

# To Share or Not To Share: Does Local Participation Matter for Spillovers from Foreign Direct Investment?

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**Abstract:** This study hypothesizes that the ownership structure in foreign investment projects affects the extent of vertical and horizontal spillovers from foreign direct investment (FDI) for two reasons. First, affiliates with joint domestic and foreign ownership may face lower costs of finding local suppliers of intermediates and thus may be more likely to engage in local sourcing than wholly owned foreign subsidiaries. This in turn may lead to higher productivity spillovers to local producers in the supplying sectors (vertical spillovers). Second, the fact that multinationals tend to transfer less sophisticated technologies to their partially owned affiliates than to wholly owned subsidiaries, combined with the better access to knowledge through the participation of the local shareholder in partially owned projects, may facilitate more knowledge absorption by local firms in the same sector (horizontal spillovers). The analysis based on a Romanian firm-level data set produces evidence consistent with these hypotheses. The results suggest that vertical spillovers are associated with projects with shared domestic and foreign ownership but not with fully owned foreign subsidiaries. They also indicate that the negative competition effect of FDI inflows is lower in the case of partially owned foreign investments as it is mitigated by larger knowledge dissipation within the sector.

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# 1. Introduction

Although domestic equity ownership requirements used to be extensively utilized by governments in developing countries,<sup>1</sup> their incidence has sharply declined in recent years (UNCTAD, 2003). Increasingly competitive environment for foreign direct investment (FDI) and the need to comply with international commitments have put pressure on governments to relax restrictions on foreign entrants.

One of the original motivations for the existence of ownership sharing conditions was the belief that local participation in foreign investment projects reveals their proprietary technology and thus benefits domestic firms by facilitating technology diffusion (see Beamish, 1988; Blomström and Sjöholm, 1999). As writing a contract specifying all aspects of the rights to use intangible assets is difficult, if not impossible, joint domestic and foreign ownership of an investment project is more likely to lead to knowledge dissipation. A local partner may use the knowledge acquired from the foreign investor in its other operations not involving the foreign shareholders or being in charge of hiring policies, as is often the case, the local partner may have less incentive to limit employee turnover.<sup>2</sup> This problem is reduced when the multinational is the sole owner of its affiliate.<sup>3</sup> As a consequence, multinationals may be more likely to transfer sophisticated technologies and management techniques to their wholly owned subsidiaries than to partially owned affiliates.<sup>4</sup>

This in turn has implications for knowledge spillovers to local producers in a host country. Less sophisticated technologies being transferred to jointly owned FDI projects may be easier to absorb by local competitors, which combined with a better access to knowledge through the actions of the local shareholder may lead to greater intra-industry (or horizontal) knowledge spillovers being associated with the shared ownership structure than with wholly owned foreign affiliates. Moreover, lower sophistication of inputs needed by jointly owned FDI projects and the familiarity of the local partner with local suppliers of intermediates may result in greater reliance on locally produced inputs and thus greater vertical spillovers accruing to local producers in upstream sectors. While a lot of

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<sup>1</sup> In the 1980s restrictions on foreign ownership were present in China, India, Indonesia, Malaysia, Mexico, Nigeria, Pakistan, the Republic of Korea, Sri Lanka and others (UNCTC, 1987).

<sup>2</sup> Both channels of knowledge dissipation find confirmation in anecdotal evidence. For instance, Unilever's joint venture partner in China began to manufacture a washing detergent that had a similar formula and was packaged in a strikingly similar box as the Omo brand produced by the joint venture (*The Economist*, April 19, 1997). As for knowledge dissipation through movement of labor, the Bulgarian Commission for the Protection of Competition investigated multiple cases of violation of business secrets by former employees. Some of these cases were brought by foreign companies operating in the country (Djankov and Hoekman, 1997).

<sup>3</sup> This argument is in line with the property rights approach developed by Grossman and Hart (1986) and Hart and Moore (1990).

<sup>4</sup> For empirical evidence see Mansfield and Romero (1980), Ramachandran (1993) and Javorcik and Saggi (2004).

research effort has been put into looking for the evidence of FDI spillovers (see the next section), little attention has been devoted to how the ownership structure affects this phenomenon.<sup>5</sup>

This paper is a step forward in understanding the implications of the ownership structure of FDI projects for the host country. Using firm-level panel data from Romania for the 1998-2003 period, we examine whether wholly owned foreign affiliates and investments with joint domestic and foreign ownership are associated with a different magnitude of spillovers within the industry of operation and to upstream sectors supplying intermediate inputs. The results suggest that the ownership structure in FDI projects does matter for productivity spillovers.

Consistent with our expectations, the analysis indicates that projects with joint domestic and foreign ownership are associated with positive productivity spillovers to upstream sectors but no such effect is detected for wholly owned foreign subsidiaries. The difference between the two coefficients is statistically significant. The magnitude of the former effect is economically meaningful. A one-standard-deviation increase in the presence of investment projects with shared domestic and foreign ownership is associated with a 4.4 percent increase in the total factor productivity of domestic firms in the supplying industries. This pattern can be found at the national as well as at the regional level. It holds for both best performers in each sector as well as for firm exhibiting lesser performance. The presence of joint ventures in downstream sectors benefits domestic firms but has no effect on foreign affiliates.

In contrast to the vertical effects, the presence of FDI appears to have a negative effect on the performance of local firms operating in the same sector. As argued by Aitken and Harrison (1999), this may be due to the fact that local producers lose part of their market share to foreign entrants and thus are forced to spread their fixed cost over a smaller volume of production. The empirical literature suggests that the negative competition effect outweighs the positive effect of knowledge spillovers in developing countries (Aitken and Harrison, 1999; Djankov and Hoekman, 2000; Konings, 2001). If greater knowledge dissipation tends to be associated with jointly owned FDI projects, we would expect that FDI with shared ownership has a less negative effect on local producers than do wholly owned foreign projects. Our findings are consistent with this expectation, as in all specifications we find the anticipated pattern. The difference between the magnitudes of the

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<sup>5</sup> Two studies compared horizontal spillovers from minority versus majority owned foreign affiliates and either found no statistically significant difference between the two (Blomström and Sjöholm, 1999) or concluded that the former were associated with greater externalities (Dimelis and Louri, 2001). As both analyses were based on cross-sectional data, they were unable to control for unobserved firm heterogeneity and thus their results should be treated with caution. Javorcik (2004a) compared the extent of vertical spillovers associated with partially and wholly owned foreign subsidiaries in Lithuania and found that only the former had a statistically significant effect. Her study, however, did not consider the implication for intra-industry effects nor did it examine the robustness of this finding.

two coefficients is statistically significant for sectors with domestic-market orientation, in the subsample of foreign firms and in the regressions focusing on regional spillovers.

While our findings are consistent with the existence of externalities associated with FDI, a word of caution is in order. We use the term "spillovers" very broadly as our methodology does not allow us to distinguish between pure knowledge externalities, the benefits of scale economies that may be enjoyed by suppliers to multinationals or the effects of increased competition resulting from foreign entry into the product market. More work is certainly needed to fully understand the effects of FDI inflows on host countries.

This paper is structured as follows. The next section reviews the existing literature. It is followed by a brief discussion of FDI inflows into Romania. Then we present the data, the estimation strategy and the empirical results. The last section concludes.

## 2. Related Literature

### *2.1 Spillover channels*

There exists a large literature searching for evidence of knowledge spillovers from FDI. Intra-industry (or horizontal) spillovers may take place when local firms learn about new technologies, marketing or management techniques by observing foreign affiliates operating in their industry or by hiring workers trained by foreign affiliates and in this way improve their performance. The early research on spillovers focuses exclusively on the horizontal effects. Studies based on industry-level data (see Blomström, 1989, for a review) find a positive correlation between foreign presence and the average value added per worker in the sector. In contrast, firm-level studies, including Haddad and Harrison (1993) on Morocco, Aitken and Harrison (1999) on Venezuela, Djankov and Hoekman (2000) on the Czech Republic, Konings (2001) on Bulgaria, Poland and Romania, and Javorcik (2004a) on Lithuania cast doubt on the existence of intra-industry spillovers from FDI in developing countries. They either fail to find a significant effect or produce evidence suggesting a negative impact of the multinational presence on domestic firms in the same sector. As Aitken and Harrison argue, entry of multinationals may lead to knowledge transfer within the sector but it may also result in local competitors losing their market shares and thus being driven up their average cost curve. If the latter effect dominates, FDI inflows may result in lower productivity of domestic firms operating in the same industry.<sup>6</sup>

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<sup>6</sup> Recent survey evidence is consistent with this interpretation. 48 percent of Czech firms interviewed in a World Bank survey believed that the presence of multinationals increased the level of competition in their sector. The same was true of two-fifth of Latvian enterprises interviewed by the World Bank. Almost 30 percent of firms in each country reported

While multinationals have an incentive to prevent knowledge dissipation that would benefit their local competitors, they may have an incentive to transfer knowledge to local firms in upstream sectors, as they may benefit from the improved performance of intermediate input suppliers. Thus contacts between multinational firms and their local suppliers are a likely channel for knowledge diffusion either through deliberate knowledge transfer by multinationals or by subjecting local suppliers to more stringent requirements for product quality and on-time delivery. And indeed the recent firm-level studies find evidence consistent with foreign presence in downstream sectors being associated with greater productivity in the supplying industries (Blalock and Gertler, 2004, in Indonesia; and Javorcik, 2004a, in Lithuania).

## *2.2 How Can the Ownership Structure Affect FDI Spillovers?*

The ownership structure of FDI projects is likely to have implications for both horizontal and vertical spillovers. It is generally believed by policy makers in developing countries that participation of a local shareholder in a foreign investment project reveals the multinational's proprietary technology and thus facilitates knowledge spillovers (UNCTAD, 2003; Blomström and Sjöholm, 1999). This may happen if the local partner applies the technology acquired through a joint venture to its own operations not involving the foreign shareholders or if the local partner is in charge of hiring policies and places local staff in key technical or managerial positions without taking actions to limit employee turnover.

The fear of technology leakage, especially in countries with limited rule of law, may induce multinationals with most sophisticated technologies to shy away from shared ownership and instead choose to invest only in wholly owned projects.<sup>7</sup> The empirical evidence corroborates this relationship. Ramachandran (1993) demonstrates that foreign investors tend to devote more resources to technology transfer to their wholly owned subsidiaries than to affiliates with joint domestic and foreign ownership. In the same manner, Mansfield and Romeo (1980) point out that the transfer of technology is more rapid within wholly owned networks of multinationals' subsidiaries than to joint ventures or licensees. Similarly, Desai, Foley and Hines (2004) find evidence that

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losing market share as a result of FDI inflows. At the same time, almost a quarter of respondents in the Czech Republic and 15 percent in Latvia reported learning from multinationals about new technologies. 12 and 9 percent, respectively, benefited from learning about new marketing techniques employed by multinationals (Javorcik and Spatareanu, 2005).

<sup>7</sup> This outcome may also stem from the tradeoff between using a joint venture to secure a better position in the product market and sharing profits with the local partner, as illustrated in the theoretical contribution by Javorcik and Saggi (2004) whose model predicts that the more technologically advanced foreign investor is less likely to choose a joint venture and prefers to enter directly.

majority and wholly owned subsidiaries receive more intangible property from their parents companies than do minority owned affiliates.

Greater technological sophistication of wholly owned foreign subsidiaries may in turn impede knowledge diffusion to local firms operating in the same sector, which may lack sufficient absorptive capacity.<sup>8</sup> In contrast, projects with joint domestic and foreign ownership may result in greater knowledge dissipation due to their lower technological sophistication and the involvement of the local partner. Thus, we would expect that greater knowledge diffusion associated with partially owned foreign affiliates would to a larger extent compensate for the negative competition effect resulting from foreign entry into the same sector.

Moving on to vertical effects, due to greater technological sophistication wholly owned foreign affiliates may require more complex inputs that may be more difficult for local firms to provide. Therefore, they may be less likely to engage in local sourcing than affiliates with shared ownership. This effect may be magnified by the fact that while foreign investors establishing wholly owned greenfield projects need to put significant efforts into developing linkages with local suppliers, investors engaged in joint ventures can take advantages of the supplier relationships of the local partner (UNCTC, 2001).<sup>9</sup> Empirical evidence consistent with this pattern has been found for Japanese investors (Belderbos et al., 2001; Kiyota et al. 2005) and for Swedish affiliates in Eastern and Central Europe (UNCTC, 2001). Given these arguments, we anticipate larger vertical spillovers to be associated with projects with joint ownership than with wholly owned foreign subsidiaries.<sup>10</sup>

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<sup>8</sup> Kokko, Tansini and Zejan (1996) argue that horizontal FDI spillovers take place only in the presence of a moderate technological gap between foreign and local firms. However, it has also been argued that a larger technology gap may present a greater potential for knowledge transfer and thus lead to more knowledge diffusion (see Blalock and Gertler, 2005).

<sup>9</sup> One can also argue that investors entering through acquisitions benefit from the knowledge of the acquired company. Although in our data set we cannot distinguish between acquisitions, joint ventures and greenfield projects, we have detailed information on the foreign equity share. To the extent that 100% foreign ownership is a proxy for greenfield projects, we expect that wholly owned foreign affiliates will be more reliant on imported inputs, while investment projects with local capital will source more locally. 100% foreign ownership is likely to be a good proxy for greenfield projects, as about 50-60 percent of FDI inflows into Romania before 2002 took form of greenfield investments (Voinea, 2003) and full acquisitions accounted for only 15 percent of all M&A activity (authors calculations based on Securities Data Corporation (SDC) Mergers and Acquisitions Database).

<sup>10</sup> A recent survey of multinationals operating in Latvia provides support for this view as it shows that while 52 percent of firms with joint domestic and foreign ownership had at least one local supplier of intermediate inputs, the same was true of only 9 percent of wholly owned foreign subsidiaries. Moreover, affiliates with shared domestic and foreign ownership reported offering more technical, managerial and financial assistance to their suppliers than wholly owned subsidiaries (FIAS, 2003). Further, the results of a study of the largest exporters in Hungary indicate that foreign affiliates with larger share of foreign equity tend to purchase fewer inputs from Hungarian companies (Toth and Semjen, 1999). Finally, Desai, Foley and Hines (2004) find evidence indicating that whole ownership is most common when firms integrate production activities across different locations.

### 3. FDI in Romania

Compared to other Central and Eastern European countries Romania was a late bloomer as an FDI destination in the region. The Romanian government's cautious approach to privatization and to transition in general had led to relatively low FDI inflows during the early 1990s. The situation changed dramatically in 1997 when substantial privatization efforts along with changes in the legislative framework provided new opportunities for foreign investors. As a result, the volume of FDI inflows in 1997 and 1998 was thirteen and twenty-one times larger, respectively, than the amount received in 1993. During the period covered by our study, 1998-2003, Romania received 8.3 billion dollars in FDI inflows which translated into 377 dollars of FDI inflows per capita (see Table 1). During this period, all sectors of the economy were open to foreign investment and there were no restrictions on the extent of foreign ownership allowed.<sup>11</sup>

According to the Romanian Agency for Foreign Investment, the Netherlands were the largest source country of FDI, followed by France, Germany and the United States. European investors accounted for 67% of the investment value, while American investors were responsible for almost 7.4%. The share of Asian countries reached 7.7% with Turkey, Korea, China and Syria being the largest source countries. Preferred sectors for FDI inflows included oil exploration, automobile and automotive component industry, banking and finance, food processing, telecommunications and construction. For more details about the sectoral distribution of FDI inflows, see Figure A1 in Appendix I.

### 4. Data Description

The data used in this study come from the commercial database Amadeus compiled by Bureau van Dijk, which contains comprehensive information on companies operating in thirty-five European countries, including Romania. In addition to the standard financial statements, Amadeus includes detailed information about the ownership structure of firms, which allows us to determine the foreign equity stake in each company. Since the ownership information pertains mostly to the last year available in the database, we use multiple releases of Amadeus to compile time-varying ownership figures. The earliest and the latest releases used are dated October 2001 and March 2005, respectively. In addition, in 5,520 cases where the information provided in Amadeus is incomplete or

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<sup>11</sup> Source: Nicolae Jantea, President of the Romanian Development Agency speaking about FDI climate in Romania at the Business Forum of the Black Sea Economic Cooperation in 1996 ([www.kappa.ro/guv96/bsec-nj.html](http://www.kappa.ro/guv96/bsec-nj.html)) and *Investment Guide for Southeast Europe 2003* (<http://www.seeurope.net/en/pdf/Romania.pdf>).

insufficient to infer the date of a foreign investor's entry, we supplement it with ownership data acquired from the Romanian Chamber of Commerce and Industry. While combining multiple data sources is a labor-intensive process, it pays off by giving us a time-varying variable capturing the share of foreign equity in each firm operating in Romania during the 1998-2003 period. A detailed description of the procedure used is presented in Appendix II.

In addition to ownership information, we use balance sheet data from the January 2005 release of the database. We limit our attention to firms with the average employment of more than 5 workers during the period of interest. We drop observations with negative values of turnover, materials and fixed assets. We also remove firms reporting unusually large fluctuations in the data.<sup>12</sup> This leaves us with 74,177 firms in the sample. This sample is used to calculate our proxies for foreign presence in the same industry and in downstream sectors.

To calculate measures of foreign presence in downstream sectors we employ annual input-output (IO) matrices provided by the Statistical Institute of Romania. As they are available for 1998-2002, we use the 2002 matrix for year 2003. The input-output matrices contain information on 105 sectors and each firm in our dataset is matched with the IO sector classification based on its primary three-digit NACE code using the concordances provided by the Statistical Institute. All sectors with available information on foreign ownership and turnover are used in computing FDI spillover proxies. Conscious of the fact that our identification strategy relies on the changes in the variables of interest taking place over time, we drop 21 sectors where there was no change in one or more spillover variables during the period of interest.

We restrict our attention to industries for which import figures are available, which means that we lose additional 27 sectors. As our goal is to estimate industry-specific production functions, we also drop sectors with insufficient number of observation for the Levinsohn-Petrin (2003) procedure to identify the coefficients. In the end, we are left with 13,129 firms in 48 industries or 40,573 firm-year observations for the 1998-2003 period, between 6,762 and 8,820 observations per year. In 2,464 firms the foreign equity share exceeds ten percent of the total and thus we classify them as foreign.<sup>13</sup>

In our analysis, we use information on output and production inputs. We define output as a firm's turnover deflated by the producer price index for the three-digit NACE sector, obtained from

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<sup>12</sup> More specifically, we calculate growth rate for each variable to be used in productivity estimation and drop the upper one percent tail.

<sup>13</sup> A handful of state-owned enterprises are included in Amadeus, yet the database does not allow us to identify all of them clearly. We are not concerned about the issue for two reasons. First, our specification in first differences will remove any firm-specific fixed effects. Second, according to the Romanian Statistical Yearbook (2002), only 0.0038% of all enterprises in manufacturing, construction, trade and other services were majority state owned in 2002.



the Statistical Institute of Romania. We measure labor input with the number of employees. Capital is proxied by the value of tangible fixed assets deflated using the GDP deflator from the IMF's *International Financial Statistics*. Material inputs are deflated by a weighted average of the producer price indices of the supplying sectors, with the weights given by the annual input-output matrices and representing the proportion of inputs sourced from a given sector. As summary statistics presented in Table 2 indicate, a large degree of heterogeneity is found in the case of output, inputs and the foreign presence within industries or in downstream sectors.

Finally, we also use information on sectoral imports and exports obtained from the UN's COMTRADE database.

## 5. Empirical Analysis

### 5.1 Empirical Specification

To compare FDI spillovers associated with different types of foreign affiliates, we proceed in two steps. First, we estimate sector-specific production functions to obtain measures of the total factor productivity (TFP). Then, we relate the TFP to the proxies for FDI spillovers. We use three approaches to TFP estimation:

(i) a log-linear transformation of a Cobb-Douglas production function:

$$\ln Y_{it} = \alpha + \beta_K \ln K_{it} + \beta_L \ln L_{it} + \beta_M M_{it} + \varepsilon_{it} \quad (1)$$

where subscripts  $i$  and  $t$  refer to firm and year, respectively.  $Y_{it}$  stands for a firm's output,  $M_{it}$ ,  $K_{it}$ ,  $L_{it}$  and represent production inputs: materials, capital and labor.

(ii) a more flexible translog specification:

$$\begin{aligned} \ln Y_{it} = a + \delta_K \ln K_{it} + \delta_L \ln L_{it} + \delta_M M_{it} + \delta_{KK} \ln K_{it}^2 + \delta_{LL} \ln L_{it}^2 + \delta_{MM} M_{it}^2 + \delta_{KL} \ln K_{it} \ln L_{it} \\ + \delta_{KM} \ln K_{it} \ln M_{it} + \delta_{LM} \ln L_{it} \ln M_{it} + \nu_{it} \quad (2) \end{aligned}$$

and (iii) the semi-parametric approach suggested by Levinsohn and Petrin (2003), which allows us to take into account the possibility that a firm's private knowledge of its productivity (unobserved by the econometrician) may affect the input decisions. This method allows for firm-specific productivity differences that exhibit idiosyncratic changes over time and thus addresses the simultaneity bias between productivity shocks and input choices. Since our study relies on correctly measuring firm productivity, obtaining consistent estimates of the production function coefficients is crucial to our

analysis. For each of the 48 sectors, defined in the classification used in the input-output matrix, we estimate a production function employing the three approaches outlined above. Thus, for each firm in the sample, we obtain three estimates of TFP.

In the second step (equation 3), we relate the estimated TFP to the proxies for foreign presence in the same sector (Horizontal) and in downstream industries (Vertical). We estimate the model in first differences to remove any fixed firm-specific unobservable variation and fixed regional and industry-specific effects.<sup>14</sup> The model also includes year dummies ( $\alpha_t$ ) and 41 regional fixed effects ( $\alpha_r$ ). The former control for economy-wide shocks, while the latter take into account productivity trends specific to a particular location (for instance, those resulting from improvements in infrastructure). Finally, we add to the model industry dummies ( $\alpha_j$ ), which in the first difference specification capture industry-specific productivity trends. To take into account a potential correlation between error terms for firms in the same industry, we cluster standard errors on industry-year combinations. The model is estimated on a sample of domestic firms to avoid a potential bias stemming from the fact that foreign investors tend to acquire stakes in large and most successful domestic companies (see Djankov and Hoekman, 2000), but as a robustness check we will also estimate the model on the sample of both domestic and foreign firms and on the foreign subsample.

$$\begin{aligned} \Delta \ln TFP_{it} = & \beta_0 + \beta_1 \Delta \text{Horizontal\_shared}_{jt} + \beta_2 \Delta \text{Horizontal\_100\%\_foreign}_{jt} \\ & + \beta_3 \Delta \text{Vertical\_shared}_{jt} + \beta_4 \Delta \text{Vertical\_100\%\_foreign}_{jt} + \beta_5 \Delta \text{Concentration}_{jt} \\ & + \beta_5 \Delta \ln \text{Imports}_{jt} + \alpha_j + \alpha_r + \alpha_t + u_{it} \quad (3) \end{aligned}$$

The proxies for foreign presence are defined as follows.  $\text{Horizontal}_{jt}$  is the share of an industry  $j$ 's output produced by foreign affiliates. Subscript  $j$  pertains to the industry classification from the input-output matrix. Since we are interested in exploring spillovers stemming from FDI projects with different ownership structures, we calculate a measure pertaining to wholly owned foreign affiliates ( $\text{Horizontal\_100\%\_foreign}$ ) and a measure pertaining to affiliates with joint domestic and foreign ownership ( $\text{Horizontal\_shared}$ ). The latter includes all firms with foreign equity share ranging from 10 to 99 percent.

The variable  $\text{Vertical}_{jt}$  is a proxy for foreign presence in downstream sectors (i.e., sectors supplied by the industry to which firm  $i$  belongs) and thus is intended to capture the effect multinational customers have on domestic suppliers. It is defined in the following way:

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<sup>14</sup> There may exist firm, time and region specific factors unknown to econometrician but known to the firm that may affect the correlation between firm productivity and foreign presence. Examples of these variables include better management in a particular firm or better infrastructure present in a given region.

$$\text{Vertical\_100\%\_foreign}_{jt} = \sum_{k, j \neq k} \alpha_{jkt} \text{Horizontal\_100\%\_foreign}_{kt} \quad (4)$$

$$\text{Vertical\_shared}_{jt} = \sum_{k, j \neq k} \alpha_{jkt} \text{Horizontal\_shared}_{kt} \quad (5)$$

where  $\alpha_{jkt}$  is the proportion of sector  $j$ 's output used by sector  $k$  at time  $t$  taken from the annual input-output matrices.<sup>15</sup> To separate the vertical channel from the effect of multinational presence in the same sector, we exclude sourcing within industry. As in the case of the Horizontal variable, we calculate two measures of Vertical to distinguish between the effects of full and partial foreign ownership.

In order to identify spillovers associated with the two types of FDI projects, we rely on the variation in changes of the two types of foreign presence within the sector and in downstream industries. Therefore, we make sure that both Horizontal variables and both Vertical proxies are defined (i.e., non-missing) for all sectors considered and that they vary over time.<sup>16</sup> As illustrated in Appendix I, which plots values of each variable across time in each sector, there are large differences across sectors in the evolution of the measures.

The variation in FDI presence has a temporal and a sectoral source. The temporal variation is due to the government's liberalization and stabilization efforts which turned Romania into a more attractive investment destination and substantially increased FDI inflows during the timeframe considered in this study. The sectoral variation in FDI inflows is determined by fixed industry technological conditions. A basic tenet of the theory of the multinational firm is that such firms rely heavily on intangible assets and thus are more prevalent in industries where R&D investment and brand names play an important role (see the survey by Markusen, 1995).

What is more important for this study is that fixed industry technological conditions are also a source of variation in the entry mode of FDI. The theoretical and empirical analysis of the ownership structure in FDI projects conducted by Asiedu and Esfahani (2001) suggests that multinationals prefer full ownership in industries where foreign investor's intangible assets are more important. This finding is confirmed in the context of transition countries where in the mid-1990s a vast majority of foreign investment projects in R&D- and advertising-intensive industries (e.g., drugs, cosmetics and health care products, beverages, electrical machinery) took form of wholly-

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<sup>15</sup> In calculating  $\alpha_{jk}$  sector  $j$ 's output sold for final consumption was excluded.

<sup>16</sup> This prevents us from confounding industry differences with FDI differences. If, for instance, we observed partially owned FDI projects only in production of widgets and fully owned projects only in production of electronic widgets, we would not be sure whether the results would reflect some inherent differences between these two sectors or differential effects of the two types of foreign presence.

owned subsidiaries rather than joint ventures (Javorcik and Saggi, 2004).<sup>17</sup> Consistent with this pattern, we find that in detergents and cosmetics, domestic appliances and power generating machinery the value of *Horizontal\_100%\_foreign* exceeds that of *Horizontal\_shared* (see Figure A1). Further, Asiedu and Esfahani (2001) find that shared ownership is preferable in resource-intensive industries where foreign investors may be willing to give up control in order to gain access to raw material sources. An indeed Figure A1 suggests greater prevalence of partially owned projects (as proxied by the *Horizontal\_shared* variable) in cement, lime and plaster, crude oil processing and extraction of clay and sand, all of which are natural-resource-based industries.

Fixed industry factor intensities may be another source of variation in FDI entry mode. For instance, one may expect that in sectors where a relatively lower initial size of investment is required (due to, for instance, a lower capital intensity), setting up wholly owned greenfield investments may be an attractive option for medium-sized foreign firms. And indeed Hunya (2002, p.7) reports that “Romania has an increasing greenfield investment sector mainly of medium sized companies located along the Western border and engaged in processing.”

Finally, historical factors may have also affected the differences between sectors in terms of prevalence of one type of FDI versus the other. It is possible that firms that had a business relationship with a Romanian entity before the beginning of transition are more familiar with the local conditions and thus in less need of a local partner. Alternatively, firms with such experience may have an easier time finding a joint venture partner or an acquisition target as their business partner from the pre-transition era may be a natural choice. For instance, Romanian automaker Dacia used to produce cars based on the license acquired from the French company Renault, thus it was not surprising that in 1999 Renault chose to acquire part of Dacia.

The model, presented in equation 3, also controls for the level of competition in the industry by including proxies for industry concentration and import competition. Concentration is measured using the Herfindahl index defined as the sum of squared market shares of all firms in the sector. Its value ranges from 0 to 1. While the usual measure of import competition is the ratio of imports to the industry output, we choose to employ the value of Romania’s imports of products of industry *j* instead. Our decision is motivated by the imperfect concordance between the Romanian industry classification and the classifications in which trade data are available in the UN COMTRADE database.<sup>18</sup> As the model is estimated in first differences, it includes the change in import volume,

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<sup>17</sup> Investors’ preference for full ownership in these industries may also be motivated by the fear of knowledge dissipation due to weak protection of intellectual property rights (IPRs). For evidence on the effects of IPR protection on FDI inflows see Javorcik (2004b).

<sup>18</sup> The concordance between Romanian IO codes and 4 digit HS classification was constructed by the authors.

thus we do not need to be very concerned about the size differences between industries. While we are not explicitly controlling for changes in industry output, such changes will be to some extent captured by industry fixed effects added to the first difference specification.<sup>19</sup> The summary statistics for all variables are presented in Table 2.

## *5.2 Baseline Results*

We begin our analysis by examining the difference between vertical spillovers associated with wholly owned foreign subsidiaries and projects with joint domestic and foreign ownership. As postulated before, we expect the latter to be associated with greater knowledge diffusion as the participation of the local partner lowers the cost of finding local suppliers and thus is likely to result in more local sourcing. It is also possible that if less sophisticated technologies are used by affiliates with joint domestic and foreign ownership, they may require less sophisticated inputs which are easier to purchase locally.

Our findings from the analysis performed on the sample of Romanian firms, i.e. those with less than 10% of foreign equity, lend support to this hypothesis. In the first three columns of Table 3, we present results for regressions including changes in two proxies for vertical spillovers and controlling for changes in industry concentration and import growth. Each of the three columns corresponds to results for the change in TFP calculated using a different method: log-linear Cobb-Douglas sector-specific production functions (column 1), translog sector-specific production functions (column 2) and sector-specific production functions estimated using the Levinsohn-Petrin (2003) approach (column 3). In all three regressions, we find a positive and statistically significant (at the one or five percent level) coefficient on the proxy for vertical spillovers from jointly owned FDI projects. The proxy for vertical spillovers from wholly owned foreign affiliates does not appear to be statistically significant in any of the models. In all three cases, the difference between the two coefficients is statistically significant. This leads us to conclude that while an increase in the downstream presence of affiliates with joint domestic and foreign ownership is positively correlated with the productivity growth of Romanian firms in the supplying industries, this is not the case for wholly owned foreign subsidiaries. The magnitude of the former effect is economically meaningful. A one-standard-deviation increase in the presence of investment projects with shared domestic and foreign ownership is associated with a 4.4 percent increase in the total factor productivity of domestic firms in the supplying industries.

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<sup>19</sup> In any case, using the ratio of imports to output would not change the main conclusions of this paper.

In the next three columns, we perform an analogous exercise for intra-industry effects. As discussed in the literature review, foreign entry tends to have two effects on local firms in the same industry. On the one hand, foreign affiliates may take part of the market share away from local competitors thus forcing the latter to spread their fixed costs over a smaller production volume, which in our analysis would manifest itself as a decline in the productivity of local producers. On the other hand, the entry of foreign subsidiaries may result in knowledge diffusion to local companies through the demonstration effect or movement of labor. Local participation in FDI projects may lead to more knowledge dissipation within the sector. In contrast, greater technological sophistication of wholly owned foreign subsidiaries may impede knowledge diffusion to local firm which may lack the absorptive capacity needed. Thus, we would expect more knowledge diffusion to be associated with projects with joint domestic and foreign ownership than with wholly owned foreign affiliates. As in our model we unable to separate the competition effect from the knowledge diffusion effect, our results capture the sum of the two.<sup>20</sup>

In two out of three regressions, we find a negative and significant coefficient on both proxies for intra-industry spillovers. The negative effect of foreign entry on local producers in the same sector supports the conclusions of the earlier literature.<sup>21</sup> The finding of a larger negative effect being associated with wholly owned foreign affiliates is in line with our hypothesis. The magnitudes of the coefficients on `Horizontal_100%_foreign` are twice a large as those on `Horizontal_shared` but due to the coefficients not being very precisely estimated, the difference between the two is not statistically significant.

In the following three columns, we combine in one model the proxies for vertical and horizontal effects. Our conclusions remain unchanged. We find a positive and significant correlation between the entry of jointly owned affiliates into downstream industries and the productivity growth of Romanian firms in the supplying sectors. No such correlation is detected for wholly owned affiliates. The difference between the two effects is statistically significant. In the case of intra-industry effects, we find that the entry of wholly owned foreign subsidiaries is associated with a greater negative effect on domestic producers than the entry of jointly owned affiliates, which is in line with our hypothesis. However, the difference between the two effects is not statistically significant.

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<sup>20</sup> If greater technological sophistication of wholly owned foreign subsidiaries implies that their entry results in a larger loss of a market share on the part of local competitors, this would only reinforce the predicted pattern.

<sup>21</sup> To be precise, our spillover proxies capture both new entry and expansion of the existing FDI projects. We use the term 'entry' as a shorthand for both effects.

Turning to other control variables, we find that an increase in the industry concentration is negatively associated with the change in the productivity of Romanian firms but this effect is not statistically significant in all specifications. The results also indicate a negative correlation between the change in the import volume and the productivity of local enterprises.<sup>22</sup> The negative coefficients on the import growth and the entry of foreign producers into the product market suggest that Romanian firms may not be yet well prepared to compete with foreign producers. While greater competition from imports and foreign entry may be expected to force the least efficient local producers to exit in the medium to long run, in the short run they will have to spread their fixed cost over a declining market share which will manifest itself in a lower observed productivity.<sup>23</sup>

As in almost all cases the results obtained for the three TFP measures lead to the same conclusions, in the subsequent section we will use our preferred measure, namely the TFP estimated using the Levinsohn-Petrin procedure.

### *5.3 Extensions and Robustness Checks*

We subject our results to several extensions and robustness checks. First, we check whether the expected pattern holds for firms that are leaders in their sectors as well as for firms exhibiting lesser performance. One may argue that industry leaders are better positioned to benefit from vertical spillovers and from knowledge externalities associated with FDI in their industry and that they are less likely to lose market share to foreign entrants. To shed some light on this question, we split the sample into two groups: (i) firms with the total factor productivity (calculated using the Levinsohn-Petrin procedure for the whole population of firms) in the top 30 percentiles in their sector; and (ii) the remaining firms. We estimate our model on domestic firms in each subsample separately and report the results in Table 4.

The results indicate that the expected pattern of vertical spillovers can be found in both subsamples. Both sector leaders and firms with lesser performance appear to be able to benefit from the entry of FDI projects with shared ownership into downstream sectors. As in the previous table, there is no indication of any spillover effects being associated with wholly owned foreign subsidiaries in downstream industries. The difference between the effects of the two types of FDI is, however, statistically significant only in the subsample of industry leaders.

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<sup>22</sup> In additional regressions (not reported here), we used the change in the ratio of imports to industry output and also obtained a negative and statistically significant coefficient.

<sup>23</sup> Note that competition from imports and foreign entry into the same sector has also been found to be negatively associated with firm performance in the Czech Republic, a country more advanced in transition than Romania (see Arnold, Javorcik and Mattoo, 2006).

As for intra-industry spillovers, the analysis performed on the subsample of lesser performers produces the expected pattern. Namely, the entry of wholly owned foreign subsidiaries appears to have a larger negative effect on Romanian firms than the entry of FDI with shared ownership. However, the difference between the two coefficients is not statistically significant. There is no evidence that industry leaders are affected by the presence of FDI in their sector, which is intuitive as they may be better prepared to compete with foreign entrants.<sup>24</sup>

As a second extension, we examine whether industries experiencing a dynamic export growth differ in the way they are affected by multinational entry. It is plausible that firms in these sectors are able to tap into know-how and information provided by foreign buyers, benefit from knowledge obtained by other exporters or improve their performance in response to more stringent requirements in foreign markets. Interactions with foreign buyers abroad may thus serve as an alternative to tapping into knowledge of foreign customers operating in Romania. To examine this possibility, we split our sample into sectors which experienced an above-average increase in exports during the period covered by our sample (1998-2003) and other industries.<sup>25</sup> We find that firms in sectors experiencing a fast export growth do not benefit from vertical spillovers. This is consistent with the explanation that contacts with buyers abroad provide an alternative source of knowledge and thus the scope for improvement due to contacts with multinationals operating in Romania may be smaller. An alternative explanation is that firms in these sectors may rely mostly on export markets and may not be engaged in supplying multinationals operating in Romania.

Further, we find that firms in sectors with a fast export growth are not affected by foreign entry into their industry. This may be explained by their greater ability to compete with multinationals, their limited sales in the domestic market or by the possibility that multinationals active in these sectors produce mostly for exports and thus their entry has little effect on the level of competition within the sector. The last possibility is probably the most plausible, as it is easy to reconcile with the finding that Romanian producers in these sectors are negatively affected by import competition.<sup>26</sup>

The results for the remaining industries support the central hypotheses of the paper. We find a positive and significant coefficient on the proxy for jointly owned FDI projects in downstream

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<sup>24</sup> As an alternative way of assessing the relationship between firm performance and its ability to benefit from spillovers, we grouped firms based on their distance to the technological frontier, which was defined as the mean performance of foreign firms in a given sector. We split firms into a subsample consisting of the 30 percent of firms with the lowest gap (regardless of their sectoral affiliation) and the remaining enterprises. The results were very similar to those presented in the first two columns of Table 4.

<sup>25</sup> The average increase in exports during the period was 127%.

<sup>26</sup> It is possible, however, that multinationals target the high end of the market in which few Romanian producers are present, while imports of lower end products from Asian countries directly compete with Romanian producers.



sectors and no significant effect of wholly owned subsidiaries in downstream industries. The difference between the two effects is statistically significant. This is consistent with the explanation that firms in these sectors have little access to other sources of knowledge about the international best practice and thus can benefit to a larger extent from interactions with multinational customers operating in Romania. The results also indicate that firms in domestic-market-oriented sectors are negatively affected by competition from foreign entry either because they are less able to compete with multinationals, because the Romanian market is the only outlet for their products or because multinationals operating in these industries are primarily focused on supplying the local market. As anticipated, we find that wholly owned subsidiaries have a larger negative effect on the local firms operating in the same sector than projects with joint domestic and foreign ownership. The difference between the two coefficients is statistically significant.

In our third extension, we split the sample into less concentrated sectors (that is, those with the Herfindahl index below the average value of .105) and sectors with greater concentration. The results for the subsample of less concentrated industries are consistent with our benchmark results. Positive vertical spillovers are only associated with jointly owned subsidiaries and entry of foreign investors appears to have a negative effect on local firms in the same sector, with a larger coefficient being associated with wholly owned subsidiaries. In contrast, Romanian firms in more concentrated sectors benefit from both types of FDI in downstream industries and do not appear to be affected by foreign entry into the same sector. Thus these results suggest that the competition effect from foreign entry is greater in less concentrated sectors.<sup>27</sup>

Next we examine whether our results are robust to including foreign firms in the sample and whether foreign affiliates also benefit from FDI spillovers. As illustrated in the last section of Table 4, the results for the sample of both domestic and foreign firms are very similar to those obtained for the subsample of Romanian firms (reproduced here from Table 3). When we focus on the subsample of foreign firms, we find that they do not benefit from vertical spillovers, which is not surprising given the fact that their technologies are probably comparable to those of other foreign firms. They do appear, however, to be negatively affected by the entry of wholly owned foreign subsidiaries into their sector but not by the entry of partially owned projects. The difference between the two effects is statistically significant.

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<sup>27</sup> Note that foreign entry does not automatically lead to an increase in competition as it may take place through an acquisition of an existing local firm.

#### *5.4 Analysis at the Regional Level*

As a final extension, we explore the geographic dimension of our data set and conduct the exercise at the regional level. We compute each spillover proxy for the region where the firm operates as well as for the remaining regions. When considering the share of output produced by foreign firms in the same industry and the same region, we exclude the output of the Romanian firm in question from the denominator. We rely on the Nomenclature of Territorial Units for Statistics (NUTS) which is a geocode standard for referencing the administrative division of countries for statistical purposes. This standard was developed by the European Union and covers the member states as well as accession countries. There are 8 NUTS regions in Romania with an average population of 2.8 million inhabitants.<sup>28</sup>

The estimation results, presented in Table 5, lend support to our hypotheses. They suggest that the entry of jointly owned FDI projects into downstream sectors both in the same region as well as in other parts of the country benefits the performance of Romanian firms in the supplying industries. The results also confirm that wholly owned foreign investments do not lead to any vertical spillovers. The difference between the two effects is statistically significant. Further, the results indicate that there exists a negative correlation between the entry of wholly owned FDI projects and the performance of Romanian firms in the same sector. No statistically significant effect is found for partially owned affiliates. The difference between the two coefficients is statistically significant in 6 out of 8 cases and does not appear to be affected by the location. In sum, we conclude that the ownership structure matters for both vertical and horizontal spillover from FDI and that such spillovers are country-wide rather than local in nature.

## **6. Conclusions**

Governments of developing countries often favor joint ventures over wholly owned FDI projects believing that active participation of local firms facilitates the absorption of new technologies and know-how. To examine whether this belief is warranted, this paper compares the magnitudes of horizontal and vertical spillovers associated with wholly and partially owned foreign subsidiaries in Romania. We expect that the ownership structure should matter for productivity spillovers for two reasons.

First, affiliates with joint domestic and foreign ownership are likely to face lower costs of finding local suppliers of intermediates, as they can benefit from the local partner's knowledge and

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<sup>28</sup> These are: Bucuresti-Ilfov, North East, South East, North West, South West, South, West and Center.

previous experience in this area. Thus they should be on average more likely to source inputs locally, which in turn should lead to more vertical knowledge spillovers to local firms in the supplying sectors. Second, the fact that multinationals tend to transfer less sophisticated technologies to their partially owned affiliates than to wholly owned subsidiaries, combined with better access to knowledge through the participation of the local shareholder, may facilitate more knowledge absorption by local firms in the same sector. Greater knowledge externalities associated with jointly owned affiliates are likely to have a larger offsetting effect on the negative impact of foreign entry on the market share (and thus the average cost) of local firms in the same industry.

Given these factors we hypothesize that the entry of partially owned foreign affiliates into downstream sectors should have a larger positive effect on the performance of local firms in the supplying industries than the entry of wholly owned foreign subsidiaries. We also expect that the presence of partially owned foreign affiliates should have a smaller negative effect (relative to wholly owned projects) on domestic firms operating in the same sector.

The analysis, performed on Romanian firm-level data for the period 1998-2003 produces results consistent with these hypotheses. We find a positive correlation between the change in the presence of partially owned FDI projects in downstream sectors and the productivity growth of Romanian firms in the supplying industries. No such effect is detected for wholly owned foreign subsidiaries in downstream sectors. When we consider intra-industry effects, we show that the change in the presence of wholly owned foreign affiliates has a larger negative effect on the productivity growth of Romanian firms in the same sector than the entry of partially owned FDI projects.

Some caution is warranted when interpreting our results. While our findings are consistent with the existence of externalities associated with FDI, these externalities are not necessarily knowledge spillovers. In the case of foreign entry into the same industry, our methodology does not allow us to distinguish between knowledge spillovers and the effects of increased competition resulting from foreign entry into the product market. In the case of vertical effects, we cannot distinguish between knowledge spillovers and the benefits of scale economies that local suppliers may enjoy as a result of receiving contracts from multinationals.

Our findings should not be interpreted as suggesting that restrictions on the extent of foreign ownership are desirable, as such restrictions may lead to lower overall FDI inflows and have other implications not addressed in our analysis. There exist other policies that could potentially be used to facilitate local sourcing by multinationals, such as improvements to the business climate or supplier development programs that assist local producers in learning how to

satisfy requirements of foreign buyers. In any case, more research is needed to enhance our understanding of host country conditions facilitating knowledge spillovers from foreign direct investment and the role government policies may play in this area.

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**Table 1. FDI Inflows into Central and Eastern European Countries 1998-2003**

	FDI inflow (millions of US dollars)						
	1998	1999	2000	2001	2002	2003	1998-2003
Poland	6,365	7,270	9,343	5,714	4,131	4,123	36,946
Czech Republic	3,700	6,313	4,987	5,641	8,497	2,021	31,158
Hungary	3,343	3,308	2,770	3,944	3,013	2,202	18,580
Romania	2,031	1,041	1,037	1,157	1,144	1,844	8,254
Croatia	932	1,464	1,085	1,338	1,213	2,133	8,165
Bulgaria	537	819	1,002	813	905	1,419	5,495

Source: IMF *International Financial Statistics*



**Table 2. Summary Statistics**

	<b>Variable</b>	<b>No. of obs.</b>	<b>Mean</b>	<b>Std. Dev.</b>
<b>Firm-specific variables</b>				
<i>Levels</i>	Turnover (mn lei 1996)	40,573	2,310	12,300
	Fixed Assets (mn lei 1996)	40,573	933	10,600
	Materials (mn lei 1996)	40,573	1,484	9,872
	Labor	40,573	85	304
<i>First differences</i>	TFP (OLS)	30,355	0.005	0.323
	TFP (Translog)	30,355	0.003	0.302
	TFP (Levinsohn-Petrin)	30,355	0.007	0.364
<b>Industry-specific variables</b>				
<i>Levels</i>	Horizontal shared	288	0.188	0.185
	Horizontal 100% foreign	288	0.119	0.137
	Vertical shared	288	0.114	0.053
	Vertical 100% foreign	288	0.081	0.039
	Concentration	288	0.105	0.138
	Imports (bn lei 1996)	288	1,330	2,150
	Exports (bn lei 1996)	288	821	1,360
<i>First differences</i>	Horizontal shared	240	0.027	0.090
	Horizontal 100% foreign	240	0.022	0.059
	Vertical shared	240	0.011	0.032
	Vertical 100% foreign	240	0.014	0.022
	Concentration	240	-0.002	0.024
	Imports (bn lei 1996)	240	151	330
	Exports (bn lei 1996)	240	111	235
<b>Industry-region-specific variables</b>				
<i>Levels</i>	Horizontal shared own region <sup>a</sup>	40,573	0.144	0.165
	Horizontal 100% foreign own region <sup>a</sup>	40,573	0.111	0.145
	Horizontal shared other regions	2,304	0.186	0.188
	Horizontal 100% foreign other regions	2,304	0.119	0.142
	Vertical shared own region	2,304	0.079	0.062
	Vertical 100% foreign own region	2,304	0.057	0.064
	Vertical shared other regions	2,304	0.112	0.054
	Vertical 100% foreign other regions	2,304	0.079	0.042
<i>First differences</i>	Horizontal shared own region <sup>a</sup>	30,848	0.016	0.114
	Horizontal 100% foreign own region <sup>a</sup>	30,848	0.022	0.059
	Horizontal shared other regions	1,920	0.026	0.094
	Horizontal 100% foreign other regions	1,920	0.022	0.062
	Vertical shared own region	1,920	0.010	0.037
	Vertical 100% foreign own region	1,920	0.011	0.029
	Vertical shared other regions	1,920	0.011	0.033
	Vertical 100% foreign other regions	1,920	0.014	0.023

<sup>a</sup> Note that this variable excludes the output of the firm in question and thus is a firm-specific variable.

**Table 3. Basic Specification in First Differences**

	OLS	Translog	LP	OLS	Translog	LP	OLS	Translog	LP
$\Delta$ Vertical shared	0.650** (0.271)	0.746*** (0.273)	0.814*** (0.287)				0.684** (0.268)	0.783*** (0.269)	0.850*** (0.285)
$\Delta$ Vertical 100% foreign	-0.115 (0.419)	-0.049 (0.419)	0.007 (0.415)				-0.154 (0.415)	-0.091 (0.410)	-0.035 (0.411)
$\Delta$ Horizontal shared				-0.220 (0.135)	-0.238* (0.131)	-0.236* (0.141)	-0.243* (0.140)	-0.263* (0.136)	-0.263* (0.144)
$\Delta$ Horizontal 100% foreign				-0.442 (0.272)	-0.478* (0.262)	-0.476* (0.272)	-0.466* (0.280)	-0.504* (0.270)	-0.502* (0.279)
$\Delta$ Concentration	-1.277** (0.629)	-1.131* (0.630)	-1.202* (0.638)	-0.940* (0.515)	-0.741 (0.525)	-0.792 (0.537)	-0.959* (0.503)	-0.788 (0.513)	-0.861* (0.516)
$\Delta$ In Imports	-0.082** (0.036)	-0.084** (0.035)	-0.100*** (0.036)	-0.061* (0.037)	-0.060* (0.036)	-0.074** (0.036)	-0.078** (0.037)	-0.079** (0.036)	-0.095** (0.037)
No. of observations	30,355	30,355	30,355	30,355	30,355	30,355	30,355	30,355	30,355
R-squared	0.02	0.03	0.02	0.02	0.03	0.02	0.03	0.03	0.02
Vertical shared = Vertical 100% foreign (p-value)	0.07	0.07	0.07				0.06	0.05	0.05
Horizontal shared = Horizontal 100% foreign (p-value)				0.39	0.34	0.35	0.39	0.35	0.36

The dependent variable is the change in the total factor productivity (expressed in natural logarithm) of a Romanian firm  $i$  at time  $t$ , derived from sector-specific log-linear Cobb-Douglas production functions (OLS), translog production functions (translog) or production functions estimated using the Levinsohn-Petrin approach (LP). All specifications include a constant, year, industry and region fixed effects. Standard errors, corrected for clustering for industry-year combinations, are reported in parentheses. \* denotes significance at the 10% level; \*\* at the 5% level; \*\*\* at the 1% level.

**Table 4. Extensions and Robustness Checks**

	Firm performance			Trade orientation			Concentration			Ownership		
	Sector leaders	Other firms	Dynamic export growth	Domestic market oriented	Less concentrated	More concentrated	Both domestic and foreign	Domestic only <sup>a</sup>	Foreign only			
$\Delta$ Vertical shared	1.114*** (0.420)	0.626** (0.254)	0.210 (0.582)	1.342*** (0.318)	0.996*** (0.326)	1.176*** (0.436)	0.839*** (0.302)	0.850*** (0.285)	0.516 (0.535)			
$\Delta$ Vertical 100% foreign	-0.292 (0.526)	0.028 (0.385)	0.042 (0.587)	-0.839 (0.673)	-0.356 (0.529)	0.941** (0.467)	-0.069 (0.418)	-0.035 (0.411)	-0.231 (0.620)			
$\Delta$ Horizontal shared	-0.118 (0.193)	-0.257** (0.119)	0.177 (0.210)	-0.546** (0.230)	-0.433* (0.254)	0.146 (0.160)	-0.252* (0.129)	-0.263* (0.144)	-0.165 (0.133)			
$\Delta$ Horizontal 100% foreign	-0.204 (0.305)	-0.557** (0.250)	0.156 (0.256)	-1.426*** (0.386)	-1.073*** (0.404)	0.200 (0.249)	-0.569** (0.272)	-0.502* (0.279)	-0.802*** (0.283)			
$\Delta$ Concentration	-0.636 (0.680)	-0.847* (0.468)	-0.64 (0.581)	-2.048** (0.930)	-2.119 (1.389)	-0.611 (0.408)	-1.144** (0.548)	-0.861* (0.516)	-2.677*** (0.838)			
$\Delta$ In Imports	-0.123** (0.048)	-0.068* (0.035)	-0.196*** (0.057)	-0.04 (0.040)	-0.108* (0.058)	-0.078** (0.033)	-0.092** (0.037)	-0.095** (0.037)	-0.081 (0.053)			
No. of observations	8,488	21,867	12,297	18,058	28,020	2,335	37,040	30,355	6,685			
R-squared	0.04	0.04	0.02	0.04	0.03	0.05	0.03	0.02	0.05			
Vertical shared = Vertical 100% foreign (p-value)	0.02	0.15	0.72	0.00	0.04	0.62	0.05	0.05	0.34			
Horizontal shared = Horizontal 100% foreign (p-value)	0.77	0.19	0.94	0.03	0.16	0.79	0.21	0.36	0.01			

The dependent variable is the change in the total factor productivity (expressed in natural logarithm) of firm  $i$  at time  $t$ , derived from sector-specific production functions estimated using the Levinsohn-Petrin approach. The model is estimated in first differences. Unless specified otherwise, the sample of Romanian firms is used. All specifications include a constant, year, industry and region fixed effects. Standard errors, corrected for clustering for industry-year combinations, are reported in parentheses. \* denotes significance at the 10% level; \*\* at the 5% level; \*\*\* at the 1% level.

<sup>a</sup> this column has been reproduced from Table 3.

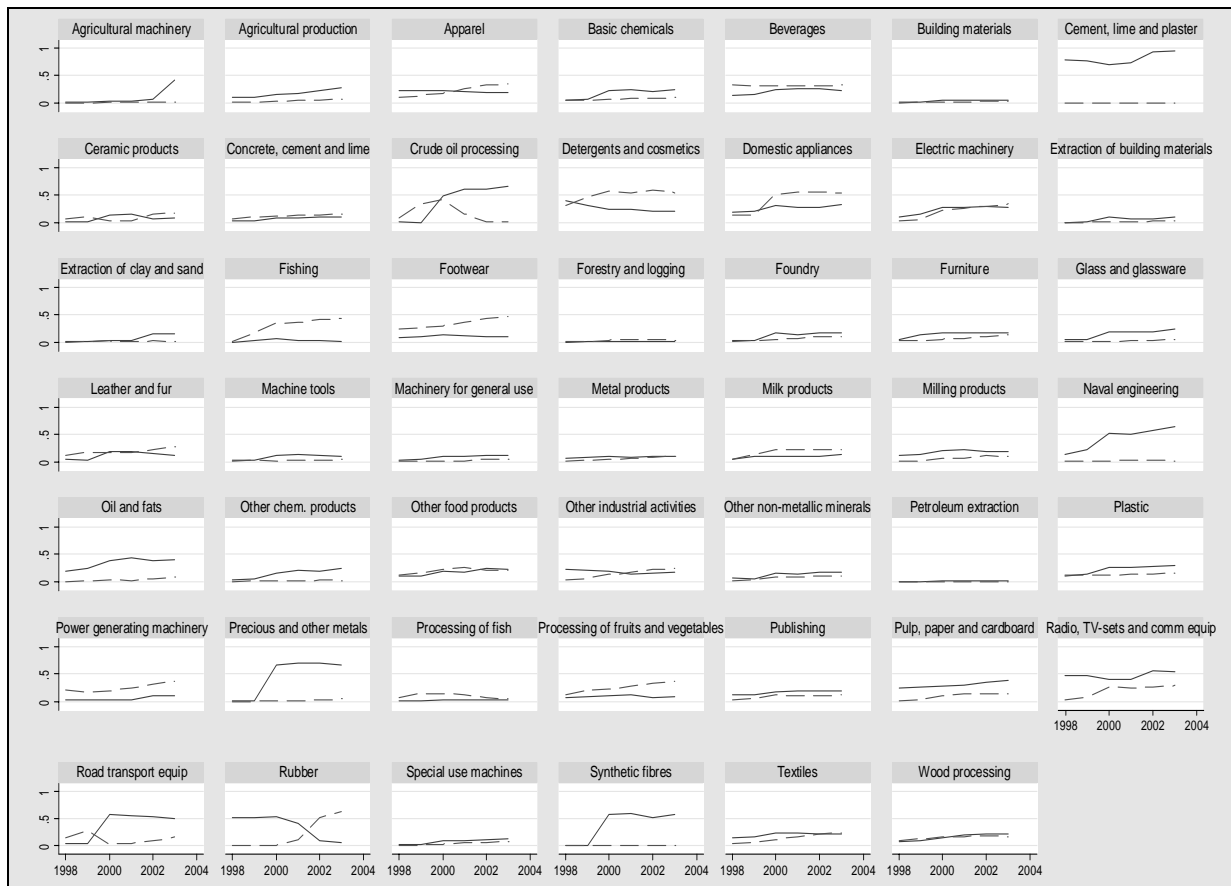
**Table 5. Regional-level Spillover Proxies**

	Other regions			Own region			Both		
$\Delta$ Vertical shared other regions	0.742*** (0.128)	0.765*** (0.128)	0.730*** (0.132)						0.749*** (0.132)
$\Delta$ Vertical 100% foreign other regions	0.032 (0.142)	0.007 (0.142)	0.033 (0.143)						0.011 (0.143)
$\Delta$ Vertical shared own region				0.160** (0.081)	0.172** (0.081)	0.072 (0.084)			0.078 (0.085)
$\Delta$ Vertical 100% foreign own region				-0.141 (0.118)	-0.151 (0.118)	-0.166 (0.117)			-0.165 (0.118)
$\Delta$ Horizontal shared other regions		-0.073 (0.059)		-0.094 (0.058)					-0.088 (0.058)
$\Delta$ Horizontal 100% foreign other regions		-0.327*** (0.064)		-0.349*** (0.064)					-0.343*** (0.065)
$\Delta$ Horizontal shared own region					-0.006 (0.014)				-0.013 (0.016)
$\Delta$ Horizontal 100% foreign own region					-0.067* (0.038)	-0.075** (0.038)			-0.071* (0.038)
$\Delta$ Concentration	-0.590*** (0.178)	-0.356** (0.175)	-0.553*** (0.177)	-0.390** (0.175)	-0.605*** (0.190)	-0.590*** (0.178)			-0.436** (0.189)
$\Delta$ In Imports	-0.096*** (0.016)	-0.077*** (0.016)	-0.080*** (0.016)	-0.096*** (0.016)	-0.075*** (0.016)	-0.097*** (0.016)			-0.096*** (0.016)
No. of observations	30,889	30,889	30,889	30,889	30,848	30,889			30,848
R-squared	0.02	0.02	0.02	0.02	0.02	0.02			0.02
Vertical shared other regions = Vertical 100% foreign other regions (p-value)	0.00	0.00	0.00	0.00	0.00	0.00			0.00
Vertical shared own region = Vertical 100% foreign own region (p-value)				0.04	0.03	0.11			0.10
Horizontal shared other regions = Horizontal 100% foreign other regions (p-value)		0.00	0.00	0.00	0.00	0.00			0.00
Horizontal shared own region = Horizontal 100% foreign own region (p-value)				0.10	0.07	0.14			0.12

The dependent variable is the change in the total factor productivity (expressed in natural logarithm) of a Romanian firm  $i$  at time  $t$ , derived from sector-specific production functions estimated using the Levinsohn-Petrin approach. The model is estimated in first differences. All specifications include a constant, year, industry and region fixed effects. Robust standard errors are reported in parentheses. \* denotes significance at the 10% level; \*\* at the 5% level; \*\*\* at the 1% level.

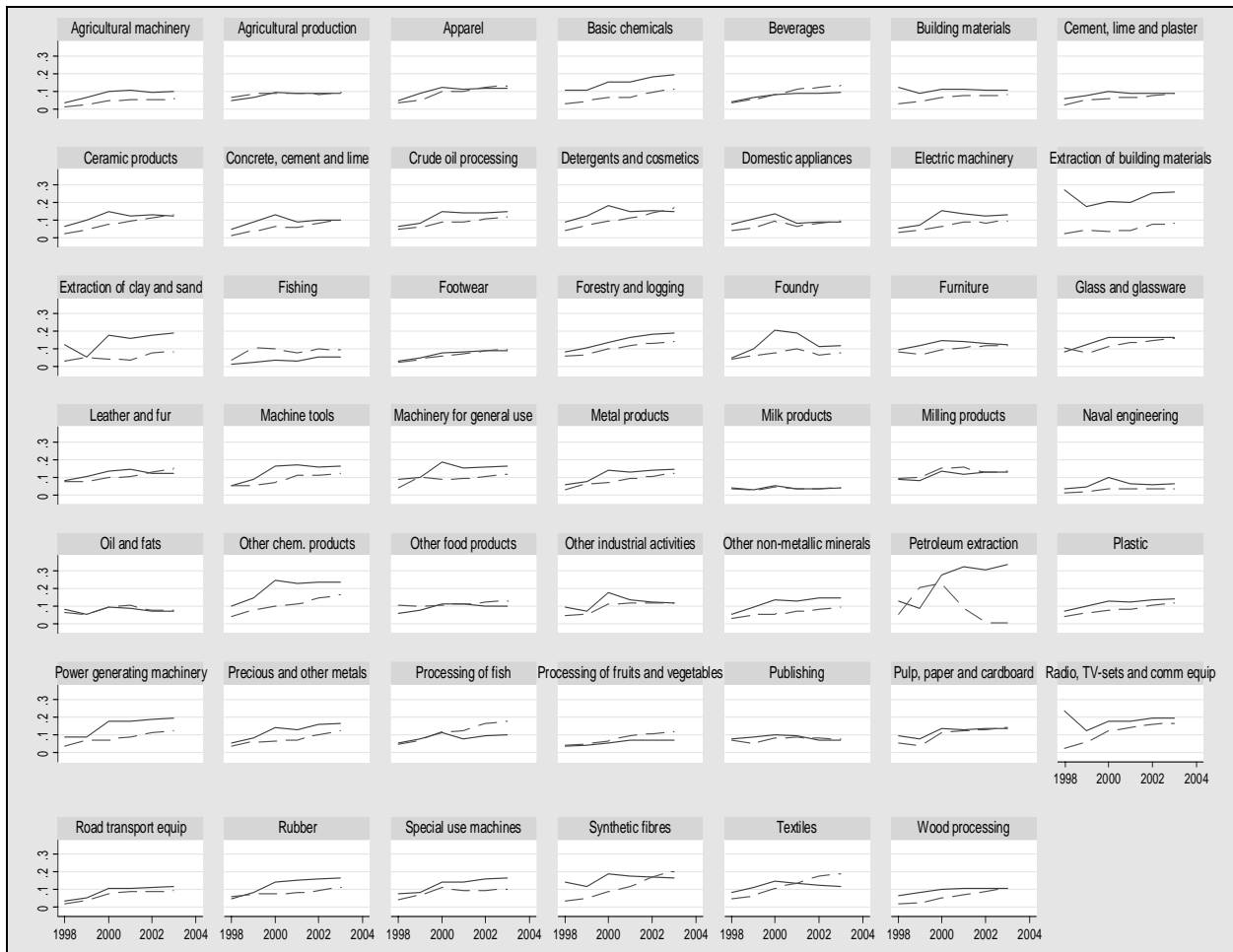
## Appendix I. Evolution of Spillover Proxies

Figure A1. Evolution of Foreign Presence within Sectors. Wholly vs. Partially Foreign Owned Projects.



Note: Horizontal\_shared variable is represented by solid lines and Horizontal\_100%\_foreign by dashed lines.

Figure A2. Evolution of Foreign Presence in Downstream Sectors. Wholly vs. Partially Foreign Owned Projects.



Note: Vertical\_shared variable is represented by solid lines and Vertical\_100%\_foreign by dashed lines.

## Appendix II. Data on Foreign Ownership

The main source of information on foreign ownership shares is the Amadeus database. The database contains information on each company's ownership structure including the names of owners, their respective ownership shares, their countries of origin and the date when the information was updated. Each release of the database lists only the latest available ownership figures. Our effort to construct the ownership shares started with four releases of Amadeus: October 2001, January 2002, January 2005 and March 2005. Upon a closer inspection of the data we realized that the database provider made hardly any updates between the January 2002 and January 2005 release. Thus we decided to rely on three releases, which contained information pertaining mostly to March 2001 (October 2001 release), 2001 and 2002 (January 2005 release) and 2004 (March 2005 release). In 5,520 cases where it was not possible to infer the date of foreign investor's entry based on Amadeus, we obtained additional information from the Romanian Chamber of Commerce and Industry (which is the provider of data for Amadeus).

The construction of the ownership variable was done in three steps. In the first step, the date of the ownership information was assigned to each firm. In minority of cases, where a different date was associated with different owners, we generated the most recent as well as the second most recent ownership year. For firms with both domestic and foreign ownership, it was based only on the dates pertaining to foreign owners. The same procedure was followed for each release of Amadeus except for the 2001 data where we only used the earliest date. In addition, for the 2001 release, whenever the ownership date pertained to the first three months of the year, we considered it as pertaining to the previous year.<sup>29</sup>

In the second step, we generated foreign ownership shares for each company and each release of the database. We used only direct ownership figures. We dropped the small percentage of firms for which the sum of ownership shares was less than 90%. We considered any owner with missing ownership country as Romanian.<sup>30</sup>

In the third step, we used the information from the Romanian Chamber of Commerce and Industry as the base. If such information was not available to us, we defined our foreign ownership variable based on Amadeus starting with the earliest release. In each year, the ownership information was updated with the corresponding new information from Amadeus and carried over to future

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<sup>29</sup> This is reasonable assumption as there is most likely a delay between the actual change and its reporting to the Romanian Chamber of Commerce and Industry (RCCI), the RCCI transmitting the data to Bureau van Dijk (which is done every six months) and Bureau van Dijk incorporating the information into a new release of the Amadeus database.

<sup>30</sup> Nine percent of observations in January 2005 release were missing information on the owner's country. A close inspection of the data by one of the authors who is native speaker of Romanian revealed that in a vast majority of cases ownership with missing country information were actually Romanian owners.

periods if no updates appeared in the database. If the Amadeus releases listed different ownership shares for the same year, the second most recent ownership date was used to assign the ownership information.

If a firm was listed as Romanian in a particular release but was missing ownership information for earlier periods, we assumed that in the earlier period it had been Romanian. In the case of foreign firms, we assumed the same ownership structure in an earlier period only if the available information pertained to no more than three years after the date of incorporation reported in Amadeus.