Does it Take Time to Travel Distance?  
Geography, Entry Timing and Knowledge Spillovers

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Abstract

This paper decomposes traditional country-wide FDI spillovers in different components determined by geographical and entry-timing dimensions. We use a sufficiently long panel (1996-2005) of Romanian manufacturing firms that allows us to investigate whether spillover are limited to the regional level or whether it may simply take more time for spillovers to manifest themselves over longer distances.

JEL classification: F2, D24.  
Keywords: FDI, Spillovers, Dynamics, Timing, Regions, Distance.

1 Introduction

Nowadays, countries actively and fiercely compete to attract foreign direct investment (see Harding and Smarzynska Javorcik (2011)). Policymakers are eager to do so because they expect to benefit in terms of faster economic growth in their country. Foreign direct investment brings additional capital and is expected to create new jobs. Moreover, a foreign firm will also bring more advanced technology to the host country to compete successfully with indigenous firms (Markusen (1995)). The belief that this transferred technology will be adopted by domestic firms is another reason for policymakers to attract foreign investors. These productivity spillovers from foreign to domestic firms have been investigated at least since Caves (1974). The current literature distinguishes between horizontal spillovers to firms in the same industry and vertical spillovers to firms in other industries linked to foreign firms through the supply chain. Notwithstanding thirty years of research, the literature surveys of Görg and Greenaway (2004) and Crespo and Fontoura (2007) on FDI spillovers conclude that there is no clear evidence of aggregate positive FDI spillovers. Following new theoretical...
insights that stress the importance of firm level heterogeneity in the study of firms’ participation in international markets (see e.g. Melitz (2003) and Helpman, Melitz, and Yeaple (2004)), the literature has moved away from the idea that spillovers are unconditional and uniform. The focus has turned to the identification of characteristics that facilitate positive spillovers. These characteristics most often concern domestic firms’ characteristics such as absorptive capability (e.g. Merlevede and Schoors (2007)) or foreign firms’ characteristics such as ownership structure (Smarzynska Javorcik and Spatareanu (85)). Several authors have also investigated whether spillovers may entail a regional dimension. Aitken and Harrison (1999) found no evidence of positive local horizontal spillovers, nor of country-wide spillovers in Venezuela. More recently, Altomonte and Colantone (2008) do find positive horizontal and backward spillovers in the top performing NUTS 2 regions in Romania, but no or negative spillovers in lagging regions. Using physical distance measures rather than administrative borders Halpern and Muraközy (2007) find that for horizontal spillovers distance matters: horizontal spillovers are only positive and significant for domestic firms close to foreign-owned firms.

This paper revisits the issue of local vs. country-wide spillovers and incorporates an important additional element in the analysis: foreign entry-timing. Merlevede, Schoors, and Spatareanu (2011) show that adequately accounting for entry-timing effects reveals important new insights in the case of country-wide spillovers. FDI spillovers are typically treated as additional ‘inputs’ explaining domestic firms’ productivity in a production function estimation where the size and significance of the resulting coefficients are then taken as evidence of FDI spillovers. Spillover variables are typically based on foreign firms’ share in total region or country-wide industry output (or employment). These spillover variables, however, lump together all foreign investment, new and old, in a single variable thus concealing possible effects of foreign entry-timing. Indeed, a newly arriving foreign firm is highly unlikely to have the same impact on domestic firms’ productivity as a foreign firm that has been present in the host country for ten years. Contrary to the current spillover literature that only allows for differences between these firms to the extent that their share in industry output differs, Merlevede, Schoors, and Spatareanu (2011) allow for time variation of the intensity of the spillover effect, i.e. the estimated coefficient.

This paper combines the geographic and entry-timing dimensions in the analysis of regional spillovers. We use a sufficiently long panel (1996-2005) of Romanian manufacturing firms that allows us to investigate whether spillover are really limited to the regional level or whether it may simply take more time for spillovers to manifest themselves over longer distances. We do not only focus on statistical significance, i.e. the existence and direction of different spillover effects, but we also investigate the relative contributions of the different
spillovers to productivity. Our data allow for a detailed regional disaggregation at NUTS 3 level. Furthermore the time-varying input-output tables for the calculation of supply chain spillovers use a Romanian industry code that maps into NACE 3-digit, which is more detailed than the typical NACE 2-digit tables (or comparable) used throughout the literature. We have 41 regions and 59 industries.

2 Literature Review

Horizontal spillovers run from a foreign firm to a host country firm in the same industry. Teece (1977) suggests two main channels for horizontal spillovers: technology imitation (the demonstration effect) and mobility of workers trained by foreign firms (see also Fosfuri, Motta, and Rønde (2001), and Görg and Strobl (2005)). Marin and Bell (2006) find that training activities by foreign subsidiaries are related to stronger horizontal spillovers. Foreign entry may also fuel competition in the domestic market. Fiercer competition urges host country firms to either use existing technologies and resources more efficiently or adopt new technologies and organizational practices, which provides another important channel of horizontal spillovers (see Aitken and Harrison (1999), and Glass and Saggi (2002)). None of these effects is necessarily positive. Labor market dynamics may entail negative spillovers such as a brain drain of local talent to foreign firms to the detriment of local firm productivity (see Blalock and Gertler (2008)) or an overall increase in wages irrespective of productivity improvements caused by foreign firms paying higher wages (see Aitken, Harrison, and Lipsey (1996)). Where foreign technology is easily copied, the foreign investor may choose to avoid leakage costs on state-of-the-art technology by transferring technology that is only marginally superior to technology found in the host country (see Glass and Saggi (1998)). Such policies obviously limit the scope for horizontal spillovers via demonstration effects. The higher productivity of foreign affiliates may also lead to lower prices or less demand for the products of domestic competitors. If domestic firms fail to raise productivity in response to the increased competition, they will be pushed up their average cost curves. Ultimately, domestic producers may not merely fall behind, but fall by the wayside, driven out of business by the shock of foreign entry (see Aitken and Harrison (1999), on this market-stealing effect). These partial effects are hard to disentangle empirically and a general measure for horizontal spillovers will identify the net effect of all these channels.

[Insert Figure 1 near here]

Figure 1 shows how backward spillovers run from the foreign firm to its upstream local suppliers. Thus, even if foreign firms attempt to minimize their technology leakage to direct
competitors (horizontal effect), they may still want to assist their local suppliers in providing inputs of sufficient quality in order to realize the full benefits of their investment. In other words, they want the inputs from the host country to be lower cost yet similar in quality to inputs in the home country. If the foreign firm decides to source locally, it may transfer technology to more than one domestic supplier and encourage upstream technology diffusion to circumvent a hold-up problem. Rodríguez-Clare (1996) shows that the backward linkage effect is more likely to be favorable when the good produced by the foreign firm uses intermediate goods intensively and when the home and host countries are similar in terms of the variety of intermediate goods produced. Under reversed conditions, the backward linkage effect could even damage the host country’s economy. Figure 1 also suggests how a forward spillover goes from the foreign firm to its downstream local buyer of inputs. The availability of better inputs due to foreign investment enhances the productivity of firms that use these inputs. However, there is also a danger that inputs produced locally by foreign firms are more expensive and less adapted to local requirements. In this case there would be a negative forward spillover.

3 A regional dynamic approach to spillovers

The empirical framework to analyse spillover effects can be seen as an 'augmented' production function, where spillover variables are added to other explanatory variables such as labour, capital, and material inputs. The typical measure employed to identify horizontal or within-industry spillovers is given by (1). For a (domestic) firm \( i \) in industry \( j \) at time \( t \) it is of the following form:

\[
HR_{jt} = \frac{\sum F_{it}Y_{it}}{\sum Y_{it}} \tag{1}
\]

where \( Y \) is either output or employment and \( F \) is an indicator of a firm \( i \)'s foreign ownership status. \( F \) could be the exact percentage of shares owned by foreign investors\(^1\) or it could be a dummy variable that takes the value 1 independent of the exact amount of shares owned by foreign investors. In line with the definition commonly applied by e.g. the OECD or the IMF, at least 10% of shares should be owned by a single foreign investor for a firm to be seen as foreign.\(^2\) \( HR_{jt} \) in (1) is the share of output that is produced by foreign firms in industry \( j \). This spillover variable is build up to industry level from firm-level data, implying that \( HR_{jt} \) has the same value for all firms \( i \) in industry \( j \) at time \( t \). This will be

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\(^1\)e.g. if 80% of shares is foreign-owned, \( F \) equals 0.8.

\(^2\)A firm where only 5% of shares are owned by one or more foreigners is considered as a domestic firm.
important for calculating appropriate standard errors on these variables (cf. infra). The definition of the backward spillover variable, $BK_{jt}$, starts from the horizontal measure and combines it with information from input-output tables as in:

$$BK_{jt} = \sum_{k \neq j} \gamma_{jkt} \times HR_{kt}$$  

(2)

where $\gamma_{jkt}$ is the proportion of industry $j$’s output supplied to sourcing industry $k$ at time $t$. The $\gamma$’s are calculated from (time-varying) IO-tables for intermediate consumption. Inputs sold within the firm’s industry are excluded ($k \neq j$) because this is captured by $HR_{jt}$. Since firms cannot easily or quickly switch industries to buy inputs, this approach avoids the problem of endogeneity by using the share of industry output sold to downstream domestic markets $k$ with some level of foreign presence $HR_{kt}$. Employing the share of firm output sold to foreign firms in different industries would cause endogeneity problems if the latter prefer to buy inputs from more productive domestic firms. In the same spirit, the forward spillover variable $FW_{jt}$ is defined as:

$$FW_{jt} = \sum_{l \neq j} \delta_{jlt} \times HR_{lt}$$  

(3)

where the IO-tables reveal the proportion $\delta_{jlt}$ of industry $j$’s inputs purchased from upstream industries $l$. Inputs purchased within the industry ($l \neq j$) are again excluded, since this is already captured by $HR$. The spillover variables $HR_{jt}$, $BK_{jt}$, and $FW_{jt}$ are then regressed on the productivity of (domestic) firm $i$ in industry $j$. The size, sign, and significance of the resulting coefficients are then taken as evidence on spillovers.

### 3.1 The geographic dimension of spillovers

The typical measure to capture within-industry spillover effects $HR_{jt}$ in (1) is thus the share of output that is produced by foreign firms in industry $j$. For a given firm $i$ in industry $j$ in region $r$ at time $t$ we can now break down (1) into different geographical subcomponents as follows:

$$HR_{jt} = \frac{\sum F_{it}Y_{it}}{\sum Y_{it}}$$  

(4)

$$= \frac{\sum R_{it}F_{it}Y_{it}}{\sum Y_{it}} + \frac{\sum NB_{it}F_{it}Y_{it}}{\sum Y_{it}} + \frac{\sum (1 - R_{it} - NB_{it})F_{it}Y_{it}}{\sum Y_{it}}$$  

(5)

where $R_{it}$ indicates whether firm $i$ is located in region $r$, and $NB_{it}$ indicates whether firm
i is located in a contiguous region of r. Finally, \((1 - R_{it} - NB_{it})\) will equal 1 if firm \(i\) is located in a further-away non-neighbouring region, i.e. a rest-of-country spillover. Clearly, (5) could be further decomposed in a straightforward manner to account for second- or even higher-order neighbours. Introducing \(HR_{jt}\) as a single variable in a regression thus involves the implicit assumption that the spillover intensity - as measured by the coefficient obtained on \(HR_{jt}\), say \(\alpha\) - is the same within and across regions. In our empirical test we relax this assumption and allow the coefficients to differ between the different subcomponents in (5), i.e. obtain estimates \(\alpha_R\), \(\alpha_{NB}\), and \(\alpha_{RoC}\).

How does this link to the existing research into regional spillovers? By introducing all three subcomponents of (5) in a regression analysis we differ from at least part of the literature on regional FDI spillovers that does not allow for cross-regional spillovers. Only the first term of the decomposition is included among the regressors, implicitly assuming that spillovers are confined to region boundaries and do not cross borders. This runs counter to Halpern and Muraközy (2007) who find that horizontal spillovers vary with distance, but do not disappear. It also runs counter to macro-spillover studies as e.g. Keller (2002) who finds that spillovers between countries are declining with distance.

There is a further difference with the regional spillover literature. To see this more clearly, rewrite (5) as follows:

\[
HR_{jt} = \frac{\sum R_{it} F_{it} Y_{it}}{\sum R_{it} Y_{it}} \times \frac{\sum R_{it} Y_{it}}{\sum Y_{it}} \\
+ \frac{\sum NB_{it} F_{it} Y_{it}}{\sum NB_{it} Y_{it}} \times \frac{\sum NB_{it} Y_{it}}{\sum Y_{it}} \\
+ \frac{\sum (1 - R_{it} - NB_{it}) F_{it} Y_{it}}{\sum (1 - R_{it} - NB_{it}) Y_{it}} \times \frac{\sum (1 - R_{it} - NB_{it}) Y_{it}}{\sum Y_{it}}
\]  

(6)

Studies that investigate regional spillovers typically define their regional spillover variable as the first part of the first term. This spillover variable is constructed as output produced by foreign firms in industry \(j\) in region \(r\) as a share of total regional industry \(j\) output, rather than as a share of country-wide industry \(j\) output.

\[
\frac{\sum R_{it} F_{it} Y_{it}}{\sum R_{it} Y_{it}}
\]  

(7)

The definition of an appropriate measure relates to one’s idea about spillover potential (this is what the variables are intended to capture). Consider two regions A and B. In region A 10 out of the total of 100 units are produced by foreign firms, while in region B 10,000 out of the total 100,000 units are produced by foreigners. If one believes that the spillover
potential is the same in both regions, (7) is appropriate. On the other hand if one believes that there is an absolute scale aspect to spillovers, the first term of (5) is a more appropriate choice. In the former case, spillovers should be thought of as limited to the region level since it is difficult to carry this definition through to the cross-region level. Suppose regions A and B are neighbours. Following the logic of relative within territorial unit presence, the spillover from neighbours could be measured as:

$$\frac{\sum NB_{it}F_{it}Y_{it}}{\sum NB_{it}Y_{it}}$$  \hspace{1cm} (8)

Definition (8) results in a value of 0.10 for both region A and B. However, it is quite counterintuitive that the spillover potential from region A to B would equal the spillover potential from B to A. This is not the case when one uses the second subcomponent in (5). In our example, this yields a spillover potential from A to B of $\frac{10}{100,100}$ and a spillover potential from B to A of $\frac{10,000}{100,100}$. These values seem to be in line with the cross-region spillover potential one would expect. Note that the subcomponents in (5) will also show a relatively high correlation with simple count measures of foreign investment.

Regional definitions for $BK$ and $FW$ follow from (2) and (3) above. Since we only have input-output tables at the country-level, we will have to assume that the technical coefficients are similar across regions and equal those derived from the country-level input output table.

### 3.2 Spillovers and the timing of foreign entry

Abstracting for the moment from the hidden geographical dimension in $HR_{jt}$ discussed in the previous subsection, (1) hides another important dimension that deserves a closer inspection. To see things more clearly, consider a different breakdown of (1):

$$HR_{jt} = \frac{\sum \tilde{F}_{it}^1Y_{it}}{\sum Y_{it}} + \frac{\sum \tilde{F}_{it}^2Y_{it}}{\sum Y_{jt}} + \ldots + \frac{\sum \tilde{F}_{it}^nY_{it}}{\sum Y_{it}}$$ \hspace{1cm} (9)

where $\tilde{F}_{it}^x$ is a variable indicating foreign ownership status and entry timing. $\tilde{F}_{it}^x$ equals the percentage of shares owned by foreign investors in firm $i$ if at least 10% of shares were owned by a single foreign investor in year $t - x + 1$ and firm $i$ was not foreign owned in year $t - x$, i.e. the investment took place between $t - x + 1$ and $t - x$. So $\tilde{F}_{it}^x$ is set to the percentage of shares owned by foreign investors if

$$\left(\sum_{v=0}^{x-1} F_{i,t-v} = x\right) \land \left(\sum_{w=x}^{\infty} F_{i,t-w} = 0\right)$$

$HR_{jt}$ is thus broken down into $HR_{jt}^1$, $HR_{jt}^2$, ..., along the lines of foreign entry timing.
(note the difference with pure calendar time or taking lags of $HR_{jt}$). Time varying definitions for $BK_{jt}^x$, and $FW_{jt}^x$ follow from (2) and (3) above:

$$BK_{jt}^x = \sum_{k \neq j} \gamma_{jkt} \ast HR_{kt}^x \tag{10}$$

$$FW_{jt}^x = \sum_{l \neq j} \delta_{jlt} \ast HR_{lt}^x \tag{11}$$

Various transmission channels discussed above imply an impact of foreign entry timing. The mobility of workers trained by foreign firms, nor technology imitation are likely to materialize in the very short run. Likewise, vertical spillovers driven by access to better inputs produced by foreign firms or by supplying inputs to multinational companies are not necessarily instantaneous nor permanent. There is also further circumstantial evidence on the importance of entry timing. For a long panel (1982-95) of firms in the Irish electronics sector Görg and Ruane (2001) find indications that foreign firms start off with a relatively low extent of local linkages, but as they get accustomed, they proceed to develop more local input linkages. Giroud (2007) finds that local suppliers benefit significantly less from foreign presence in Vietnam than in Malaysia that opened up its economy to foreign entry much earlier. Ivarsson and Alvstam (2005) conclude that technology transfer to suppliers seems more efficient in older MNE plants based on their Volvo case study. Within multinationals technology is also not necessarily easily or rapidly transferred (see Urata and Kawai (2000)). This may give rise to specific time patterns in the transfer of technology to foreign affiliates and the ensuing spillovers. Merlevede, Schoors, and Spatareanu (2011) allow for an entry-timing pattern of spillover effects, i.e. every term in (9) has its own coefficient $\alpha_{F(x)}$. They find that newly arriving foreign entrants generate spillover effects that are very different from those generated by more mature foreign firms that have been present in the domestic economy for a longer period.

Table 1 summarizes our regional dynamic approach to spillovers. The decomposition along foreign entry timing is highly relevant for the study of the regional aspects of spillovers. It is not unlikely that the timing pattern for within-region spillovers is different from the timing pattern for cross-region spillovers. It may take more time for domestic firms to absorb spillovers from foreign firms in further-away regions. A failure to find cross-region spillovers on the basis of aggregate variables as in (5) could simply be due to the fact that entry timing has been neglected, rather than that these spillovers are truly absent. Further note that some papers limit the scope of spillovers to the boundaries of the region by the construction of the spillover variable without accounting for possible cross-region effects (e.g. Nicolini and...
4 Empirical approach

As indicated above, FDI spillovers are commonly analyzed in a production function framework. Firm level total factor productivity is obtained in a first step estimation and in a second step the FDI spillover variables together with some further controls are treated as additional ‘input’ explaining domestic firms’ productivity. The careful estimation of the production function is thus an important building block in the analysis. The basic problem in estimating productivity is that firms react to firm-specific productivity shocks that are not observed by the researcher. Griliches and Mairesse (1995) provide a detailed account of this problem and make the case that inputs should be treated as endogenous variables since they are chosen on the basis of the firm’s unobservable assessment of its productivity. OLS estimates of production functions therefore yield biased estimates of factor shares and biased estimates of productivity. The semi-parametric approaches by Olley and Pakes (1996) (OP) and a more recent modification of it by Levinsohn and Petrin (2003) (LP), and the dynamic panel data approach by Blundell and Bond (1998) (DPD) are alternative methodologies to overcome the endogeneity bias in estimating production functions. Both types of methodologies have been widely used in the recent literature on firm level heterogeneity for derivation of total factor productivity measures. More recently, Ackerberg, Caves, and Frazer (2008) (ACF) argue that, while there are some solid and intuitive identification ideas in the paper by Levinsohn and Petrin (2003), their semi-parametric techniques suffer from collinearity problems casting doubt on the methodology. They suggest an alternative methodology that make use of the ideas in these papers, but do not suffer from these collinearity problems. We will use ACF TFP as our base case, but we check the robustness of our results with respect to other TFP-measures.

We estimate domestic industry production functions separately for each NACE 2-digit manufacturing industry $j$ in the period 1996–2005, excluding firms that are foreign at some point in time from the estimation. Capital, labor, and material inputs elasticities are thus treated as industry-specific. A measure of total factor productivity $tfp_{ijt}$ for firm $i$ in industry $j$ at time $t$ is obtained as the difference between output and capital, labor, and material inputs, multiplied by their estimated coefficients:

$$tfp_{ijt} = Y_{ijt} - \hat{\beta}_l l_{ijt} - \hat{\beta}_k k_{ijt} - \hat{\beta}_m m_{ijt}$$

(12)
In the second step, we relate $t\hat{f}p_{ijt}$ to a firm specific effect, a vector of spillover variables, $\text{FDI}_{jt}$, and firm and industry level controls. Note that (13) now pools firms from all industries together in one large panel, whereas (12) is estimated by industry. This specification follows the standard in the literature (e.g. Smarzynska Javorcik (2004)).

$$t\hat{f}p_{ijt} = \alpha_i + \Psi_1 f(\text{FDI}_{jt-1}) + \Psi_2 Z_{i(j)t} + \xi_{ijt} \quad (13)$$

The vector of spillover variables ($\text{FDI}_{jt-1}$) covers different horizontal and vertical spillover variables described above. More specifically, $HR, BK, \text{ and FW}$ are decomposed in function of geography and foreign entry timing (for clarity industry and time subscripts are dropped). We consider three different regional dimensions: within-region spillovers, $HR\_reg^x$, first-order neighbours, $HR\_nb^x$ and the regions that make up the rest-of-country, $HR\_roc^x$. Considering the time span of our dataset (1996-2005, cf. infra) we opt to include $HR\_X^1$ to $HR\_X^{4}$ and create a variable $HR\_X^{5+}$ which aggregates all foreign firms that have been present for at least four full years on the domestic market, hence the summation from 1 to 5+ in (14). Since we do not have information on foreign entry time prior to 1996, the time span of the dataset for the estimations reduces to 2001-2005 because of missing values.

$$\Psi_1 f(\text{FDI}_{jt-1}) = \sum_{x=1}^{5+} (\alpha_{reg}^x HR\_reg^x + \alpha_{nb}^x HR\_nb^x + \alpha_{roc}^x HR\_roc^x)$$

$$+ \sum_{x=1}^{5+} (\alpha_{reg}^x BK\_reg^x + \alpha_{nb}^x BK\_nb^x + \alpha_{roc}^x BK\_roc^x)$$

$$+ \sum_{x=1}^{5+} (\alpha_{reg}^x FW\_reg^x + \alpha_{nb}^x FW\_nb^x + \alpha_{roc}^x FW\_roc^x)$$

$Z_{i(j)t}$ is a vector of control variables. Specifically we control for competition within the industry, measured by the Herfindahl index, import competition in the industry, the share of intermediates supplied in total industry output, and firm age. Further we use the region-industry share of national industry activity and the region’s share of national manufacturing activity to control for region and region-industry agglomeration effects.

Specification (13) is first-differenced and then estimated by OLS, including industry ($\alpha_j$), region ($\alpha_r$), and time dummies ($\alpha_t$). Because $\text{FDI}_{jt}$ and some control variables are defined at the industry level, and estimations are performed at the firm level, standard errors need to be adjusted (Moulton (1990)). Standard errors are therefore clustered for all observations in the same region, industry and year (Smarzynska Javorcik (2004)). This results in (15) as final specification to be estimated:
\[ \Delta f p_{ijrt} = \Psi_1 \Delta f (FDI_{jt-1}) + \Psi_2 \Delta Z_{i(j)t} + \alpha_t + \alpha_j + \alpha_r + \epsilon_{ijrt} \]  

(15)

5 Data

We use firm-level data for a panel of Romanian manufacturing firms during 1996–2005. Because most foreign investment entered Romania after 1996, Romania makes a very good candidate to study the dynamic impact of recent foreign investment on domestic firm productivity. Our firm-level data are taken from the Bureau van Dijk Electronic Publishing (sues) database by Bureau Van Dijk. Amadeus is a pan-European database of financial information on public and private companies. Every month Bureau Van Dijk issues a new DVD with updated information. A single issue of the DVD contains only the latest information on ownership and firms that go out of business are dropped from the database fairly rapidly. Furthermore, because Bureau Van Dijk updates individual ownership links between legal entities rather than the full ownership structure of a given firm, the ownership information on a specific DVD-issue often consists of a number of ownership links with different dates, referring to the last verification of a specific link. To construct our dataset with entry, exit, and time-specific foreign entry in local Romanian firms, we therefore employed a series of different issues of the database. However, since ownership information is gathered at irregular intervals, we do not have ownership information for all firm-owner-year combinations. Given these specificities of Amadeus, we first created a dataset at the firm-owner-year-level with the available information from Amadeus. We then filled out missing firm-owner-year-entries under restriction that the full ownership structure cannot exceed 100%. In case of time gaps between entries for the same owner-firm combination but with a different share-size we assume that changes show up immediately in the database. We then fill out the gaps with the older information.

Data are deflated using industry price level data at Nace rev.1.1 2-digit level. These are taken from the Industrial Database for Eastern Europe from the Vienna Institute for International Economic Studies (2008) and from the Romanian National Statistical Office.

\[ \begin{array}{c|cc}
\text{Amadeus} & \text{immediate} \\
\hline
2000 & 40 & 40 \\
2001 & 40 & 40 \\
2002 & 50 & 50 \\
\end{array} \]

Identifying the same owner in different issues is not always straightforward since an ID is only listed in case the owner is a firm that is listed in Amadeus itself. For all other owners matching is done on the basis of the name. Differences in spacings, plurals, addition to the name of a company-type, the use of characters specific to Romanian versus standard Roman characters in different issues are corrected for.

4 e.g.

5 *Nomenclature générale des activités économiques dans les Communautés européennes.*
Real output $Y$ is measured as operating revenues deflated by producer price indices of the appropriate NACE industry; real material inputs $M$, are deflated by a weighted intermediate input deflator where the industry-specific weighting scheme is drawn from the IO tables. Labor $L$ is expressed as the number of employees. Real capital $K$ is measured as fixed assets, deflated by the average of the deflators for the following five NACE industries: machinery and equipment (29); office machinery and computing (30); electrical machinery and apparatus (31); motor vehicles, trailers, and semi-trailers (34); and other transport equipment (35) (see Smarzynska Javorcik (2004)). IO tables for the period 1996–2005 were obtained from the RNSO. The tables are in national industry classification, but the RNSO provided a mapping into NACE rev. 1.1. The RNSO tables are fairly detailed and identify 59 manufacturing sectors. This provides us with richer detail in vertical relationships than the more common IO-tables at NACE 2-digit that only have 22 manufacturing sectors.

We restrict the dataset to firms with on average 5 employees over the sample period. The dataset is further trimmed for outliers by removing the top and bottom percentiles of the annual growth rates of real operating revenues, real capital, labour, and real material inputs. Table 2 lists the annual number of firms, and the entry and exit rate of all firms and for the subsample of foreign firms. The share of foreign firms in the total number of sample firms steadily increased from 17% to 24% (10% to 15% if small firms are not excluded). The 2003 exit rate is high, but this pattern is confirmed by the pattern in the Romanian Trade Register (Trade Register data also include agriculture and services though).

Table 3 lists summary statistics for both domestic and foreign firms. The stylized facts commonly found in the literature are confirmed in our dataset. Foreign firms are larger in terms of employment and capital, produce more output and are more productive. The latter holds across different estimation techniques. The productivity bonus of foreign over domestic firms ranges between 13% in case of the fixed effects methodology (FE) and 4% in case of the Levinsohn-Petrin methodology (LP), with a fairly high correlation between the TFP-measures resulting from different estimation techniques. For our empirical results we will mainly rely on the TFP measure obtained by the methodology proposed by Ackerberg, Caves, and Frazer (2008).

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6If the ‘outlier’ is the first or last observation for a specific firm and other data points are normal, the other firm-year data are kept. If not all observations for this firm are dropped from the dataset.
As a unit of geographical observation we focus on the NUTS 3 level. From the Amadeus database we know in which NUTS 3 region a firm is located. The NUTS (Nomenclature of territorial units for statistics) classification is a hierarchical system for dividing up the economic territory of the EU. NUTS 3 regions are defined as ‘small regions for specific diagnoses’ (population between 150,000 and 800,000). At this level Romania is divided in 42 territorial units, i.e. 41 counties and the capital Bucharest. Our data, however, do not allow us to discriminate between Bucharest and the surrounding county Ilfov. Therefore we have 41 territorial units in our analysis. As a control we will also collapse the data to the NUTS 2 level that divides Romania in 8 regions. The use of region or location in the remainder of the paper always refers to the NUTS 3 classification, unless explicitly mentioned otherwise. To avoid problems with multi-plant firms we focus on unconsolidated data.

6 Results

This section presents results of different sets of estimations. For the sake of clarity and in order to keep the tables manageable we do not report control variables. If not mentioned otherwise results include age, industry competition, competition from imports in the industry, the share of intermediates supplied in total industry output, and time, industry and region dummies. We consider horizontal, backward and forward spillovers. Forward spillovers turn out to be unimportant and are not presented. We think of them as additional control variables.

6.1 Basic specifications

Table 4 and table 5 show our basic results. We observe that in the case of horizontal spillovers, these are negative in the first couple of years after entry, but become positive later on. The intensity of these spillovers does not vary significantly in terms of where the FDI is located, with very similar spillover magnitude countrywide or in the host/neighbouring regions. The results suggest that firms experience an initial negative shock from foreign firms’ entry, either due to competition effects or labour cherry picking from domestic firms. However, in time, the entry of foreign firms does promote an increase in productivity of local firms.

[Insert Table 4 near here]

The backward spillovers offer more interesting results. For this type of spillovers distance seems to be very important, with firms located in the same regions as the foreign direct
investment benefiting substantially more than the other companies. However, even if further away, a general country-wide effect is present, albeit less strong. The timing pattern in the host region seems to run opposite to what we would expect, with very strong initial impact which slowly decreases over time. Country-wide this pattern is less evident with spillovers manifesting themselves a year after entry and slightly decreasing after that. Over the medium-run however these spillovers are non-significant.

[Insert Table 5 near here]

6.2 Regional heterogeneity

Aside from our basic results, we look further at how regional heterogeneity might influence the intensity of our spillovers. We investigate whether spillovers are stronger in regions with above average productivity compared to less productive regions. Horizontal spillovers are similar in both types of regions.

[Insert Tables 6 and 7 near here]

The backward spillovers provide more interesting results, with above productivity regions benefiting much more from the regional presence of foreign firms. This confirms the basic results that being close plays an extra role in the productivity gains of domestic companies.

[Insert Tables 8 and 9 near here]

6.3 Robustness analyses

In this section we perform some robustness checks in order to ensure that our results are stable and are not being driven by factors which have not been taken into account in the analysis. Firstly we consider the problem of endogeneity of firm location, as this could bias our coefficients. Secondly, and closely related to the previous point, we consider the distribution of FDI across Romanian regions and its impact on our previous findings.

6.3.1 Endogeneity of location

One could argue that foreign firms locate in the regions where they expect a larger share of productive firms to be located, and thus regions where (vertical) spillovers would be more likely. To make sure that location is not determined by such factors, we first look at where foreign firms locate within the country, as depicted in figure 2. We observe that the majority
of foreign companies locate either near the Western border with Hungary (border effect), or in the capital, thus making location non-random.

[Insert Figure 2 near here]

On the other hand, figure 3 plots the aggregated regional productivities of domestic firms in years 2000 and 2005\(^7\). The two graphs suggest that most of the regions are undergoing significant changes in terms of productivity, potentially due to the transition of Romania from a centrally planned to a market economy. Compared to figure 2 however, the image is less clearcut. Whilst the North-East seemed to be more productive in the first period, the center of the country seems to have progressed better in the second period. Interestingly, the regions with higher foreign presence were among the least productive in 2000 and amongst the most productive in 2005.

[Insert Figure 3 near here]

To further investigate how regional productivity impacts the location of new foreign firms, we run two OLS regressions, both on regional level and on industry-region level. Since we expect the border to have a significant impact on firm location due to the closeness to the Western market, we include as controls a dummy for border, one for the main national road connecting Bucharest with Hungary and the regional rural rate. The results in table 10 indicate that location is indeed heavily influenced by our control variables but can not be explained by the lagged first difference of regional productivity of domestic firms. We therefore conclude that foreign firm location is not influenced by the location of the most productive domestic firms, excluding potential endogeneity threats.

[Insert Table 10 near here]

6.3.2 Impact without important FDI hubs

In line with the fact that the distribution of foreign firms is not uniformly distributed across regions, we perform some further robustness checks by eliminating some important FDI ‘hubs’. This will allow us to check whether the results are primarily driven by these major investment locations or hold more broadly. Figure 4 helps us identify such hubs by plotting the countrywide spillover potential. and we see that two major regions emerge as

\[^7\text{We compute this value by a weighted sum of their individual productivities as suggested in Foster, Haltiwanger, and Krizan (2001): } P_r = \sum s_{ir} \ast p_i \text{ and where } s_{ir} \text{ is the regional output share of firm } i \text{ in region } r \text{ and } p_i \text{ is its productivity.}\]
winners in attracting foreign direct investment: the capital Bucharest and Timiş - the most west positioned region.

[Insert Figure 4 near here]

Having determined two potential regions that might drive our basic results, we proceed in re-running the analysis by eliminating first Bucharest (B), then Timiş (TM) and then both of these regions at once. Table 11 presents the results for the horizontal spillovers. We observe that eliminating the two regions does not have a significant impact on the interpretation of our results. Just as in the basic specification, while initially some negative effects from foreign FDI arise, at $t - 4 +$ years there are significant positive effects. As before, the regional level at which these are recorded does not seem to matter, with the impact being similar across regional specifications. Removing one of the two regions or both of them does however diminish the positive spillover effect ever so slightly.

[Insert Table 11 near here]

In the case of backward spillovers our results do change as a consequence of removing Bucharest and Timiş regions. First of all the country wide positive spillovers are much more short-lived, lasting for two periods only. However, the most important finding is that the regional effect is eroded by the removal of one of the two hubs, completely disappearing if we exclude both of them. This suggest that the importance of being close-by is driven by these two major FDI regions and potentially hints to the necessity of a critical mass of foreign firms for generating backward spillovers.

[Insert Table 12 near here]

7 Conclusion

This study analyzes horizontal and vertical productivity spillovers of foreign direct investment on domestic Romanian manufacturing companies from 1996 to 2005. We add to the literature by investigating the impact of physical distance and entry timing on spillovers. Since spillover variables are typically based on foreign firms’ share in total industry output, they are often lumped together, new and old, in one variable. Moreover, the literature usually measure spillovers at country level, disregarding the distance between foreign firms and domestic ones. We allow spillovers to vary both over time and distance according to the timing of foreign entry and the Nuts 3 geographic location and find results that are economically intuitive and consistent with theory.
In terms of horizontal spillovers, their impact seems to be homogeneous across regions, with positive and significant effects found mainly in the medium-run. This indicates the fact that it takes time for domestic firms to adjust to foreign competition in the short-run, with productivity improvements being felt provided these withstand the pressures from foreign entrants and are able to absorb the new foreign technology. This finding is replicated for both above and below median productivity regions and is also robust to the removal of the two most FDI intensive regions of Romania.

In terms of backward spillovers, our basic results indicate that these are dominating particularly in the short-run. Moreover, we find that being located in the same region as other foreign firms has a much bigger impact on productivity compared to a general country-wide effect. This suggest that on top of a country-wide impact, the local suppliers will have an additional advantage in terms of spillovers if their location is significantly close to that of foreign companies. This effect is further amplified if the domestic companies are located in regions above median productivity level. Finally, our robustness checks hint towards the fact that backward spillovers are only significant in the presence of a critical mass of foreign firms. Once the two main FDI receivers are removed, these regional spillovers become insignificant. Attracting foreign direct investment is therefore beneficial for the local firm productivity but varies in its impact not only with maturity but also with its geographical distance.
References


Merlevede, B., K. Schoors, and M. Spatareanu (2011). FDI spillovers and the time since foreign entry. Working Papers of Faculty of Economics and Business Administration, Ghent University, Belgium.


Figure 1: Horizontal, backward and forward spillovers through the supply chain

Figure 2: Share of foreign firms
Figure 3: Regional productivity of domestic firms

Figure 4: Spillover potential
Table 1: Spillover dynamics

<table>
<thead>
<tr>
<th>Region/Time of Entry</th>
<th>t</th>
<th>t-1</th>
<th>t-2</th>
<th>t-3</th>
<th>t-4+</th>
</tr>
</thead>
<tbody>
<tr>
<td>same region</td>
<td>$C_{R,t}$</td>
<td>$C_{R,t-1}$</td>
<td>$C_{R,t-2}$</td>
<td>$C_{R,t-3}$</td>
<td>$C_{R,t-4+}$</td>
</tr>
<tr>
<td>neighbour region</td>
<td>$C_{NB1,t}$</td>
<td>$C_{NB1,t-1}$</td>
<td>$C_{NB1,t-2}$</td>
<td>$C_{NB1,t-3}$</td>
<td>$C_{NB1,t-4+}$</td>
</tr>
<tr>
<td>rest of country</td>
<td>$C_{RoC,t}$</td>
<td>$C_{RoC,t-1}$</td>
<td>$C_{RoC,t-2}$</td>
<td>$C_{RoC,t-3}$</td>
<td>$C_{RoC,t-4+}$</td>
</tr>
</tbody>
</table>

Table 2: Number of firms, entry and exit

<table>
<thead>
<tr>
<th>Year</th>
<th>All firms</th>
<th>Foreign Firms</th>
<th>Penetration</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Entrants</td>
<td>Exiters</td>
<td>Number</td>
</tr>
<tr>
<td>1996</td>
<td>14393</td>
<td>2450</td>
<td>0.17</td>
</tr>
<tr>
<td>1997</td>
<td>15618</td>
<td>1057</td>
<td>91</td>
</tr>
<tr>
<td>1998</td>
<td>16768</td>
<td>996</td>
<td>190</td>
</tr>
<tr>
<td>1999</td>
<td>18054</td>
<td>1200</td>
<td>761</td>
</tr>
<tr>
<td>2000</td>
<td>19480</td>
<td>1845</td>
<td>301</td>
</tr>
<tr>
<td>2001</td>
<td>20908</td>
<td>1374</td>
<td>507</td>
</tr>
<tr>
<td>2002</td>
<td>21912</td>
<td>1224</td>
<td>988</td>
</tr>
<tr>
<td>2003</td>
<td>22579</td>
<td>1336</td>
<td>2447</td>
</tr>
<tr>
<td>2004</td>
<td>21525</td>
<td>1066</td>
<td>462</td>
</tr>
<tr>
<td>2005</td>
<td>20963</td>
<td>4945</td>
<td>0.24</td>
</tr>
</tbody>
</table>

Table 3: Summary statistics

<table>
<thead>
<tr>
<th>Variables</th>
<th>all firms</th>
<th>domestic firms</th>
<th>foreign firms</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>St. Dev.</td>
<td>N</td>
</tr>
<tr>
<td>ln(real output)</td>
<td>13.592</td>
<td>2.069</td>
<td>213419</td>
</tr>
<tr>
<td>ln(employment)</td>
<td>12.048</td>
<td>2.400</td>
<td>210662</td>
</tr>
<tr>
<td>ln(capital)</td>
<td>11.788</td>
<td>2.321</td>
<td>165139</td>
</tr>
<tr>
<td>ln(tfp) ACF</td>
<td>5.743</td>
<td>1.516</td>
<td>133154</td>
</tr>
<tr>
<td>ln(tfp) OP</td>
<td>1.973</td>
<td>0.945</td>
<td>182558</td>
</tr>
<tr>
<td>ln(tfp) LP</td>
<td>7.003</td>
<td>1.851</td>
<td>157654</td>
</tr>
<tr>
<td>ln(tfp) FE</td>
<td>1.900</td>
<td>0.994</td>
<td>182665</td>
</tr>
<tr>
<td>ln(tfp) TL</td>
<td>6.118</td>
<td>2.257</td>
<td>182665</td>
</tr>
<tr>
<td>ln(tfp) Index</td>
<td>0.022</td>
<td>1.148</td>
<td>149673</td>
</tr>
</tbody>
</table>
### Table 4: Horizontal Spillovers

<table>
<thead>
<tr>
<th>Region/Time of entry</th>
<th>t</th>
<th>t-1</th>
<th>t-2</th>
<th>t-3</th>
<th>t-4+</th>
</tr>
</thead>
<tbody>
<tr>
<td>same region</td>
<td>-0.573</td>
<td>-2.483***</td>
<td>-1.426***</td>
<td>0.263</td>
<td>1.546***</td>
</tr>
<tr>
<td>neighbouring region</td>
<td>0.888</td>
<td>-1.575***</td>
<td>-2.461***</td>
<td>0.083</td>
<td>1.814***</td>
</tr>
<tr>
<td>rest of country</td>
<td>0.183</td>
<td>-1.089***</td>
<td>-1.427***</td>
<td>0.583***</td>
<td>2.109***</td>
</tr>
</tbody>
</table>

*** p<0.01, ** p<0.05, * p<0.1

### Table 5: Backward Spillovers

<table>
<thead>
<tr>
<th>Region/Time of entry</th>
<th>t</th>
<th>t-1</th>
<th>t-2</th>
<th>t-3</th>
<th>t-4+</th>
</tr>
</thead>
<tbody>
<tr>
<td>same region</td>
<td>18.229***</td>
<td>10.983***</td>
<td>3.342***</td>
<td>3.844***</td>
<td>0.525</td>
</tr>
<tr>
<td>neighbouring region</td>
<td>-0.347</td>
<td>5.202</td>
<td>6.227**</td>
<td>2.785</td>
<td>-1.368</td>
</tr>
<tr>
<td>rest of country</td>
<td>2.712</td>
<td>8.464***</td>
<td>4.223***</td>
<td>4.287***</td>
<td>-0.439</td>
</tr>
</tbody>
</table>

*** p<0.01, ** p<0.05, * p<0.1

### Table 6: HR - Above average productivity

<table>
<thead>
<tr>
<th>Region/Time of entry</th>
<th>t</th>
<th>t-1</th>
<th>t-2</th>
<th>t-3</th>
<th>t-4+</th>
</tr>
</thead>
<tbody>
<tr>
<td>same region</td>
<td>-0.504</td>
<td>-2.266**</td>
<td>-1.316**</td>
<td>0.409</td>
<td>1.713***</td>
</tr>
<tr>
<td>neighbour region</td>
<td>-0.941</td>
<td>-1.662**</td>
<td>-2.506***</td>
<td>0.16</td>
<td>2.136***</td>
</tr>
<tr>
<td>rest of country</td>
<td>0.571</td>
<td>-0.852*</td>
<td>-1.475***</td>
<td>0.767***</td>
<td>2.301***</td>
</tr>
</tbody>
</table>

*** p<0.01, ** p<0.05, * p<0.1
Table 7: HR - Below average productivity

<table>
<thead>
<tr>
<th>Region/Time of entry</th>
<th>$t$</th>
<th>$t-1$</th>
<th>$t-2$</th>
<th>$t-3$</th>
<th>$t-4+$</th>
</tr>
</thead>
<tbody>
<tr>
<td>same region</td>
<td>0.86</td>
<td>-4.242</td>
<td>-10.850***</td>
<td>-4.784</td>
<td>1.652</td>
</tr>
<tr>
<td>neighbour region</td>
<td>1.800***</td>
<td>-3.358***</td>
<td>-3.255***</td>
<td>0.089</td>
<td>1.584***</td>
</tr>
<tr>
<td>rest of country</td>
<td>-0.584</td>
<td>-1.247***</td>
<td>-1.157***</td>
<td>0.404</td>
<td>1.998***</td>
</tr>
</tbody>
</table>

*** $p<0.01$, ** $p<0.05$, * $p<0.1$

Table 8: BK - Above average productivity

<table>
<thead>
<tr>
<th>Region/Time of entry</th>
<th>$t$</th>
<th>$t-1$</th>
<th>$t-2$</th>
<th>$t-3$</th>
<th>$t-4+$</th>
</tr>
</thead>
<tbody>
<tr>
<td>same region</td>
<td>17.618**</td>
<td>11.669***</td>
<td>3.577***</td>
<td>3.808***</td>
<td>0.264</td>
</tr>
<tr>
<td>neighbour region</td>
<td>-3.248</td>
<td>3.813</td>
<td>2.039</td>
<td>1.022</td>
<td>-1.01</td>
</tr>
<tr>
<td>rest of country</td>
<td>2.258</td>
<td>8.711***</td>
<td>3.761***</td>
<td>3.680***</td>
<td>-0.383</td>
</tr>
</tbody>
</table>

*** $p<0.01$, ** $p<0.05$, * $p<0.1$

Table 9: BK - Below average productivity

<table>
<thead>
<tr>
<th>Region/Time of entry</th>
<th>$t$</th>
<th>$t-1$</th>
<th>$t-2$</th>
<th>$t-3$</th>
<th>$t-4+$</th>
</tr>
</thead>
<tbody>
<tr>
<td>same region</td>
<td>49.695</td>
<td>46.056*</td>
<td>13.994</td>
<td>21.948</td>
<td>10.432</td>
</tr>
<tr>
<td>neighbour region</td>
<td>17.84</td>
<td>8.43</td>
<td>19.132***</td>
<td>8.411*</td>
<td>-2.834</td>
</tr>
<tr>
<td>rest of country</td>
<td>4.253</td>
<td>8.071***</td>
<td>4.962***</td>
<td>5.775***</td>
<td>-0.4</td>
</tr>
</tbody>
</table>

*** $p<0.01$, ** $p<0.05$, * $p<0.1$
Table 10: Location of foreign firms

<table>
<thead>
<tr>
<th>Control variables</th>
<th>New foreign firms (region)</th>
<th>New foreign firms (region industry)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regional productivity</td>
<td>0.021 [0.576]</td>
<td>0.006 [0.006]</td>
</tr>
<tr>
<td>DN1 road</td>
<td>11.146*** [2.550]</td>
<td>0.220*** [0.048]</td>
</tr>
<tr>
<td>HU border</td>
<td>10.564*** [2.424]</td>
<td>0.313*** [0.057]</td>
</tr>
<tr>
<td>Rural rate</td>
<td>-52.326*** [11.965]</td>
<td>-1.740*** [0.194]</td>
</tr>
<tr>
<td>Observations</td>
<td>369</td>
<td>6,293</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.356</td>
<td>0.061</td>
</tr>
</tbody>
</table>

The table shows the regression results of local firm productivity change on foreign firm location. Standard errors are reported in brackets. * significant at 10 percent; ** significant at 5 percent; *** significant at 1 percent. The dependent variables are the lag of the first difference in regional/region-industry firm productivity of domestic firms, a dummy indicating whether the main national road is crossing the region, a dummy for bordering regions with Hungary and the regional rural rate.

Table 11: HR - excluding TFP hubs

<table>
<thead>
<tr>
<th>Excluded</th>
<th>Region/Time of entry</th>
<th>t</th>
<th>t-1</th>
<th>t-2</th>
<th>t-3</th>
<th>t-4+</th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
<td>same region</td>
<td>-1.601**</td>
<td>-1.787**</td>
<td>-1.244</td>
<td>-0.467</td>
<td>1.264*</td>
</tr>
<tr>
<td></td>
<td>neighbour region</td>
<td>0.548</td>
<td>-1.678***</td>
<td>-2.760***</td>
<td>0.058</td>
<td>1.498***</td>
</tr>
<tr>
<td></td>
<td>rest of country</td>
<td>-0.514*</td>
<td>-1.321***</td>
<td>-2.015***</td>
<td>-0.495**</td>
<td>1.492***</td>
</tr>
</tbody>
</table>

| TM       | same region          | -2.707** | -3.214** | -1.690 | -0.200 | 1.300 |
|          | neighbour region     | 0.915** | -2.056*** | -3.217*** | 0.340 | 1.830*** |
|          | rest of country      | 0.619* | -2.048*** | -2.100*** | 0.29 | 1.881*** |

| B&TM     | same region          | -1.761*** | -2.227** | -1.094 | -0.033 | 1.293** |
|          | neighbour region     | 0.224 | -2.081*** | -2.853*** | -0.108 | 1.271*** |
|          | rest of country      | -0.658** | -2.514*** | -2.783*** | -0.786*** | 1.111*** |

*** p<0.01, ** p<0.05, * p<0.1
Table 12: BK - excluding TFP hubs

<table>
<thead>
<tr>
<th>Excluded</th>
<th>Region/Time of entry</th>
<th>t</th>
<th>t-1</th>
<th>t-2</th>
<th>t-3</th>
<th>t-4+</th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
<td>same region</td>
<td>19.634</td>
<td>18.895**</td>
<td>10.226*</td>
<td>4.062</td>
<td>0.773</td>
</tr>
<tr>
<td></td>
<td>neighbour region</td>
<td>-11.374**</td>
<td>0.718</td>
<td>7.691***</td>
<td>1.43</td>
<td>-1.088</td>
</tr>
<tr>
<td></td>
<td>rest of country</td>
<td>-3.658**</td>
<td>7.162***</td>
<td>6.976***</td>
<td>1.083</td>
<td>-0.966**</td>
</tr>
<tr>
<td>TM</td>
<td>same region</td>
<td>25.04</td>
<td>30.858**</td>
<td>8.11</td>
<td>8.11</td>
<td>0.06</td>
</tr>
<tr>
<td></td>
<td>neighbour region</td>
<td>4.85</td>
<td>5.75</td>
<td>5.701*</td>
<td>1.63</td>
<td>-2.146*</td>
</tr>
<tr>
<td></td>
<td>rest of country</td>
<td>3.145*</td>
<td>6.042***</td>
<td>3.960***</td>
<td>3.348***</td>
<td>-0.28</td>
</tr>
<tr>
<td>B&amp;TM</td>
<td>same region</td>
<td>15.467</td>
<td>13.243</td>
<td>6.314</td>
<td>3.781</td>
<td>0.939</td>
</tr>
<tr>
<td></td>
<td>neighbour region</td>
<td>-9.840**</td>
<td>-3.179</td>
<td>7.296***</td>
<td>-0.256</td>
<td>-1.253</td>
</tr>
<tr>
<td></td>
<td>rest of country</td>
<td>-5.500***</td>
<td>4.585***</td>
<td>6.239***</td>
<td>0.097</td>
<td>-0.773*</td>
</tr>
</tbody>
</table>

*** p<0.01, ** p<0.05, * p<0.1