Spillovers from FDI:
What are the Transmission Channels?

Henning Mühlen

August 2012

(Preliminary draft: Please do not cite)

Abstract

Foreign direct investment (FDI) projects are assumed to be accompanied by potential external effects – so-called FDI spillovers – on domestic and foreign owned firms in FDI host countries. Much work has been focused on qualifying and quantifying this phenomenon, particularly, within country case studies. Only few studies have addressed the way of how foreign presence affects firms in a certain host country market. The aim of this study is to estimate the spillovers from foreign presence on firms' productivity levels in a panel data analysis which includes ten Latin American countries. The effect is measured as an average for the full set of Latin American countries as well as for each country separately to compare differences between the economies. Furthermore, the paper investigates the transmission channels through which the spillover effects are working. The results indicate that there is a negative spillover once the effect is estimated for the full sample whereas regarding the economies separately a negative spillover is found for only four of the ten countries.

Keywords: FDI, spillovers, cross-country firm-level data, Enterprise Surveys, Latin America, transmission channels

JEL classification: F21, F23, O33

Henning Mühlen

Ruhr-University Bochum
Faculty of Management and Economics
Chair of International Economics
44780 Bochum, Germany
E-mail: henning.muehlen@rub.de

1. Introduction

Foreign direct investment (FDI) is a widespread phenomenon in today's globalized world. Especially for transition and developing economies FDI is not only seen as a source of capital but is also believed to foster economic growth and to make a contribution to the developing process. For the beneficiary firm FDI has a direct effect on the firm's productivity level. Furthermore, FDI is expected to affect the productivity levels of other firms (belonging to the same sector) indirectly through, so-called, spillover effects. As multinational enterprises (MNEs) are supposed to be more productive than domestically-oriented firms, policy makers expect that there will be positive spillover effects from inward FDI on firms in the host country. That is why the governments of many countries make considerable efforts to attract FDI inflows.

Theoretically, productivity spillovers of horizontal FDI are expected to work through four main channels – demonstration, competition, trade, and labor mobility (Görg and Strobl, 2005; Damgaard, 2011). The prediction from these theoretical considerations with respect to the resulting effect from foreign presence in an industry on the firms in the host country is ambiguous. The demonstration effect is believed to have a positive impact and works through the imitation of products and production processes. The competition effect is either positive or negative. Due to a larger number of MNEs in the host country market the competition will increase. In order to compete with the new rivals domestic firms try to produce more productively. On the other hand, if the MNEs are predominant, some firms already serving the host country market might be forced to exit as they cannot compete. For the labor mobility channel there is also a positive and negative impact possible. Positive knowledge spillovers occur if there is worker migration from MNEs to other firms. In this case potential state-of-the-art know-how is transmitted to (domestic) firms of the host country. The other way round, there might also be (highly skilled) worker migration from domestic firms to MNEs because the latter pay higher wages. Finally, the trade channel works through the imitation of export strategies of MNEs which affect domestically oriented firms positively. Furthermore, a crowding out of domestic suppliers due to substitutes from foreign suppliers is also possible as MNEs might purchase their inputs from suppliers resided in other countries.

Regarding vertical FDI, the spillovers arise through forward and backward linkages between foreign and domestic firms. It is debatable whether the term vertical *spillover effects* is correct. Smeets (2008) argues that empirical studies on vertical FDI spillovers actually measure knowledge *transfer* rather than knowledge *spillovers*. Consequently, the effects of

vertical FDI are most likely no externalities or spillovers, respectively. As this study's focus lies on pure spillover effects, vertical measures are not considered in the following analysis.

The empirical literature of the last decade is mainly concentrated on qualifying and quantifying the productivity spillover effects from FDI in host countries; see for example Aitken and Harrison (1999) and Javorcik and Spatareanu (2011). That is, the papers are country case studies and analyze the spillovers by employing firm-level data. Overall, the results are mixed which is also documented in some surveys and meta-analyses on this topic (Görg and Strobl, 2001; Görg and Greenaway, 2004). Moreover, the majority of the empirical studies focuses on analyzing the spillover effects without examining the determinants of those spillovers – the transmission channels. Recent studies like Görg and Strobl (2005) have begun to address this issue.

The aim of this paper is to contribute to the existing literature in two ways. The analysis, first, investigates whether there are significant (positive or negative) spillover effects from foreign presence on firms' productivity levels. To obtain the estimates, a sample of cross-country panel data on the firm-level from ten Latin American economies is applied. This allows comparing estimated spillover effects from different countries which is connected to suggestions stated by Javorcik (2008). Secondly, it is examined through which channels the spillover effects are working.

The remainder of this paper is structured as follows. Section 2 describes the construction of the data sample and shows the distribution of the firms on industries and countries. Part 3 depicts the empirical strategy followed by section 4 which illustrates the empirical results and the interpretation of the findings. Finally, chapter 5 concludes.

2. Sample Construction and Data Description

The data is taken from the Enterprise Surveys provided by the World Bank (World Bank, 2011). It covers ten Latin American countries (Argentina, Bolivia, Chile, Colombia, Ecuador, Guatemala, Panama, Paraguay, Peru, and Uruguay) and provides firm-level information for the years 2006 and 2010.

The sample is constructed from separate panel datasets for each of the aforementioned countries. The original datasets contain firms from manufacturing, retail, and services industries. Matching the firm-level data of those countries is possible as each dataset covers the same relevant and applied information of a firm for the same time periods. The World Bank uses the three standardized questionnaires for all firms in Latin American countries – one for

manufacturing industries, one for the retail sector, and one for the (so-called) "core module" – in order to collect comparable firm-level information. In the analysis a reduced sample of the data is used. Those firms that were interviewed in only one of the two years are dropped in advance as the study's focus lies on a panel analysis. Also, all firms belonging to the retail sector or services industries are excluded from the analysis.[1] Finally, the working sample includes about 1500 firms from different manufacturing sectors.[2]

All monetary values from the original datasets are given in local currency units (LCUs). For standardization, those values are converted into U.S. dollars and afterwards deflated by the GDP deflator (in U.S. dollars with 2006 as the base year).[3]

Table 1 shows how many firms are located in each country and how these firms are distributed over the manufacturing sectors. Argentina is the country with the highest number of firms (375 which is 24 percent of the total sample) in the survey sample. In contrast, the country with the lowest number of firms is Guatemala where 47 firms (about three percent of the total sample) are resided. On average over all countries, the two predominant sectors of the survey sample are the "Food" sector and the "Textiles & Garments" sector. The former corresponds to the International Standard Industrial Classification (ISIC) 15 and the latter to ISIC 17 and 18. More than half of all firms, 896 of 1584, are active in those industries. This holds also for most of the countries except for Chile, Ecuador and Paraguay where the firms are distributed differently. In Chile and Paraguay firms from "Chemicals, Rubber & Plastics" industries are more represented. Furthermore, the sector of "Fabricated Metals & Machinery" (ISIC 28 and 29) plays a major role in Chile as well as in Argentina where in each one quarter of all firms belong to those industries. 85 percent of all firms from ISIC 28 and 29 in the Latin American economies are located in Chile and Argentina. Overall, few establishments are active in industries of "Non-metallic & Basic Metal Products" (ISIC 26 and 27). Finally, "Other Manufacturing" includes firms from "Electronics" (ISIC 31) and firms which could not be exactly matched to an industry category. Listing the distribution of firms across industries is in so far relevant as the productivity measure as well as the measure for foreign presence

[1] This exclusion is due to the fact that quantifying the effect of foreign presence on firms' productivity levels is based on estimating a common – "Solow-style" – production function which holds in particular for firms from manufacturing industries, but is more complicated in use with firms from the retail sector or services industries. Furthermore, the exclusion of retail firms is also reasonable in the present case as there is a large number of missing values in the variables within the first wave of the data collection process regarding those firms.

[2] Please note that the exact number of firms or observations, respectively, differs with respect to the regressions presented in the following parts of the study. This is due to infrequent missing values within some variables.

[3] The definition of the exchange rate and the corresponding values for all countries are stated in the appendix (Table 6).

(which are used later in the analysis) are estimated or calculated, respectively, separately for each industry.

Table 1: Number of Firms and Distribution on Industries by Country

Country	Number of Firms		Firm Distribution on Industries by Country					
			Food	Textiles & Garments	Chemicals; Rubber & Plastics	Non-metallic & Basic Metals	Fabricated Metals & Machinery	Other Manufacturing
Argentina	375		103	99	44	3	92	34
Bolivia	76		30	19	12	6	4	5
Chile	315		65	56	83	15	78	18
Colombia	205		47	100	47	1	3	7
Ecuador	65		21	11	9	0	7	17
Guatemala	47		16	19	6	1	3	2
Panama	55		21	7	3	9	6	9
Paraguay	70		18	7	22	6	4	13
Peru	200		64	74	57	1	1	3
Uruguay	176		67	52	38	0	2	17
Total	*1,584*		*452*	*444*	*321*	*42*	*200*	*125*

Table 2 depicts the presence of foreign ownership within the sample for each of the two years given by the share of firms who are partly or fully foreign owned in each country. With respect to partly foreign owned firms, two groups are considered. Column (1) refers to establishments that have a foreign ownership at all (one percent or more) and column (2) refers to a foreign ownership of at least ten percent. Regarding the total number of firms in all countries, the share of partly and fully owned establishments has not changed from one period to the other and stays at 10.92 percent (column (1)). With respect to columns (2) and (3), the structure of foreign ownership has changed very slightly from 2006 to 2010. The share of firms that were foreign owned by ten percent or more as well as the part that covers only fully foreign owned firms has decreased from 10.54 percent to 10.48 percent and from 6.44 percent to 5.93 percent, respectively. But, overall, the share of foreign ownership has remained very similar form one period to the other.

Looking at the countries separately, the picture is mixed. In the economies of Bolivia, Chile, Ecuador, Guatemala, Panama, and Peru the share of partly foreign owned establishments has increased. In Guatemala and Peru this holds also for the share of fully foreign owned firms whereas in the other countries this share remains at the same level or decreases. In Argentina, Colombia, Paraguay, and Uruguay the share of partly foreign owned establish-

ments decreases. In total, this indicates that there is a small but significant change of the share of foreign owned firms over time.

Table 2: Share of Foreign Owned Firms by Country

Country	(1) Foreign Ownership: 1% or more		(2) Foreign Ownership: 10% or more		(3) Foreign Ownership: 100%	
	2006	**2010**	**2006**	**2010**	**2006**	**2010**
Argentina	12.80	12.00	12.53	12.00	8.53	8.00
Bolivia	13.16	14.47	11.84	13.16	7.89	5.26
Chile	9.21	9.84	9.21	9.52	5.71	5.71
Colombia	4.93	3.41	3.90	2.44	2.44	1.95
Ecuador	10.77	16.92	9.23	13.85	6.15	6.15
Guatemala	10.64	17.02	8.51	17.02	6.38	8.51
Panama	12.73	16.36	12.73	16.36	9.09	5.45
Paraguay	17.14	12.86	17.14	12.86	8.57	8.57
Peru	10.00	11.50	10.00	11.50	3.50	4.50
Uruguay	14.77	10.80	14.20	10.23	9.09	6.82
All countries	*10.92*	*10.92*	*10.54*	*10.48*	*6.44*	*5.93*

3. Economic Model and Methodology

The aim of this paper is to quantify the effect of foreign presence in a host country market on domestic foreign owned firms' productivity levels. Therefore, the analysis is conducted in three steps. First, total factor productivity (TFP) is estimated separately for different industries. Second, it is examined whether there are spillover effects from foreign presence in a sector where a firm is active. Third, the study wants to find out through which channels the spillovers are transmitted.

The starting point of deriving the econometric model that is applied to estimate TFP is a standard Cobb-Douglas production function with constant returns to scale which is based on the seminal work by Solow (1957) and stated in Equation (1)

$$Y_{ijct} = A_{ijct}\, MAT_{ijct}^{\beta_1}\, LAB_{ijct}^{\beta_2}\, CAP_{ijct}^{\beta_3} \tag{1}$$

where the dependent variable *Y* is the output which is defined as total annual sales of a firm *i* that is active in sector *j* and resided in country *c* at time *t*. *MAT*, *LAB* and *CAP* represent

materials, labor, and capital, respectively which are the inputs of a firm used in the production process. The costs of raw materials and intermediate goods reflect the materials measure. Labor is determined by total labor costs and capital is measured by the costs for the establishment to re-purchase all of its machinery, vehicles, equipment, land, and buildings.[4] Finally, *A* is the Hicksian neutral efficiency level of a firm which is defined as TFP as it affects all factors' marginal product at the same time. Taking natural logs of Equation (1) leads to a production function in linear form:

$$\ln Y_{ijct} = \beta_0 + \beta_1 \ln MAT_{ijct} + \beta_2 \ln LAB_{ijct} + \beta_3 \ln CAP_{ijct} + \varepsilon_{ijct} \quad (2)$$

with $\ln A_{ijct} = \beta_0 + \varepsilon_{ijct}$ where β_0 is "the mean efficiency level across firms" (Van Beveren, 2012, p. 100), sectors, countries and over time. The residual term ε_{ijct} represents the firm-specific TFP at time *t* which cannot be observed by the researcher but (at least) partly by the decision makers within the firm. Consequently, firm decisions on factor inputs can be changed due to given efficiency levels. This means that the factor inputs are dependent on TFP or the residual term, respectively, and therefore correlated with each other. This issue of endogeneity is well-known in the literature and common as the so-called simultaneity problem. Ignoring this fact would lead to biased estimates of the input coefficients using the ordinary least squares (OLS) technique when estimating TFP.

To overcome this issue, firstly, the residual term is split up into two components ($\varepsilon_{ijct} = \gamma_{ijct} + u_{ijct}$) where the first part γ_{ijct} can be observed by the firm and, thus, is correlated with the inputs. The second part u_{ijct} is a random term which cannot be observed by the firm and therefore is assumed to be independent as well as identically distributed. Secondly, a further (and stronger) assumption is imposed on the first term γ_{ijct} ,that is, it is a firm-specific but time-invariant characteristic which leads to the following notation γ_i (Van Beveren, 2012). Given these conditions, the fixed-effects (FE) estimator is an appropriate method to obtain unbiased coefficients.[5]

[4] These measures are suggested and also applied by Saliola & Seker (2011) to estimate TFP using a broader sample of countries from the Enterprise Surveys. Furthermore, a detailed definition of output, capital, labor, and materials is given in the appendix, see Table 7.

[5] There are further common and perhaps more sophisticated methods which are used to overcome the simultaneity problem like the semi-parametric estimation algorithms suggested by Olley & Pakes (1996) and Levinsohn & Petrin (2003). Unfortunately, both strategies do not fit with the data of this study. In short, the reasons are as follows. The Olley-Pakes method makes use a firm's investments which are strictly required to be positive for all firms and this does not hold for over 30 percent of the observations in this sample. The Levinsohn-Petrin strategy applies lags of relevant variables. Hence, we cannot apply this method with our panel data which covers only

As cross-country panel data is applied for the analysis the econometric model has to be adjusted by adding a country-specific effect (θ_c) and a year dummy (δ_t) to account for different conditions in the economies and for period shocks, respectively. Finally, the econometric model is given by

$$\ln Y_{ijct} = \beta_0 + \beta_1 \ln MAT_{ijct} + \beta_2 \ln LAB_{ijct} + \beta_3 \ln CAP_{ijct} + \gamma_i + \theta_c + \delta_t + u_{ijct} \qquad (3)$$

Now, TFP is obtained through estimating the coefficients of Equation (3) by applying the FE technique and afterwards predicting the two component residual $\gamma_i + u_{ijct}$. To account for industry heterogeneity, Equation (3) is estimated for each sector separately.[6]

The estimated coefficients of the production function, the first-stage TFP estimation results, are provided in Table 3.

Table 3 First-Stage TFP Estimation

	(1) Food	(2) Textiles & Garments	(3) Chemicals, Rubber & Plastics	(4) Non-metallic & Basic Metals	(5) Fabricated Metals & Machinery	(6) Other Manufacturing
lnMAT	0.211***	0.194***	0.221***	0.246	0.158***	0.415***
	(2.993)	(5.572)	(3.781)	(0.917)	(3.208)	(3.440)
lnLAB	0.284***	0.299***	0.228***	0.658**	0.093	0.245
	(3.799)	(5.452)	(2.950)	(2.301)	(1.203)	(1.425)
lnCAP	0.015	0.037**	-0.009	0.208	0.060	-0.020
	(0.669)	(2.508)	(-0.408)	(1.256)	(1.386)	(-0.456)
Constant	7.660***	7.044***	8.640***	0.061	10.02***	5.796***
	(6.917)	(10.94)	(7.292)	(0.024)	(10.14)	(3.153)
Number of firms	342	379	273	26	161	91
Observations	511	580	397	39	242	118
Within R^2	0.384	0.475	0.329	0.801	0.466	0.520
F	14.89	26.10	6.751	27.49	10.25	8.862

Notes: FE estimation. Dependent variable is the natural log of sales. *t*-values obtained from robust standard errors in parentheses. All regressions include year dummies.
*significant at 10% level; **significant at 5% level; ***significant at 1%level

Columns (1) to (6) show the estimates for the different industry groups. Overall, the results are mixed, but adequate, and comparable to findings of other studies, for example Görg

two time periods. However, Van Beveren (2012) argues that it turned out that the estimates of different estimation techniques are very similar.

[6] Estimating TFP for each industry or industry groups separately is reasonable as the estimated coefficients of factor inputs differ significantly across sectors. Therefore, this is a common strategy in the literature (see for instance Görg & Strobl, 2005).

& Strobl (2005) or Waldkirch & Ofoso (2010). The coefficient of materials is significant throughout except for column (4). Regarding the estimates for the industries of "Non-metallic & Basic metal Products" in column (4), only the labor coefficient is significant. This is likely to be explained by the small number of observations. Obviously, the estimates for capital are unreasonable low and insignificant except for column (2) where it is significant at the 5% level. When applying the FE estimators on Cobb-Douglas production functions, these findings of the capital coefficients are observed very often (Van Beveren, 2012).

Having the predicted values of TFP ready, the econometric model of productivity is formulated in EQUATION where the logarithm of TFP is dependent on the following variables

$$lnTFP_{ijct} = \beta_0 + \beta_1 lnSL_{ijct} + \beta_2 FDI_{ijct} + \beta_3 FDIsec_{jct} + \beta_4 (FDI_{ijct} * FDIsec)_{ijct} + \gamma_i + \mu_j + \theta_c + \delta_t + u_{ijct} \quad (4)$$

SL_{ijct} is a control variable and represents skilled labor measured by non-production workers. *FDI* represents a firm's private foreign ownership share at time *t*, ranging from 0 percent (no foreign ownership) to 100 percent (fully foreign owned). Consequently, β_2 measures the intra firm effect of foreign ownership on productivity. The main variable of interest is given by *FDIsec* which is the measure for foreign presence in sector *j* in country *c* where firm *i* is active. Calculating the foreign ownership share on the sector-level, this study follows a common strategy applied by Aitken & Harrison (1999) or Javorcik (2004), for example, where *FDIsec* is computed as a weighted average of foreign ownership over all firms in a sector *j*. Particularly, it is weighted by a firm's size measured through total employment (EMP_{ijct}).

$$FDIsec_{jct} = \frac{\sum_i (FDI_{ijct} \cdot EMP_{ijct})}{\sum_i EMP_{ijct}} \quad (5)$$

As this study applies cross-country panel data, the *FDIsec* measure is calculated separately for each country *c* and year *t*. Consequently, the coefficient β_3 can be interpreted as follows. If foreign presence in sector *j* in country *c* increases by one percentage point TFP increases or decreases by β_3 percent. The impact of *FDIsec* could be positive or negative as both directions are possible. It depends on which effect is predominant given the potential

theoretical considerations stated in the beginning. Finally, the interaction term measures the difference between the foreign presence effect on domestic and foreign owned firms.

4. Discussion of the Results

This part of the study presents and discusses the regression results. At first, the baseline estimations are stated where the foreign presence spillover is estimated as an average effect across the Latin American countries. Secondly, the FDI spillover effect is estimated for each country separately, that is, the analysis considers differences with respect to the spillovers between the economies.

Baseline Estimation

Table 4 presents the baseline results which cover the effects of foreign presence in an industry on firm-level productivity. The estimated effect is an average over all countries. The first two columns depict the findings from the econometric model given by Euation (4) where the difference between both columns is that in column (1) the interaction term of *FDI* and *FDIsec* is excluded. The overall fit of the model is adequate regarding the F-value of roughly five and the R-squared. The control variable *SL* is highly significant on the 1% level and positive as expected.

The measure of foreign ownership of a firm (*FDI*) is negative but insignificant. Whereas, the measure for spillovers from foreign presence in an industry (*FDIsec*) is negative and significant on the 10% level and once including the interaction term negative significant on the 5% level. The quantity of the coefficients is nearly similar in both specifications and indicates that an increase of foreign presence in an industry of a country by one percentage point leads on average to a decrease of a firm's productivity by about 0.004 percent. The coefficient of the interaction term is positive but insignificant and suggests that there is no difference of the spillover effect between domestic and foreign owned firms.

In columns (3) and (4) the spillover effect is measured by a slightly adjusted measure of *FDIsec*. As in various sectors in some countries of the sample only a few firms (with foreign ownership) are active one could argue that the measure of foreign presence in an industry is likely to be driven and dominated by one firm. Consequently, the spillover effect on that particular firm is measured deficient. The measure *FDIsec* calculated through Equation (5) has to be adjusted in that way that the foreign ownership of firm k to which the measure is matched has to be subtracted from the sum in an industry. The adjusted measure is given by the following expression

$$FDIind_{kjct} = \frac{\sum_i (FDI_{ijct} \cdot EMP_{ijct} - FDI_{kjct} \cdot EMP_{kjct})}{\sum_i (EMP_{ijct} - EMP_{kjct})} \quad (6)$$

The findings of column (3) and (4) support those from the first two columns, namely, that there is a small, significant negative spillover effect from foreign presence in an industry. It is not only that the significance is very similar also the magnitude of the estimates is hardly different.

Table 4: Spillovers of Foreign Presence on TFP across Countries

	(1) lnTFP	(2) lnTFP	(3) lnTFP	(4) lnTFP	(5) lnTFP	(6) lnTFP
lnSL	0.153***	0.152***	0.155***	0.153***	0.154***	0.154***
	(4.040)	(4.048)	(4.084)	(4.102)	(4.117)	(4.105)
FDI	-0.0011	-0.0029	-0.0013	-0.0033	-0.0012	-0.0022
	(-0.559)	(-0.999)	(-0.701)	(-1.240)	(-0.636)	(-0.741)
FDIsec	-0.0039*	-0.0045**				
	(-1.901)	(-2.130)				
FDIxFDIsec		0.0001				
		(0.970)				
FDIind			-0.0036**	-0.0043**		
			(-2.078)	(-2.393)		
FDIxFDIind				0.0001		
				(1.273)		
FDIregion					0.0044	0.0040
					(1.011)	(0.933)
FDIxFDIregion						0.0001
						(0.657)
Constant	-0.299***	-0.287***	-0.305***	-0.290***	-0.434***	-0.430***
	(-3.045)	(-2.927)	(-3.205)	(-3.065)	(-3.582)	(-3.530)
Number of firms	1,262	1,262	1,262	1,262	1,262	1,262
Observations	1,872	1,872	1,872	1,872	1,872	1,872
Within R^2	0.038	0.041	0.038	0.044	0.035	0.036
Overall R^2	0.460	0.455	0.463	0.452	0.503	0.504
F	5.266	4.415	5.359	4.659	4.324	3.514

Notes: FE estimation. Dependent variable is the natural log of total factor productivity. *t*-values obtained from robust standard errors in parentheses. All regressions include year dummies.
*significant at 10% level; **significant at 5% level; ***significant at 1% level

Finally, the specifications of column (5) and (6) include a different measure in order to estimate a spillover effect from foreign presence on productivity. The applied measure refers to foreign presence in a region of country *c* and is calculated very closely to Equation (5). It is

calculated as a weighted average of foreign ownership over all firms in a region *r* in country *c*. This measure is also applied by Bwalya (2006). The interpretation of this measure goes more in the direction that spillover effects occur because of proximity to foreign owned firms in whatever industry they are active. The outcome is interesting as the coefficients of *FDIregion* are positive contrary to the first findings. However, the estimates are statistically insignificant.

Country-Specific Analysis

After quantifying the effect of foreign presence on TFP as an average over all ten Latin American countries, the spillovers are estimated separately for each country to analyze whether there are differences between the economies, that is, whether the (negative) effect from Table 4 is valid for each economy. Therefore Equation (4) is estimated for each country applying the FE technique. The corresponding results are shown in Table 5 which is structured in three parts with respect to the three different measures for foreign presence. The columns refer to the countries.

Regarding the first two parts, the results are referred to the measures of foreign presence in an industry. All in all, the findings look very similar. The negative effect from foreign presence in a sector on productivity is only found for four economies, namely, Ecuador, Guatemala, Paraguay, and Peru. The coefficient ranges from -0.0121 for Ecuador to -0.0447 for Peru and is in every case larger than the effect from column (1) which is the average effect estimated across all countries. With respect to Guatemala the interaction term is also significant but positive and with a smaller magnitude as *FDIsec* which indicates that foreign owned firms are less affected by foreign presence in an industry. In all other countries the coefficient of foreign presence in a sector is insignificant, that is, firms are not affected. The results from the adjusted measure *FDIind* support the findings of the negative effect in the four countries, although, the coefficient for Guatemala is only almost significant on the 10% level.

The third part of Table 5 regards foreign presence in a region measured by *FDIregion*. The results are somehow different compared to those from the other two measures. In the subsamples for Argentina as well as Paraguay there seem to be positive spillover effects on productivity. Due to proximity to foreign owned establishments domestic and other foreign owned firms benefit with respect to their productivity levels. For all other countries the coefficient is mostly positive but far from being significant. To sum up, the findings for different countries in Latin America are mixed and vary with respect to the measure used to quantify the effect.

Table 5: Country-Specific Spillovers of Foreign Presence on TFP

	(1) All Countries	(2) Argentina	(3) Bolivia	(4) Chile	(5) Colombia	(6) Ecuador	(7) Guatemala	(8) Panama	(9) Paraguay	(10) Peru	(11) Uruguay
Foreign presence measure: FDIsec											
FDI	-0.0029	0.0003	-0.0248	0.0021	0.0022*	0.0035	-0.0280***		-0.0013	-0.0012	0.0782**
	(-0.999)	(0.0636)	(-0.142)	(0.970)	(1.841)	(0.848)	(-22.68)		(-0.220)	(-0.116)	(2.149)
FDIsec	-0.0045**	-0.0029	-0.0068	0.0050	0.0043	-0.0121*	-0.0151*	0.0191	-0.0189**	-0.0447**	0.0037
	(-2.130)	(-0.604)	(-0.529)	(1.175)	(0.975)	(-1.973)	(-2.020)	(0.347)	(-2.197)	(-2.186)	(0.202)
FDIxFDIsec	0.00007	0.00001	-0.00004	-0.00027**	-0.00015***	0.00001	0.00065***	0.00003	-0.00001	0.00004	-0.00260**
	(0.970)	(0.0422)	(-0.00496)	(-2.564)	(-2.635)	(0.0932)	(4.762)	(0.604)	(-0.0195)	(0.135)	(-2.057)
Within R^2	0.041	0.074	0.583	0.105	0.075	0.337	0.758	0.283	0.582	0.150	0.055
F	4.415	2.466	.	2.072	3.413	3.959	12778	.	16.57	3.064	16.05
Foreign presence measure: FDIind											
FDI	-0.0033	0.0017	-0.0271***	0.0011	0.0020	0.0017	-0.0265***		-0.0054***	-0.0149	0.0569**
	(-1.240)	(0.423)	(-4.463)	(0.552)	(1.541)	(0.511)	(-22.72)		(-6.580)	(-1.055)	(2.257)
FDIind	-0.0043**	-0.0028	-0.0066	0.0042	0.0041	-0.0092*	-0.0075	0.0135	-0.0170*	-0.0412*	0.0082
	(-2.393)	(-0.592)	(-0.581)	(1.051)	(0.965)	(-1.791)	(-1.529)	(0.270)	(-1.787)	(-1.947)	(0.455)
FDIxFDIind	0.00009	-0.00006	0.00028	-0.00025**	-0.00015**	0.00003	0.00043***	0.00004	0.00050	0.00043	-0.00228**
	(1.273)	(-0.390)	(0.0692)	(-2.461)	(-2.493)	(0.418)	(4.293)	(0.852)	(1.070)	(1.003)	(-2.195)
Within R^2	0.044	0.075	0.584	0.102	0.074	0.318	0.715	0.279	0.604	0.132	0.057
F	4.659	2.521	.	1.948	3.129	3.794	.	.	15279	2.289	10.88
Foreign presence measure: FDIregion											
FDI	-0.0022	0.0056	-0.173	-0.0100*	0.0176***	0.0058	-0.0223*		0.0102	0.0058	0.0091
	(-0.741)	(0.921)	(-0.316)	(-1.708)	(4.189)	(1.479)	(-1.800)		(0.580)	(0.999)	(0.747)
FDIregion	0.0040	0.0208**	-0.213	0.0068	-0.0047	0.0100	0.0083	0.0201	0.0273*	0.0325	-0.0149
	(0.933)	(2.017)	(-1.417)	(0.787)	(-0.104)	(0.734)	(0.679)	(0.747)	(1.751)	(0.750)	(-0.567)
FDIxFDIregion	0.00006	-0.00013	0.0110	0.00051	-0.00649***	-0.00019	0.00013	0.00011	-0.00062	-0.00022	-0.00027
	(0.657)	(-0.801)	(0.272)	(1.135)	(-3.820)	(-1.061)	(0.342)	(0.577)	(-0.594)	(-0.959)	(-0.578)
Within R^2	0.036	0.100	0.595	0.062	0.071	0.264	0.551	0.284	0.560	0.088	0.044
F	3.514	3.339	.	1.462	27.37	3.027	.	.	6.195	1.590	.
Number of firms	1,262	296	46	286	182	57	38	30	47	167	113
Observations	1,872	438	57	457	280	94	57	39	65	236	149

Notes: FE estimation. Dependent variable is the natural log of total factor productivity. *t*-values obtained from robust standard errors in parentheses. All regressions include year dummies. The coefficients of the constant term and the control variable *SL* are not reported in the table.
*significant at 10% level; **significant at 5% level; ***significant at 1%level

5. Concluding Remarks

Theoretical considerations suggest both positive and negative potential spillover effects transmitted through mainly four channels. This study employs firm-level data from ten Latin American developing countries in order to estimate the spillover effects from foreign presence on productivity. More precisely, the impact is analyzed once as an average effect for all included economies and once for each country separately.

The results indicate that on average over all economies there is a weak negative spillover effect from foreign presence in an industry on firms' productivity levels. In the country-specific investigation, the negative is only found for four of the ten countries. For the other six economies there seems to be no significant impact from foreign presence on the sector level. This negative effect is also found in a recent country case study by Waldkirch and Ofosu (2010) for Ghana. Given the estimated results of the present study, one of the contributions of this work is that the cross-country data allows for a comparable analysis of different (developing) economies.

In a further step, the study employs a different measure that assesses the influence of foreign presence in a region of a country on in order to account for proximity to foreign owned firms. The findings are different compared to the measure on the sector level, that is, for the full sample of firms covering all countries there is no impact investigated. But, with respect to the country-specific estimations, a positive effect of foreign presence in a region on productivity for Argentina and Peru can be shown.

With respect to the transmission channels it is still unclear which channel dominates. For the negative effect of foreign presence in an industry on productivity the competition effect is most likely whereas a definite proposition for the included countries is not possible. Looking at Paraguay, the results show a positive effect for proximity to foreign firms in a country which is most likely to be transmitted through the mobility of workers. On the other hand, there is a negative effect from foreign presence in an industry assessed for Paraguay transmitted most likely through the competition channel. Consequently, it is ambiguous on through which channels the effects are transmitted.

References

Aitken, B. J. & Harrison A. E. (1999): "Do Domestic Firms Benefit from Direct Foreign Investment? Evidence from Venezuela" *American Economic Review*, 89 (3), 605-618.

Bwalya, S. M. (2006): "Foreign Direct Investment and Technology Spillovers: Evidence from Panel Data Analysis of Manufacturing Firms in Zambia" *Journal of Development Economics*, 81 (2), 514-526.

Damgaard, J. (2011): "Productivity Spillovers from FDI: Ownership Structures, Domestic Firm Characteristics, and FDI Characteristics" *Danmarks Nationalbank Working Papers*, No. 72.

Görg, H. & Greenaway (2004): "Much Ado about Nothing? Do Domestic Firms Really Benefit From Foreign Direct Investment?" *World Bank Research Observer*, 19 (2), 171-197.

Görg, H. & Strobl, E. (2001): "Multinational Companies and Productivity Spillovers: A Meta-Analysis" *Economic Journal*, 111 (475), 723-739.

Görg, H. & Strobl, E. (2005): "Spillovers from Foreign Firms through Worker Mobility: An Empirical Investigation" *Scandinavian Journal of Economics*, 107 (4), 693-709.

Javorcik, B. S. (2004): "Does Foreign Direct Investment Increase the Productivity of Domestic Firms? In Search of Spillovers through Backward Linkages" *American Economic Review*, 94 (3), 605-627.

Javorcik, B. S. (2008): "Can Survey Evidence Shed Light on Spillovers from Foreign Direct Investment" *World Bank Research Observer*, 23 (2), 139-159.

Javorcik, B. S. & Spatareanu, M. (2011): "Does It Matter Where You Come from? Vertical Spillovers from Foreign Direct Investment and the Origin of Investors" *Journal of Development Economics*, 96, 126-138.

Levinsohn, J. & Petrin, A. (2003): "Estimating Production Functions Using Inputs to Control for Unobservables" *Review of Economic Studies*, 70 (2), 317-342.

Olley, S. & Pakes, A. (1996): "The Dynamics of Productivity in the Telecommunications Equipment Industry" *Econometrica*, 64, 1263-1297.

Saliola, F. & Seker, M. (2011): "Total Factor Productivity Across the Developing World" *Enterprise Note Series*, Enterprise Note No. 23, World Bank Group.

Smeets, R. (2008): "Collecting the Pieces of the FDI Knowledge Spillovers Puzzle" *World Bank Research Observer*, 23 (2), 107-138.

Solow; R. M. (1957): "Technical Change and the Aggregate Production Function" *Review of Economics and Statistics*, 39, 312-320.

Van Beveren, I. (2012): "Total Factor Productivity Estimation: A Practical Review" *Journal of Economic Surveys*, 26 (1), 98-128.

Waldkirch, A. & Ofosu, A. (2010): "Foreign Presence, Spillovers, and Productivity: Evidence from Ghana" *World Development*, 38 (8), 1114-1126.

World Bank (2011): "Enterprise Surveys" (http://www.enterprisesurveys.org).

Appendix:

Table 6: Official Exchange Rate (LCU/USD; Annual Average)

Country	**2006**	**2010**
Argentina	3.05	3.90
Bolivia	8.01	7.02
Chile	530.28	510.25
Colombia	2361.14	1898.57
Ecuador	LCU = USD since 2000	LCU = USD since 2000
Guatemala	7.60	8.06
Panama	1.00	1.00
Paraguay	5635.46	4735.46
Peru	3.27	2.83
Uruguay	24.07	20.06

Note: Definition given by the World Bank: "The official exchange rate refers to the exchange rate determined by national authorities or to the rate determined in the legally sanctioned exchange market. It is calculated as an annual average based on monthly averages (local currency units relative to the U.S. dollar)."

Source: IMF (International Financial Statistics) assessed by the World Bank

Table 7: Definition of Firm-Level Variables

Variable	Description
Y	Output: Total sales in last fiscal year in USD
MAT	Costs of raw materials and intermediate goods used in production in last fiscal year in USD
LAB	Total labor costs (incl. wages, salaries, etc.) in last fiscal year in USD
CAP	Costs for establishment to re-purchase all of its machinery, vehicles, equipment, land, and buildings in USD
FDI	Percent owned by private foreign individuals, companies or organizations
EMP	Total employment: Number of permanent and temporary, full-time employees at the end of the last fiscal year
LP	Labor productivity: Which is calculated as total sales divided by total employment ($LP = Y / EMP$)
SL	Skilled labor: Number of permanent, full-time non-production workers (e.g. managers, administration, sales) at the end of last fiscal year