douglas Production Function with panel data on 2002-2005 firms**

	(1) ALL	(2) LARGE	(3) SMALL	(4) MNFG	(5) SERV
Δ Backward	0.190** (0.091)	0.282** (0.115)	0.139 (0.124)	0.206 (0.183)	0.101 (0.114)
Δ Forward	-0.033 (0.083)	-0.022 (0.112)	0.044 (0.115)	-0.257* (0.130)	0.133 (0.159)
Δ Horizontal	-0.030 (0.047)	0.081 (0.051)	-0.087 (0.065)	-0.023 (0.076)	0.065 (0.069)
Δ Share Exports	0.302*** (0.068)	0.336*** (0.096)	0.240*** (0.091)	0.291** (0.127)	0.467*** (0.077)
Δ HHI	-0.038 (0.035)	-0.077 (0.052)	-0.022 (0.046)	-0.047 (0.071)	0.034 (0.058)
Δ Sales to MNEs	-0.015 (0.031)	-0.038 (0.054)	-0.003 (0.038)	0.026 (0.063)	-0.036 (0.044)
Δ Share imports	0.006 (0.020)	0.033 (0.029)	-0.005 (0.026)	-0.029 (0.044)	0.013 (0.026)
Observations	684	258	426	160	398
R-squared	0.64	0.71	0.62	0.65	0.63

Note: The table reports the estimated effects on total factor productivity using a Cobb-Douglas production function, where the dependent variables is growth rate of sales revenues; the independent variables include three inputs (utilization adjusted capital, number of employees, materials), country and industry fixed effects, and the reported variables. See text for definition of variables. Large firms are defined as firms with more than 30 employees. MNFG = manufacturing firms according to NACE classification. Robust clustered standard errors in parentheses; \* significant at 10%; \*\* significant at 5%; \*\*\* significant at 1%

**Table 3: Effect of Whole v. Partial Foreign Ownership on Spillovers**

	(1)	(2)	(3)	(4)	(5)
	ALL	LARGE	SMALL	MNFG	SERV
Δ Backward (whole)	0.094*	0.095	0.107*	0.113	0.091
	(0.050)	(0.079)	(0.065)	(0.076)	(0.085)
Δ Backward (partial)	0.101	0.187*	0.053	0.025	0.134
	(0.069)	(0.110)	(0.089)	(0.109)	(0.104)
Δ Forward (whole)	0.032	0.113*	-0.014	-0.012	0.019
	(0.041)	(0.062)	(0.054)	(0.058)	(0.081)
Δ Forward (partial)	-0.047	-0.091	-0.031	0.262**	-0.077
	(0.066)	(0.099)	(0.086)	(0.131)	(0.136)
Δ Horizontal (whole)	0.011	0.032	-0.002	-0.023	0.065*
	(0.018)	(0.027)	(0.024)	(0.029)	(0.035)
Δ Horizontal (partial)	0.011	0.067	-0.025	0.014	-0.007
	(0.028)	(0.042)	(0.037)	(0.042)	(0.055)
Δ Share Exports	0.231***	0.244***	0.212***	0.231***	0.255***
	(0.028)	(0.042)	(0.036)	(0.037)	(0.049)
Δ HHI	-0.015	-0.005	-0.021	-0.009	-0.021
	(0.014)	(0.022)	(0.017)	(0.022)	(0.023)
Sales to MNEs in 2005	0.058***	0.037**	0.073***	0.050***	0.055**
	(0.013)	(0.017)	(0.020)	(0.018)	(0.024)
Share imports in 2005	-0.006	0.003	-0.010	-0.014	-0.004
	(0.008)	(0.013)	(0.010)	(0.012)	(0.012)
Observations	4622	1580	3042	1879	2081
R-squared	0.61	0.63	0.60	0.65	0.57

Note: The table reports the estimated effects on total factor productivity using a Cobb-Douglas production function, where the dependent variables is growth rate of sales revenues; the independent variables include three inputs (utilization adjusted capital, number of employees, materials), country and industry fixed effects, and the reported variables. Each of the Backward, Forward, and Horizontal variables have been subdivided into two separate variables that capture the share of output produced by wholly owned v. partially owned foreign firms in a two digit industry. Large firms are defined as firms with more than 30 employees. MNFG = manufacturing firms according to NACE classification. The variables measuring changes in forward, backward and horizontal linkages are recalculated to differentiate the share of output in industry  $j$  produced by wholly-owned v. partially-owned foreign firms. Robust clustered standard errors in parentheses; \* significant at 10%; \*\* significant at 5%; \*\*\* significant at 1%

**Table 4: Effect of Source of FDI on Spillovers**

	(1)	(2)	(3)	(4)	(5)
	ALL	LARGE	SMALL	MNFG	SERV
Δ Backward (OECD)	0.097*	0.045	0.141**	0.059	0.114
	(0.053)	(0.087)	(0.066)	(0.087)	(0.081)
Δ Backward (Non-OECD)	0.135**	0.243***	0.048	0.058	0.026
	(0.052)	(0.090)	(0.067)	(0.074)	(0.123)
Δ Forward (OECD)	-0.043	0.013	-0.054	0.103	-0.074
	(0.046)	(0.074)	(0.059)	(0.076)	(0.094)
Δ Forward (Non-OECD)	0.029	0.105	-0.018	-0.017	0.088
	(0.049)	(0.069)	(0.067)	(0.074)	(0.100)
Δ Horizontal (OECD)	0.008	0.038	-0.008	-0.003	0.060
	(0.016)	(0.025)	(0.021)	(0.025)	(0.040)
Δ Horizontal (Non-OECD)	-0.003	0.076**	-0.044	-0.050	-0.013
	(0.023)	(0.033)	(0.030)	(0.036)	(0.049)
Δ Share Exports	0.211***	0.228***	0.188***	0.186***	0.261***
	(0.031)	(0.045)	(0.039)	(0.037)	(0.056)
Δ HHI	-0.013	0.005	-0.020	-0.003	-0.018
	(0.013)	(0.022)	(0.017)	(0.022)	(0.023)
Sales to MNEs in 2005	0.061***	0.040**	0.077***	0.059***	0.055**
	(0.013)	(0.016)	(0.020)	(0.018)	(0.023)
Share imports in 2005	-0.007	0.002	-0.012	-0.017	-0.003
	(0.008)	(0.013)	(0.010)	(0.012)	(0.012)
Observations	4379	1498	2881	1771	1983
R-squared	0.55	0.56	0.55	0.59	0.51

Note: The table reports the estimated effects on total factor productivity using a Cobb-Douglas production function, where the dependent variables is growth rate of sales revenues; the independent variables include three inputs (utilization adjusted capital, number of employees, materials), country and industry fixed effects, and the reported variables. Each of the Backward, Forward, and Horizontal variables have been subdivided into two separate variables that capture the share of output in a two digit industry produced by FDI of OECD v. Non-OECD origin. Large firms are defined as firms with more than 30 employees. MNFG = manufacturing firms according to NACE classification. The variables measuring changes in forward, backward and horizontal linkages have been recalculated to differentiate the share of output in industry  $j$  produced by foreign with an OECD origin v. foreign firms with a non-OECD origin. Robust standard errors in parentheses; \* significant at 10%; \*\* significant at 5%; \*\*\* significant at 1%

**Table 5: Effect of Bribes on Strength of Spillovers and Total Factor Productivity**

	(1)	(2)	(3)	(4)	(5)
	ALL	LARGE	SMALL	MNFG	SERV
$\Delta$ Backward	0.087** (0.037)	0.104* (0.056)	0.070 (0.047)	0.165** (0.070)	0.117** (0.058)
$\Delta$ Forward	0.062 (0.044)	0.107 (0.080)	0.049 (0.052)	0.010 (0.067)	0.039 (0.074)
$\Delta$ Horizontal	0.015 (0.015)	0.045** (0.023)	-0.004 (0.020)	-0.021 (0.027)	0.058* (0.030)
$\Delta$ Backward * $\Delta$ Bribe	-1.206 (2.015)	-0.414 (3.160)	-1.977 (2.589)	1.698 (3.017)	-4.674 (3.197)
$\Delta$ Forward * $\Delta$ Bribe	-0.009 (1.520)	0.569 (2.415)	0.288 (1.928)	0.705 (2.435)	0.332 (2.267)
$\Delta$ Horizontal * $\Delta$ Bribe	-0.254 (0.579)	-0.503 (0.821)	-0.146 (0.791)	-0.833 (0.956)	-0.577 (1.227)
$\Delta$ Bribe	0.151 (0.153)	0.085 (0.238)	0.125 (0.197)	0.233 (0.291)	-0.067 (0.221)
$\Delta$ Share Exports	0.230*** (0.028)	0.248*** (0.041)	0.207*** (0.036)	0.227*** (0.037)	0.249*** (0.050)
$\Delta$ HHI	-0.010 (0.014)	0.004 (0.024)	-0.019 (0.017)	0.004 (0.024)	-0.028 (0.023)
Observations	4616	1577	3039	1877	2080
R-squared	0.60	0.62	0.60	0.65	0.56

Note: The table reports the estimated spillover effects on total factor productivity using the specification in equation (8) in the paper. The bribe variable is constructed as the sum of the answers to the following two questions: 1) “On average, what percent of total annual sales do firm’s like yours typically pay in unofficial payments/gifts to public officials?”; 2) When firms in your industry do business with the government, what percent of the contract value would be typically paid in additional or unofficial payments/gifts to secure the contract? Robust clustered standard errors in parentheses; \* significant at 10%; \*\* significant at 5%; \*\*\* significant at 1%

**Table 6: Effect of Manager's time spent with bureaucrats on the strength of spillovers and total factor productivity**

	(1)	(2)	(3)	(4)	(5)
	ALL	LARGE	SMALL	MNFG	SERV
Δ Backward	0.094*** (0.035)	0.106** (0.050)	0.096* (0.053)	0.108 (0.082)	0.143** (0.069)
Δ Forward	0.060 (0.044)	0.105 (0.076)	0.020 (0.055)	0.036 (0.069)	0.004 (0.083)
Δ Horizontal	0.016 (0.017)	0.045* (0.026)	-0.005 (0.021)	-0.007 (0.028)	0.047 (0.031)
Δ Backward * ΔMangr's time	0.091 (0.585)	0.807 (0.842)	-1.366 (0.946)	0.997 (1.304)	-0.563 (1.080)
Δ Forward * Δ Mangr's time	0.386 (0.457)	0.119 (0.416)	1.138 (0.974)	-1.275 (1.512)	1.039 (1.039)
Δ Horizontal * Δ Mangr's time	0.162 (0.294)	0.172 (0.393)	0.018 (0.390)	0.250 (0.419)	-0.210 (0.532)
Δ Manager's time	0.027 (0.066)	0.064 (0.104)	-0.025 (0.093)	0.243* (0.137)	-0.147 (0.103)
Δ Share Exports	0.229*** (0.028)	0.246*** (0.042)	0.207*** (0.036)	0.227*** (0.037)	0.250*** (0.049)
Δ HHI	-0.012 (0.014)	-0.003 (0.023)	-0.018 (0.017)	-0.011 (0.024)	-0.021 (0.023)
Observations	4625	1581	3044	1879	2084
R-squared	0.60	0.62	0.60	0.65	0.56

Note: The table reports the estimated spillover effects on total factor productivity using the specification in equation (8) in the paper. Bureaucratic pressure is measured as the share of management's time spent on dealing with officials. Robust clustered standard errors in parentheses; \* significant at 10%; \*\* significant at 5%; \*\*\* significant at 1%

**Table 7. Effect of Hold-Up in Trade on the strength of spillovers and total factor productivity.**

	(1) ALL	(2) LARGE	(3) SMALL	(4) MNFG	(5) SERV
Δ Backward	0.139*** (0.045)	0.222*** (0.070)	0.053 (0.061)	0.131** (0.063)	0.264 (0.168)
Δ Forward	0.041 (0.058)	0.056 (0.089)	0.078 (0.078)	0.048 (0.082)	0.203 (0.181)
Δ Horizontal	0.012 (0.022)	0.049 (0.033)	-0.015 (0.031)	-0.024 (0.038)	0.116 (0.085)
Δ Backward * Δ (Wait-time)	-0.039 (0.068)	0.012 (0.100)	-0.097 (0.098)	-0.215* (0.117)	0.479** (0.199)
Δ Forward * Δ (Wait-time)	0.030 (0.047)	0.024 (0.065)	0.040 (0.068)	0.032 (0.089)	-0.288** (0.144)
Δ Horizontal * Δ (Wait-time)	0.001 (0.024)	-0.033 (0.031)	0.024 (0.037)	-0.006 (0.034)	-0.003 (0.094)
Δ Wait-time)	-0.012* (0.006)	-0.007 (0.010)	-0.013 (0.009)	-0.005 (0.010)	0.005 (0.014)
Δ Share Exports	0.235*** (0.029)	0.233*** (0.043)	0.232*** (0.041)	0.224*** (0.037)	0.271*** (0.051)
Δ HHI	-0.007 (0.020)	0.033 (0.032)	-0.033 (0.026)	-0.015 (0.027)	-0.080 (0.049)
Observations	3130	1130	2000	1750	988
R-squared	0.64	0.67	0.62	0.65	0.61

Note: The table reports the estimated spillover effects on total factor productivity using the specification in equation (8) in the paper. Wait time is the number of days waiting at customs to get imports in or exports out. Robust clustered standard errors in parentheses; \* significant at 10%; \*\* significant at 5%; \*\*\* significant at 1%

**Table 8. Distance from the frontier and the effect of foreign presence on the total factor productivity**

	(1)	(2)	(3)	(4)	(5)
	ALL	LARGE	SMALL	MNFG	SERV
$\Delta$ Backward	-0.028 (0.124)	0.152 (0.171)	-0.025 (0.184)	0.133 (0.151)	-0.045 (0.271)
$\Delta$ Forward	0.093 (0.096)	0.164 (0.124)	-0.172 (0.146)	0.015 (0.134)	0.083 (0.197)
$\Delta$ Horizontal	0.068 (0.044)	0.055 (0.056)	0.046 (0.067)	0.059 (0.066)	0.227** (0.095)
$\Delta$ Backward * $\ln(1+Dist)$	0.039 (0.045)	-0.013 (0.061)	0.034 (0.066)	-0.050 (0.057)	0.036 (0.091)
$\Delta$ Forward * $\ln(1+Dist)$	-0.006 (0.033)	-0.022 (0.044)	0.080 (0.050)	0.058 (0.054)	-0.002 (0.066)
$\Delta$ Horizontal * $\ln(1+Dist)$	-0.025 (0.018)	-0.006 (0.024)	-0.023 (0.026)	-0.035 (0.027)	-0.070** (0.034)
$\ln(1+Dist)$	-0.006 (0.004)	-0.003 (0.007)	-0.003 (0.006)	-0.010 (0.007)	-0.017** (0.008)
$\Delta$ Share Exports	0.227*** (0.028)	0.249*** (0.043)	0.200*** (0.037)	0.210*** (0.038)	0.265*** (0.049)
$\Delta$ HHI	-0.015 (0.015)	-0.007 (0.025)	-0.022 (0.018)	-0.004 (0.024)	-0.032 (0.025)
Observations	4516	1529	2987	1846	2024
R-squared	0.61	0.63	0.60	0.64	0.57

Note: The table reports the estimated spillover effects on total factor productivity using the specification in equation (9) in the paper. Distance is measured according to the Mahalanobis metric using all foreign firms. See text for further details on the construction of this metric. Robust clustered standard errors in parentheses; \* significant at 10%; \*\* significant at 5%; \*\*\* significant at 1%

**Table 9: Effect of the Education on the strength of spillovers and total factor productivity**

	(1)	(2)	(3)	(4)	(5)
	ALL	LARGE	SMALL	MNFG	SERV
$\Delta$ Backward	0.093* (0.049)	0.088 (0.091)	0.031 (0.073)	0.031 (0.073)	0.095 (0.082)
$\Delta$ Forward	0.075* (0.040)	0.112* (0.060)	0.205*** (0.068)	0.205*** (0.068)	0.079 (0.066)
$\Delta$ Horizontal	0.010 (0.020)	-0.012 (0.030)	-0.025 (0.030)	-0.025 (0.030)	0.070 (0.044)
$\Delta$ Backward * Edu	-0.167 (0.133)	0.065 (0.262)	-0.142 (0.199)	-0.142 (0.199)	-0.237 (0.193)
$\Delta$ Forward * Edu	0.068 (0.110)	-0.058 (0.178)	-0.216 (0.205)	-0.216 (0.205)	0.109 (0.153)
$\Delta$ Horizontal * Edu	-0.001 (0.049)	0.218** (0.096)	0.048 (0.080)	0.048 (0.080)	-0.045 (0.077)
Edu	0.030*** (0.012)	0.010 (0.024)	0.032* (0.019)	0.032* (0.019)	0.038** (0.016)
$\Delta$ Share Exports	0.236*** (0.027)	0.261*** (0.041)	0.225*** (0.037)	0.225*** (0.037)	0.268*** (0.045)
$\Delta$ HHI	-0.015 (0.014)	-0.007 (0.024)	0.002 (0.023)	0.002 (0.023)	-0.032 (0.023)
Observations	4582	1553	3029	1864	2061
R-squared	0.60	0.63	0.60	0.64	0.57

Note: The table reports the estimated spillover effects on total factor productivity using the specification in equation (8) in the paper. Edu is the share of worker with higher education (university education). Robust clustered standard errors in parentheses; \* significant at 10%; \*\* significant at 5%; \*\*\* significant at 1%

## **APPENDIX TABLES**

**Table A1: Number of interviews and quotas achieved in BEEPS III (2005)**

Country	No. of interviews		City/Town			Sector		Main activity		Size of enterprise			Foreign owned	Export
	Target	Completed	Large	Medium	Small	Private	State	Industry	Services	Small	Medium	Large		
Albania	200	204	38.7%	40.2%	21.1%	91.2%	8.8%	49.5%	50.5%	74.0%	18.6%	7.4%	10.8%	20.1%
Armenia	200	201	51.2%	26.4%	22.4%	90.0%	10.0%	46.8%	53.2%	75.1%	13.9%	10.9%	11.4%	12.9%
Azerbaijan	200	200	64.5%	21.5%	14.0%	90.0%	10.0%	48.5%	51.5%	74.0%	18.0%	8.0%	11.0%	11.5%
Belarus	300	325	32.0%	52.0%	16.0%	88.6%	11.4%	42.2%	57.8%	71.4%	17.8%	10.8%	10.2%	16.3%
Bosnia	200	200	34.5%	49.0%	16.5%	90.0%	10.0%	45.5%	54.5%	61.0%	29.0%	10.0%	12.0%	18.0%
Bulgaria	300	300	23.7%	39.0%	37.3%	90.0%	10.0%	28.3%	71.7%	74.0%	16.0%	10.0%	10.3%	15.0%
Croatia	200	236	29.7%	31.8%	38.6%	89.0%	11.0%	44.9%	55.1%	64.8%	21.2%	14.0%	8.9%	19.1%
Czech Republic	300	343	21.9%	31.2%	46.9%	91.3%	8.7%	38.5%	61.5%	76.1%	16.0%	7.9%	9.0%	14.6%
Estonia	200	219	51.6%	21.0%	27.4%	90.9%	9.1%	32.4%	67.6%	74.4%	16.0%	9.6%	15.1%	14.2%
FR Yugoslavia	300	300	45.0%	35.3%	19.7%	86.3%	13.7%	37.3%	62.7%	65.7%	20.7%	13.7%	11.0%	16.3%
FYROM	200	200	60.5%	23.0%	16.5%	91.5%	8.5%	36.0%	64.0%	73.5%	16.5%	10.0%	10.5%	17.0%
Georgia	200	200	50.5%	32.5%	17.0%	88.0%	12.0%	30.0%	70.0%	74.5%	17.5%	8.0%	13.0%	13.5%
Hungary	300	312	34.6%	43.6%	21.8%	94.2%	5.8%	35.3%	64.7%	74.0%	16.3%	9.6%	13.8%	17.0%
Kazakhstan	300	300	40.3%	45.7%	14.0%	90.3%	9.7%	43.7%	56.3%	73.3%	16.0%	10.7%	11.0%	5.0%
Kyrgyzstan	200	202	32.3%	39.6%	28.2%	89.1%	10.9%	43.6%	56.4%	63.4%	26.2%	10.4%	14.4%	13.4%
Latvia	200	205	55.6%	10.7%	33.7%	88.8%	11.2%	22.9%	77.1%	74.1%	15.6%	10.2%	9.8%	12.2%
Lithuania	200	205	30.7%	37.6%	31.7%	87.8%	12.2%	36.1%	63.9%	68.3%	22.0%	9.8%	10.7%	19.0%
Moldova	200	200	44.0%	25.0%	31.0%	90.5%	9.5%	31.5%	68.5%	69.0%	21.5%	9.5%	10.5%	12.5%
Poland	550	580	14.1%	62.2%	23.6%	89.3%	10.7%	37.9%	62.1%	68.4%	21.9%	9.7%	9.5%	15.3%
Romania	300	315	19.0%	49.2%	31.7%	88.9%	11.1%	41.3%	58.7%	62.5%	27.0%	10.5%	11.7%	11.7%
Russia	550	599	56.9%	28.0%	15.0%	90.0%	10.0%	40.9%	59.1%	66.3%	21.9%	11.9%	10.0%	9.7%
Slovak Republic	200	220	41.4%	40.9%	17.7%	89.1%	10.9%	26.8%	73.2%	67.7%	22.3%	10.0%	11.8%	17.7%
Slovenia	200	223	21.1%	22.0%	57.0%	89.2%	10.8%	39.0%	61.0%	70.9%	16.6%	12.6%	7.6%	29.6%
Tajikistan	200	200	37.0%	41.0%	22.0%	90.5%	9.5%	44.0%	56.0%	61.5%	28.5%	10.0%	10.0%	12.5%
Turkey	550	559	54.4%	27.0%	18.6%	90.2%	9.8%	36.5%	63.5%	71.6%	18.8%	9.7%	9.8%	15.7%
Ukraine	550	594	36.5%	47.5%	16.0%	90.2%	9.8%	42.8%	57.2%	70.9%	19.0%	10.1%	10.9%	10.1%
Uzbekistan	300	300	29.0%	39.3%	31.7%	89.7%	10.3%	37.7%	62.3%	73.0%	17.0%	10.0%	11.0%	9.7%

**Total**                      **7600**                      **7942**

Source: Table 3 of Synovate (2005)

**Table A2: Sources and Years of Input-Output Tables**

Year	Country	Source
2000	Albania	Horrige, Mark (1)
2000	Bulgaria	National statistical office
1999	Croatia	National statistical office
1999	Czech Republic	Czech Republic National Statistical Yearbook
1997	Estonia	Eurostat
1998	Hungary	Eurostat
2002	Kazakhstan	Hare, Paul and Naumov, Alexander (2005, p 28).
1998	Latvia	National statistical office
2001	Lithuania	National statistical office
2000	Poland	Eurostat
2002	Romania	National statistical office
		National accounts of Russia, Eastview database, www.eastview.com.
2003	Russia	
2000	Slovakia	National statistical office
2001	Slovenia	Eurostat
2003	Ukraine	National statistical office

Note: All input-output tables were at the NACE 2-digit level, except for those for Kazakhstan and Russia, which were at the 1-digit level and were converted to two-digits using weights constructed from data on output by industries.

(1) Horrige, Mark. "Albania Input-Output Table." GTAP/USAID. Table downloaded from <http://www.monash.edu.au/policy/archivep.htm>.

**Table A3a. Descriptive Statistics on Inputs by country**

country	N	lnY		lnKU		lnL		lnM	
		mean	sd	mean	sd	mean	sd	mean	sd
Albania	201	0.058	0.274	0.118	0.265	0.193	0.445	0.063	0.223
Croatia	228	0.041	0.250	0.090	0.250	0.031	0.423	0.054	0.194
Slovenia	221	0.112	0.247	0.131	0.254	0.102	0.415	0.104	0.207
Poland	960	-0.011	0.265	0.055	0.185	-0.008	0.445	0.026	0.192
Ukraine	560	0.172	0.353	0.161	0.320	0.151	0.546	0.132	0.277
Hungary	594	0.010	0.276	0.088	0.253	0.028	0.446	0.030	0.243
Czech_Rep	338	0.025	0.176	0.067	0.169	0.118	0.444	0.047	0.119
Slovakia	209	0.054	0.260	0.077	0.246	0.057	0.506	0.088	0.186
Romania	575	0.128	0.298	0.161	0.297	0.120	0.541	0.126	0.239
Bulgaria	288	0.054	0.270	0.112	0.268	0.087	0.477	0.036	0.215
Latvia	194	0.076	0.309	0.119	0.294	0.125	0.478	0.116	0.225
Lithuania	199	0.119	0.261	0.182	0.295	0.143	0.495	0.150	0.200
Estonia	209	0.121	0.288	0.123	0.258	0.075	0.505	0.092	0.225
Kazakhstan	572	0.153	0.281	0.102	0.224	0.137	0.493	0.136	0.230
Russia	567	0.156	0.296	0.113	0.254	0.168	0.468	0.166	0.251
Total	5915	0.082	0.288	0.108	0.255	0.092	0.482	0.089	0.228

**Table A3b. Descriptive Statistics on Inputs by Industry**

industry	N	lnY		lnKU		lnL		lnM	
		mean	sd	mean	sd	mean	sd	mean	sd
Extraction	56	0.165	0.283	0.212	0.340	0.134	0.460	0.136	0.250
Food and tobacco	548	0.075	0.290	0.122	0.287	0.147	0.469	0.084	0.255
Textiles and app	494	0.020	0.293	0.073	0.251	0.002	0.509	0.052	0.243
Wood, paper prod	169	0.106	0.251	0.173	0.272	0.100	0.468	0.114	0.192
Chemicals	168	0.120	0.233	0.130	0.294	0.047	0.516	0.132	0.206
Basic metals	482	0.076	0.294	0.111	0.250	0.053	0.469	0.096	0.240
Manufacturing	502	0.118	0.279	0.126	0.255	0.113	0.436	0.115	0.234
Construction	588	0.114	0.301	0.111	0.243	0.129	0.563	0.121	0.240
Sale, maintenanc	157	0.087	0.273	0.157	0.271	0.066	0.419	0.102	0.227
wholesale trade	459	0.103	0.312	0.122	0.257	0.114	0.513	0.098	0.258
retail trade	716	0.032	0.297	0.082	0.230	0.088	0.439	0.061	0.231
Hotels&restauran	303	0.034	0.265	0.081	0.235	0.031	0.398	0.067	0.190
Land Transport	228	0.096	0.294	0.088	0.274	0.132	0.510	0.094	0.213
Other transport	166	0.112	0.279	0.093	0.254	0.096	0.511	0.091	0.215
Financial	201	0.106	0.297	0.088	0.251	0.095	0.543	0.069	0.180
Renting	118	0.108	0.261	0.107	0.264	0.093	0.470	0.069	0.196
Health, educatio	262	0.115	0.305	0.127	0.256	0.141	0.546	0.082	0.187
Recreational	117	0.113	0.222	0.096	0.234	0.099	0.369	0.078	0.183
Other services	181	0.072	0.231	0.076	0.175	0.077	0.350	0.087	0.182
Total	5915	0.082	0.288	0.108	0.255	0.092	0.482	0.089	0.228

**Table A4a. Descriptive Statistics on Linkages by Country**

country	N	$\Delta$ backward		$\Delta$ forward		$\Delta$ horizontal	
		mean	sd	mean	sd	mean	sd
Albania	196	-0.062	0.047	-0.079	0.132	-0.041	0.168
Croatia	236	-0.047	0.092	-0.068	0.069	-0.084	0.242
Slovenia	223	-0.084	0.020	-0.096	0.033	-0.062	0.075
Poland	975	-0.022	0.016	-0.016	0.034	-0.063	0.158
Ukraine	594	0.118	0.095	0.167	0.154	0.053	0.155
Hungary	610	-0.192	0.078	-0.156	0.054	-0.207	0.224
Czech_Rep	343	-0.042	0.110	-0.027	0.111	-0.083	0.236
Slovakia	219	-0.047	0.051	0.014	0.128	-0.008	0.231
Romania	600	0.002	0.027	0.072	0.032	0.011	0.127
Bulgaria	300	0.056	0.109	0.021	0.105	-0.008	0.194
Latvia	205	-0.075	0.070	-0.120	0.045	0.054	0.305
Lithuania	205	-0.038	0.177	-0.197	0.141	-0.037	0.346
Estonia	219	0.013	0.071	0.042	0.056	0.020	0.180
Kazakhstan	585	0.011	0.062	-0.009	0.041	0.023	0.147
Russia	599	-0.089	0.024	-0.095	0.023	-0.060	0.105
Total	6109	-0.030	0.106	-0.023	0.123	-0.039	0.199

**Table A4b. Descriptive Statistics on Linkages by Industry**

industry	N	$\Delta$ backward		$\Delta$ forward		$\Delta$ horizontal	
		mean	sd	mean	sd	mean	sd
Extraction	57	-0.014	0.102	-0.056	0.132	-0.073	0.470
Food and tobacco	572	-0.029	0.068	-0.011	0.092	-0.107	0.187
Textiles and app	507	-0.035	0.106	-0.004	0.107	-0.054	0.195
Wood, paper prod	179	-0.004	0.107	-0.014	0.115	0.062	0.355
Chemicals	171	-0.037	0.120	-0.009	0.279	0.021	0.317
Basic metals	496	-0.090	0.149	0.001	0.157	-0.037	0.152
Manufacturing	523	0.006	0.119	-0.025	0.148	-0.036	0.244
Construction	609	-0.035	0.068	-0.020	0.108	-0.001	0.158
Sale, maintenanc	163	-0.045	0.068	-0.039	0.104	0.083	0.239
wholesale trade	474	-0.046	0.098	-0.058	0.095	-0.077	0.167
retail trade	741	-0.011	0.100	-0.035	0.097	-0.073	0.099
Hotels&restauran	310	-0.040	0.131	-0.060	0.093	-0.009	0.115
Land Transport	235	-0.016	0.117	-0.050	0.136	-0.004	0.149
Other transport	168	0.000	0.102	0.000	0.125	-0.024	0.152
Financial	203	-0.027	0.081	-0.030	0.093	-0.054	0.131
Renting	123	-0.009	0.095	0.027	0.110	-0.097	0.240
Health, educatio	278	-0.021	0.097	-0.005	0.122	0.005	0.238
Recreational	118	-0.061	0.110	-0.009	0.077	0.041	0.096
Other services	182	-0.033	0.067	-0.016	0.111	-0.116	0.229
Total	6109	-0.030	0.106	-0.023	0.123	-0.039	0.199

**Table A5a. Descriptive Statistics on Quality of FDI by Country**

country	N	total		OECD		non-OECD		Wholly owned		Partially owned	
		mean	sd	mean	sd	mean	sd	mean	sd	mean	sd
Albania	203	0.128	0.220	0.085	0.138	0.043	0.144	0.082	0.198	0.046	0.091
Croatia	236	0.126	0.179	0.071	0.124	0.054	0.152	0.092	0.159	0.034	0.054
Slovenia	223	0.114	0.170	0.103	0.155	0.011	0.026	0.109	0.165	0.004	0.010
Poland	975	0.093	0.098	0.070	0.092	0.023	0.032	0.053	0.093	0.040	0.041
Ukraine	594	0.186	0.147	0.124	0.087	0.063	0.102	0.101	0.148	0.085	0.098
Hungary	610	0.238	0.146	0.186	0.121	0.052	0.068	0.167	0.123	0.070	0.062
Czech_Rep	343	0.128	0.110	0.108	0.110	0.020	0.051	0.099	0.107	0.029	0.035
Slovakia	219	0.157	0.175	0.119	0.123	0.038	0.119	0.076	0.102	0.081	0.149
Romania	600	0.132	0.104	0.105	0.100	0.027	0.028	0.066	0.084	0.066	0.051
Bulgaria	300	0.146	0.214	0.064	0.120	0.082	0.172	0.091	0.148	0.055	0.154
Latvia	205	0.221	0.332	0.139	0.255	0.082	0.165	0.122	0.272	0.100	0.148
Lithuania	205	0.147	0.216	0.106	0.205	0.041	0.083	0.123	0.179	0.025	0.066
Estonia	219	0.248	0.268	0.176	0.219	0.072	0.109	0.195	0.238	0.053	0.082
Kazakhstan	585	0.095	0.116	0.014	0.027	0.081	0.117	0.063	0.099	0.033	0.038
Russia	599	0.059	0.058	0.033	0.044	0.026	0.033	0.032	0.052	0.027	0.040
Total	6116	0.139	0.165	0.094	0.128	0.045	0.094	0.089	0.140	0.050	0.079

**Table A5b. Descriptive Statistics on Quality of FDI by Industry**

industry	N	total		OECD		non-OECD		Wholly owned		Partially owned	
		mean	sd	mean	sd	mean	sd	mean	sd	mean	sd
Extraction	57	0.191	0.227	0.115	0.117	0.076	0.236	0.089	0.231	0.101	0.107
Food and tobacco	572	0.119	0.146	0.061	0.086	0.058	0.084	0.061	0.126	0.059	0.061
Textiles and app	507	0.190	0.195	0.155	0.197	0.035	0.026	0.116	0.149	0.074	0.067
Wood, paper prod	179	0.275	0.232	0.190	0.213	0.085	0.099	0.131	0.196	0.144	0.143
Chemicals	171	0.330	0.280	0.163	0.199	0.167	0.254	0.180	0.218	0.150	0.226
Basic metals	496	0.159	0.153	0.109	0.124	0.050	0.100	0.106	0.156	0.053	0.064
Manufacturing	523	0.191	0.137	0.137	0.118	0.054	0.057	0.123	0.120	0.068	0.066
Construction	609	0.082	0.119	0.031	0.046	0.050	0.120	0.056	0.101	0.026	0.032
Sale, maintenanc	163	0.181	0.223	0.104	0.136	0.077	0.131	0.127	0.221	0.054	0.109
wholesale trade	474	0.148	0.101	0.115	0.085	0.033	0.050	0.107	0.088	0.041	0.040
retail trade	741	0.061	0.049	0.039	0.034	0.022	0.028	0.029	0.044	0.032	0.028
Hotels&restauran	310	0.207	0.180	0.127	0.132	0.080	0.086	0.149	0.142	0.059	0.078
Land Transport	235	0.048	0.087	0.046	0.086	0.002	0.008	0.034	0.084	0.014	0.034
Other transport	168	0.090	0.107	0.080	0.105	0.010	0.028	0.033	0.067	0.057	0.096
Financial	203	0.023	0.044	0.005	0.013	0.018	0.037	0.010	0.027	0.013	0.033
Renting	123	0.123	0.174	0.086	0.132	0.037	0.136	0.069	0.144	0.054	0.119
Health, educatio	278	0.252	0.191	0.224	0.146	0.029	0.103	0.238	0.197	0.014	0.024
Recreational	125	0.085	0.161	0.048	0.096	0.037	0.094	0.055	0.119	0.030	0.066
Other services	182	0.023	0.060	0.023	0.060	0.000	0.000	0.017	0.061	0.006	0.010
Total	6116	0.139	0.165	0.094	0.128	0.045	0.094	0.089	0.140	0.050	0.079

**Table 6a. Descriptive Statistics on Firm-level Linkage Variables by Country**

country	N	Share of sales to MNES		Export		Import		export growth rate		Δ HHI	
		mean	sd	mean	sd	mean	sd	mean	sd	mean	sd
Albania	184	0.057	0.152	0.302	0.460	0.732	0.444	0.035	0.151	0.028	0.252
Croatia	217	0.053	0.147	0.353	0.479	0.686	0.465	0.021	0.115	-0.163	0.290
Slovenia	214	0.111	0.277	0.447	0.498	0.538	0.500	0.039	0.139	0.039	0.144
Poland	964	0.071	0.185	0.226	0.419	0.426	0.495	0.020	0.115	-0.146	0.123
Ukraine	584	0.041	0.150	0.153	0.360	0.574	0.495	0.024	0.114	-0.020	0.279
Hungary	591	0.122	0.250	0.315	0.465	0.554	0.497	0.023	0.144	-0.198	0.244
Czech_Rep	317	0.094	0.230	0.231	0.422	0.539	0.499	0.029	0.108	-0.047	0.326
Slovakia	204	0.086	0.209	0.354	0.479	0.751	0.433	0.031	0.120	0.039	0.284
Romania	569	0.051	0.164	0.208	0.406	0.496	0.500	0.019	0.116	-0.242	0.209
Bulgaria	288	0.037	0.147	0.227	0.420	0.533	0.500	0.024	0.139	0.037	0.223
Latvia	192	0.060	0.177	0.205	0.405	0.623	0.486	0.016	0.086	0.002	0.311
Lithuania	196	0.054	0.194	0.273	0.447	0.493	0.501	0.012	0.109	0.050	0.122
Estonia	209	0.084	0.200	0.274	0.447	0.525	0.501	0.029	0.152	-0.081	0.236
Kazakhstan	583	0.051	0.170	0.106	0.308	0.359	0.480	0.012	0.085	-0.121	0.161
Russia	590	0.048	0.176	0.119	0.324	0.392	0.489	0.018	0.107	-0.074	0.210
Total	5902	0.067	0.191	0.227	0.419	0.510	0.500	0.022	0.119	-0.092	0.241

**Table 6b. Descriptive Statistics on Firm-level Linkage Variables by Industry**

industry	N	Share of sales to MNES		Export		Import		export growth rate		Δ HHI	
		mean	sd	mean	sd	mean	sd	mean	sd	mean	sd
Extraction	55	0.156	0.282	0.475	0.504	0.541	0.502	0.055	0.174	-0.106	0.205
Food and tobacco	565	0.070	0.203	0.177	0.382	0.327	0.469	0.024	0.125	-0.096	0.131
Textiles and app	449	0.053	0.175	0.387	0.487	0.649	0.478	0.031	0.155	-0.166	0.191
Wood, paper prod	175	0.063	0.174	0.356	0.480	0.567	0.497	0.040	0.117	-0.010	0.174
Chemicals	168	0.108	0.244	0.535	0.500	0.721	0.450	0.046	0.164	0.049	0.235
Basic metals	485	0.103	0.236	0.403	0.491	0.556	0.497	0.044	0.165	-0.288	0.379
Manufacturing	505	0.106	0.234	0.478	0.500	0.694	0.461	0.070	0.189	-0.132	0.192
Construction	592	0.057	0.173	0.097	0.296	0.427	0.495	0.007	0.078	-0.008	0.214
Sale, maintenanc	159	0.041	0.137	0.104	0.307	0.681	0.468	0.008	0.080	-0.009	0.236
wholesale trade	463	0.070	0.190	0.308	0.462	0.684	0.466	0.039	0.158	0.069	0.178
retail trade	735	0.027	0.126	0.099	0.298	0.501	0.500	0.002	0.070	-0.094	0.187
Hotels&restauran	302	0.039	0.131	0.161	0.368	0.248	0.433	0.013	0.082	-0.158	0.253
Land Transport	224	0.087	0.212	0.370	0.484	0.404	0.492	0.030	0.161	-0.183	0.229
Other transport	151	0.092	0.199	0.435	0.497	0.565	0.497	0.052	0.160	-0.068	0.317
Financial	200	0.034	0.151	0.020	0.139	0.255	0.437	0.003	0.031	-0.178	0.228
Renting	117	0.093	0.200	0.363	0.483	0.565	0.498	0.050	0.168	-0.076	0.186
Health, educatio	259	0.085	0.221	0.194	0.396	0.421	0.495	0.012	0.100	-0.116	0.217
Recreational	120	0.053	0.185	0.288	0.455	0.456	0.500	0.032	0.154	0.107	0.192
Other services	178	0.035	0.162	0.049	0.217	0.456	0.499	0.000	0.031	-0.002	0.169
Total	5902	0.067	0.191	0.259	0.438	0.510	0.500	0.027	0.132	-0.092	0.241

**Table7a. Descriptive Statistics on Institutional Variables by Country**

country	N	$\Delta$ bureaucratic pressure		$\Delta$ waiting time		$\Delta$ corruption		education		distance	
		mean	sd	mean	sd	mean	sd	mean	sd	mean	sd
Albania	204	-0.013	0.048	-0.220	0.474	-0.012	0.036	0.263	0.228	2.916	0.806
Croatia	236	-0.022	0.041	0.209	0.601	-0.003	0.019	0.260	0.274	2.999	0.880
Slovenia	223	-0.050	0.039	0.470	0.809	-0.013	0.016	0.206	0.262	2.988	0.793
Poland	975	-0.055	0.032	0.131	0.660	-0.012	0.015	0.201	0.263	2.388	0.748
Ukraine	594	-0.021	0.051	-0.244	0.636	-0.009	0.015	0.427	0.334	2.512	0.653
Hungary	610	-0.013	0.032	0.468	0.634	-0.005	0.025	0.165	0.233	2.404	0.831
Czech_Rep	343	0.003	0.040	0.116	1.038	0.002	0.016	0.138	0.231	2.895	0.660
Slovakia	219	-0.030	0.043	0.340	0.783	-0.018	0.024	0.263	0.281	2.894	0.711
Romania	600	-0.078	0.043	-0.172	0.659	-0.031	0.018	0.176	0.202	2.040	0.797
Bulgaria	300	-0.003	0.027	-0.615	0.746	0.001	0.027	0.284	0.316	2.761	0.734
Latvia	205	-0.043	0.058	-0.027	1.616	0.000	0.017	0.292	0.300	3.330	0.658
Lithuania	205	-0.019	0.040	-0.272	0.635	0.009	0.013	0.313	0.301	3.402	0.676
Estonia	219	-0.013	0.040	-0.156	0.276	-0.004	0.010	0.309	0.313	3.034	0.679
Kazakhstan	585	-0.061	0.046	0.604	0.535	-0.032	0.016	0.272	0.255	2.161	0.905
Russia	599	-0.020	0.043	0.155	0.886	-0.001	0.013	0.381	0.322	2.370	0.824
Total	6117	-0.034	0.048	0.117	0.776	-0.011	0.022	0.259	0.287	2.546	0.857

**Table7b. Descriptive Statistics on Institutional Variables by Industry**

industry	N	Δ bureaucratic pressure		Δ waiting time		Δ corruption		education		distance	
		mean	sd	mean	sd	mean	sd	mean	sd	mean	sd
Extraction	57	-0.063	0.151	-0.412	1.193	0.014	0.045	0.211	0.232	3.203	0.798
Food and tobacco	572	-0.030	0.020	-0.264	0.702	-0.015	0.018	0.151	0.169	2.140	0.875
Textiles and app	507	-0.045	0.051	0.401	0.646	-0.009	0.024	0.145	0.202	2.246	0.726
Wood, paper prod	179	-0.052	0.054	0.015	0.740	-0.008	0.027	0.364	0.328	2.723	0.802
Chemicals	171	-0.017	0.025	0.073	0.698	-0.006	0.024	0.209	0.206	2.576	0.656
Basic metals	496	-0.048	0.035	0.254	0.376	-0.021	0.018	0.160	0.184	2.128	0.761
Manufacturing	523	-0.038	0.037	0.479	0.575	-0.014	0.011	0.246	0.241	2.213	0.820
Construction	609	-0.028	0.044	-0.068	0.852	-0.012	0.017	0.217	0.253	2.601	0.924
Sale, maintenanc	163	-0.053	0.053	0.603	1.402	-0.010	0.011	0.270	0.270	2.793	0.776
wholesale trade	474	-0.023	0.039	0.177	0.486	-0.011	0.020	0.400	0.335	2.249	0.742
retail trade	741	-0.031	0.032	-0.049	0.680	-0.011	0.014	0.251	0.286	2.491	0.643
Hotels&restauran	310	-0.033	0.051	.	.	-0.003	0.015	0.170	0.199	2.662	0.734
Land Transport	235	-0.029	0.079	-0.503	1.269	-0.011	0.040	0.166	0.215	3.021	0.783
Other transport	168	-0.036	0.028	-0.500	0.716	-0.003	0.025	0.421	0.356	3.148	0.506
Financial	204	-0.054	0.052	.	.	-0.016	0.035	0.450	0.349	3.330	0.800
Renting	123	-0.016	0.046	0.514	1.213	-0.002	0.019	0.488	0.356	3.136	0.594
Health, educatio	278	-0.025	0.047	0.695	1.097	-0.002	0.021	0.524	0.368	2.782	0.597
Recreational	125	-0.021	0.079	1.407	0.000	-0.019	0.040	0.446	0.299	3.462	0.600
Other services	182	-0.030	0.063	1.897	0.000	-0.001	0.015	0.195	0.278	3.393	0.841
Total	6117	-0.034	0.048	0.117	0.776	-0.011	0.022	0.259	0.287	2.546	0.857