Where are the Productivity Gains from Foreign Investment?

Evidence on Spillovers and Reallocation from Firms, Industries and Countries*

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Abstract

We identify the net effect of foreign direct investment (FDI) on the host economy by separating positive productivity (TFP) effects of knowledge spillovers from negative effects of competition. We allow for foreigners selecting into productive firms and sectors. Using a new and unique firm/establishment-level data set for a large set of countries during last decade with information on economic activity, ownership stake, type, sector, and country of origin of foreign investors, we show that the positive effect of FDI on the host economy's aggregate productivity is a myth. Foreigners invest in high productivity firms and sectors but do not increase productivity of the acquired firms and enhance productivity of the average domestic firm. For emerging markets, we find that the acquired firms increase their productivity but the effect is too small to generalize to the aggregate economy. A higher level of foreign investment in the same sector of operation leads to strong negative competition effects both in developed and in emerging markets. In developed countries, we find evidence of positive spillovers through knowledge transfers only for domestic firms with very high initial productivity levels operating within the same broad sector as the multinational investor but in a different sub-sector. Our results not only confirm the predictions of the new trade and FDI literature but also show the importance of double heterogeneity in productivity and foreign investment for the effect of FDI on economic growth.

JEL: E32, F15, F36, O16.

Keywords: Multinationals, FDI, Knowledge Spillovers, Selection, Productivity.

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1 Introduction

A key feature of globalization of the past two decades is the increasing role of foreign direct investment (FDI) in total capital flows in both developed countries and emerging markets. Policymakers around the world have welcomed this development and encouraged it given the perceived benefits of FDI such as technology transfer, knowledge spillovers and better management practices. Several macro-level studies confirm these predictions by documenting a positive correlation between aggregate growth and aggregate FDI flows (see Kose, Prasad, Rogoff, and Wei (2009)). Researchers argue that this positive correlation between FDI and growth is a result of knowledge spillovers from multinationals and their foreign-owned affiliates to domestic firms in the host country.[1] Unfortunately, there is no direct *causal* evidence at the firm-level supporting this view for a large set of countries. Available evidence lacks external validity and the existing findings vary to a great extent between developed countries and emerging markets depending on the focus of the particular study.[2]

There is a central identification problem at the heart of this literature stemming from selection and simultaneity. The new trade theory stresses the fact that firms *select* themselves into becoming exporters and multinationals (see Melitz (2003), Helpman, Melitz, and Yeaple (2004)). Multinationals that engage in FDI are likely to be more productive and likely to buy local firms with relatively high productivity. If foreign affiliates do not become more productive upon receiving foreign investment then there is no reason to expect that multinationals pass on the productivity enhancing knowledge to domestic firms. On the contrary, foreign-owned companies might drive weak domestic firms out of business, leading to the erroneous result that domestic firms in the foreign activity sector are becoming more productive. Hence any finding of a positive relation between foreign ownership and domestic productivity can be an artifact of a) foreigners investing in productive firms in productive sectors and b) exit of low productivity domestic firms in such productive sectors. Under these circumstances, establishing a causal effect of FDI on productivity (directly on foreign owned firms and indirectly via spillovers on domestic firms) is difficult. To

[1] In general, the positive correlation found between FDI and economic growth is conditional on some threshold level of human capital and financial development in the country; see Alfaro, Chandra, Kalemli-Ozcan, and Sayek (2004), Borensztein, De Gregorio, and Lee (1998) and Villegas-Sanchez (2010).

[2] See survey by Barba-Navaretti and Venables (2004).

identify such an effect, firm and sector specific selection effects, and exit of weak domestic firms must be accounted for.

The second difficulty in the quest for identification arises from the *simultaneity* problem. Allowing for the selection effects described above, foreign affiliates might become more productive over time after receiving the foreign investment and they might spill this effect over to the domestic firms. They might also steal domestic firms' business leading to market share reallocations. Both of these dynamic effects might be driven simultaneously with the increased presence of foreigners due to other firm specific and time varying factors. To account for this problem, we need to decompose the productivity effects into knowledge spillovers and competition, while at the same time using exogenous variation for the changes in firm-level foreign investment over time.

We employ a new and unique data set and a novel empirical approach both of which will allow us to undertake such an exercise. Our data comes from AMADEUS and ORBIS databases (compiled by Bureau van Dijk Electronic Publishing, BvD), covering 60 countries worldwide, developed and emerging.[3] The data set has financial accounting information from detailed harmonized balance-sheet representations on target companies, their investors, and non-acquired companies. It also provides the amount of foreign investment together with the type and country of origin of the investor. The dataset is crucially different from the other data sets that are commonly-used in the literature such as COMPUSTAT for the United States, COMPUSTAT GLOBAL, and WORLDSCOPE databases in that 99 percent of the data in ORBIS covers private companies, whereas the former popular data sets are mainly for large listed companies.[4] A fundamental advantage of this dataset is the detailed ownership information provided. For example, if a company in Germany receives investment from a foreign entity, we know if the foreign entity is a U.S. bank or a Belgian company operating in the same or different sector (up to four digit classification) than the target German company and we also know the exact amount of investment; i.e., the percentage of voting shares held. We have this information for most private companies of all sizes and for the universe of listed companies.

[3]AMADEUS is a European sub-set of ORBIS; the U.S. data is identical to data from Dun&Bradstreet (D&B). We are in the process of adding data for the U.S. together with Japan, Korea, and Canada. Our main analysis will use 30 countries given the problematic firm coverage in the other available countries as detailed in Appendix Table A-1 (except U.S., Canada, Japan, and Korea).

[4]For listed companies, disclosure rules vary from country to country but for most of our countries, we know the identity of the owner if the stakes owned exceed 3-5 percent.

Our methodology is based on identifying patterns in *changes* in firm-level foreign investment and productivity over time. We first ask whether foreign-owned firms are more productive and become more productive over time with increased foreign ownership? Our quest for causality implies that we need to control both firm level and sector level selection; i.e., we have to condition on multinationals targeting growing industries in certain countries as well as high productivity firms through the use of firm, sector-time, and country-time fixed effects. Second, we ask whether domestic firms that operate in the same or in a different sector then the foreign affiliates become more productive with increased foreign presence in such sectors? This requires us to decompose productivity effects into knowledge spillovers and competition. The latter can be studied both at the extensive and intensive margins. On the extensive margin, we account for survival bias. On the intensive margin, we explore the productivity effects of multinationals and their affiliates on continuing domestic firms. For both questions, in order to identify pure causal effects, firm-specific time-series variation must be exogenous since this is the main variation used for identification. Our instrumentation strategy relies on interacting initial predicted foreign ownership shares with the growth of country and sector specific FDI. Since firm, country, and sector specific factors and time trends and shocks for sectors and countries are accounted for, exclusion and validity of the instrument is justified.

Our data and methodology has several advantages. The first advantage of our data set is its dynamic nature with direct micro FDI observations. Although a dummy for foreign ownership that changes over time can be used in a firm fixed effect estimation, it will only be informative about the extensive margin and will be silent on the intensive margin. This is important given the results of the new trade literature emphasizing firm heterogeneity (see Helpman (2006)). The productivity effects (both direct and via spillovers) of foreign investment might vary if the presence of foreigners amount to owning companies in excess of 50 percent or less than this amount. Due to data availability, the literature most often uses a dummy variable to separate foreign and domestic companies (see, for example, Harrison, Love, and McMillan (2004), De Haas and Van Lelyveld (2006) and Bloom, Sadun, and Van Reenen (2009)), where the dummy indicates that the firm is owned by an "overseas" company in the amount of more than a certain percent. Other papers use 100 percent owned foreign subsidiaries of multinationals (See Desai, Foley, and Forbes (2007) and Alfaro and Chen (2012), for an example). Neither case will give the full picture regarding direct

and spillover effects of FDI.[5]

Figure 1 below demonstrates the importance of heterogeneity in the data in terms of productivity and foreign ownership. This figure plots the two-digit sectoral average of the logarithm of TFP (computed using the Wooldridge (2009)-Levinsohn and Petrin (2003) procedure) against the sectoral average of firm-level foreign ownership. Clearly, firms in sectors such as manufacturing of chemical products or pharmaceuticals are more productive then firms that manufacture wood products. The high productivity sectors are also composed of firms that typically are more than 50 percent owned by foreigners while foreign ownership typically is less than 50 percent in the wood producing sector. It will be elusive to try to identify the effect of foreign investment on productivity without any regards for this type of heterogeneity. We argue that this correlation is a result of two facts: more productive firms becoming multinationals and multinationals investing into more productive domestic firms acquiring a controlling stake.

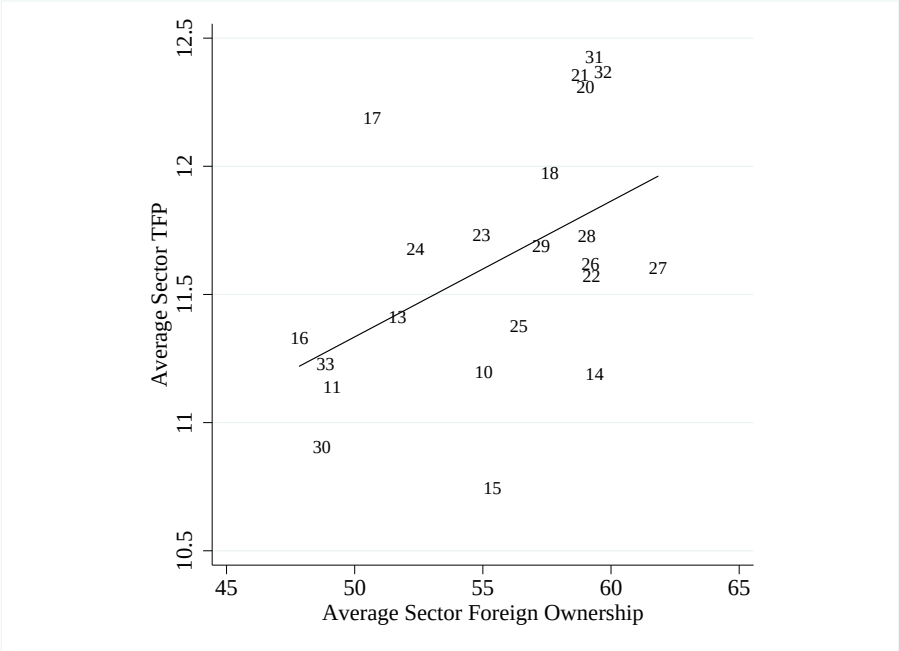


Figure 1: Foreign Investment and Productivity

Notes: The figure plots, for 2-digit industries, average firm productivity against average direct foreign ownership stake (in percent). Figure is build over firms which had a foreign owner in at least one year over the sample period. See Table A-2 for industry classification and Section 4 for the details on construction of variables.

[5]Exceptions are Javorcik (2004), Aitken and Harrison (1999), and Arnold and Javorcik (2009), where the former two aggregates the firm-level ownership shares into sectoral foreign presence to investigate spillovers to domestic firms and the latter investigates the direct effect of ownership shares on acquired firms using propensity-score techniques.

Our second advantage is the detailed sector classification of our dataset in a multi-country setup. The existing literature is based on a two-digit sector classification of firms while we can exploit a much finer classification at the four-digit sector. Our cross-country standardized data facilitates the possibility of controlling for global sectoral effects over time. The spillover literature, whether using dummies or direct observations of firm-level FDI, aggregates firm-level observations to proxy sectoral level FDI and then test for potential productivity spillovers to domestic firms in the same sector or vertically-linked sectors. As a result, this literature cannot separate sector-time trends from sector-time multinational presence. Our global data set enables us to do exactly that. A final distinct advantage of our data is the ability to separate, for the first time, both the amount and the type of FDI as we can separate between Industrial FDI and Financial FDI, where the former investors are industrial firms while the latter investors are banks and financial institutions.[6]

Our preliminary results show that foreign owned firms/multinational affiliates are more productive both in developed and emerging countries; however, as shown by our instrumental variables exercise, this effect in developed countries is solely driven by future fundamentals (growth potential); i.e., growing firms becoming foreign-owned. In emerging markets the positive effect survives the IV analysis but quantitatively too small to have any meaningful effects in the aggregate. We find evidence of positive spillovers from foreign activity to domestic firms only when we look at a finer sectoral classification where the domestic firms are not direct competitors of the foreign firms and where domestic firms are at the top of the productivity distribution. For the other domestic firms that are direct competitors there are strong negative competition effects. In the light of our previous finding of foreign owned firms are more productive due to their growth potential and not due to being foreign owned, we interpret this finding as the business creation effect of foreigners for the domestic firms that operate in the same two-digit but different four-digit sector.[7] In emerging

[6] "Industry-FDI," refers to the case where a non-financial company buys another company most likely in the same sector, whereas "Financial-FDI" is undertaken by a hedge fund, mutual fund or a bank. The motives behind these different types of FDI differ. Both might be, of course, driven by return and diversification considerations. "Industry-FDI," if it is horizontal, may be undertaken to avoid trade costs by locating production facilities overseas as argued by Markusen (1984). If it is vertical in nature, then it represents the desire to take advantage of cross-border factor differences as argued by Helpman (1984) and Helpman and Krugman (1985). Most of the literature finds that FDI is mostly horizontal. A recent paper by Alfaro and Charlton (2009) cast doubt on this view showing that vertical FDI has been underestimated due to data limitations of the earlier literature. "Financial-FDI," on the other hand, might refer to a situation where financial companies invest in lower productivity firms at discount prices and reinvent them by reorganization and/or breaking them apart and selling off the pieces.

[7] We fudge with the labeling and call this knowledge spillovers following the literature since we lack a better name for now.

markets, we find evidence of negative productivity spillovers which are driven mainly by market share reallocation effects within sectors rather than pure entry and exit. Foreign-owned firms capture higher market shares in terms of employment even from non-direct competitors preventing knowledge spillovers completely.

The rest of the paper is structured as follows. Section 2 reviews the literature. Section 3 presents a detailed description of our methodology and construction of the instrument. Section 4 reviews the data. Section 5 shows the results and Section 6 concludes.

2 Literature Review

Our paper is related to several strands of the literature. It contributes to the extensive literature on productivity and technology spillovers from multinationals to the domestic economy. Examining plant level data in Venezuela, Aitken and Harrison (1999) find that the net effect of FDI on productivity is quite small in the same sector—FDI raises productivity within plants that receive foreign investment but lowers that of domestically owned plants. Haskel, Pereira, and Slaughter (2007) and Keller and Yeaple (2009), on the other hand, find evidence of such positive horizontal spillovers for the UK and the United States. Javorcik (2004), using panel data for Lithuania, finds evidence for vertical spillovers with productivity of domestic firms being correlated with the presence of multinationals in downstream and upstream sectors (potential suppliers and customers).

Above papers start by showing positive correlations between foreign ownership and productivity of the acquired firms.[8] Hence, it is assumed that once firms are bought out they become more productive and turn into a potential source of spillovers. As it is clear from Table 1 below, the use of firm fixed effects are fundamental to the robustness of such a conclusion. The table posits correlations between labor productivity, value added (output minus materials) per worker and foreign activity for all firms, and for manufacturing firms only. Many recent trade and FDI models are inspired by this positive correlation, interpreting this loosely as the positive impact of multinationals on productivity.[9] After inclusion of firm fixed effects, in the case of labor productivity, the positive

[8] An exception is Arnold and Javorcik (2009) who account for the the fact that multinationals buy the most productive firms via propensity score matching techniques.

[9] See Helpman, Melitz, and Yeaple (2004) for a similar regression of labor productivity using data on U.S. multinationals only.

coefficient becomes minuscule (columns (1)-(4)) and, in the case of value added, the positive effect completely disappears (columns (5)-(8)) highlighting the importance of firm-level selection. This result holds for all firm sample and for manufacturing firms only sample. In fact, in column (6), the foreign ownership has a negative effect on firm level productivity when we use all firm sample, implying foreign owned firms increase their usage of intermediate inputs over time with increased ownership shares more than domestic firms in certain sectors, if not in manufacturing. Inclusion of firm-fixed effects means that the identification relies on changes over time. Hence it is not the case that presence of multinationals is causing an increase in productivity of the acquired firms but rather multinationals themselves are more productive and invest into productive firms.

Table 1: Foreign Activity, Labor Productivity and Value Added

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dependent Variable: Productivity								
Firms:	All	All	Manuf.	Manuf.	All	All	Manuf.	Manuf.
LHS:	Y/L	Y/L	Y/L	Y/L	VA/L	VA/L	VA/L	VA/L
Foreign Ownership	0.518***	0.027***	0.622***	0.037***	0.552***	-0.018***	0.494***	0.002
	(0.008)	(0.005)	(0.012)	(0.008)	(0.007)	(0.005)	(0.011)	(0.008)
Firm fixed	no	yes	no	yes	no	yes	no	yes
Sector fixed	yes	yes	yes	yes	yes	yes	yes	yes
Country-Year fixed	yes	yes	yes	yes	yes	yes	yes	yes
Observations	4,288,260	4,288,260	1,104,777	1,104,777	3,091,452	3,091,452	872,039	872,039

Note: Y refers to operating revenue, L is the number of employees, VA is value-added computed as the difference between operating revenue and cost of materials.

In terms of decomposing productivity spillover and competition effects while accounting for selection effects, the literature did not make much progress—at least empirically. (Alfaro and Chen (2012) constructs a structural model aimed at such decomposition.) In general, the literature investigates the effects of resource allocations. Hsieh and Klenow (2009), for example, show that allocation of factors across heterogenous firms has a huge impact on cross-country income differences. Aitken, Harrison, and Lipsey (1996) and Feenstra and Hanson (1997) find that wages of skilled workers increase as a result of foreign activity in certain sectors. Our paper in general related to the determinants of total factor productivity literature at the firm-level that uses non-parametric techniques for TFP estimation. Our contribution is to investigate the causal effect of

foreign investment on firm-level total factor productivity by decompiling the effect into knowledge spillovers, competition and selection and quantifying each channel.

3 Methodology

3.1 Firm Productivity and Foreign Ownership

We start the empirical analysis by exploring the relationship between foreign ownership and firm productivity. We estimate the following equation:

$$\ln\left(TFP_{i,s,c,t}\right) = \beta FO_{i,s,c,t} + \alpha_i + \delta_{c,t} + \phi_{s,t} + \epsilon_{i,s,t}\,, \tag{1}$$

where $TFP_{i,s,c,t}$ refers to total factor productivity of firm i, in country c, in sector s, at time t and $FO_{i,s,c,t}$ is the percentage of firm i's capital owned by foreign investors at time t. We also distinguish among industrial and financial foreign ownership and $FO^I_{i,s,c,t}$ represents the share of capital owned by foreign industrial investors and $FO^F_{i,s,c,t}$ represents the share of capital owned by foreign financial investors. α_i represents firm-specific dummies, $\delta_{c,t}$ represents country times year dummies, and and $\phi_{s,t}$ represents sector times year dummies or fixed effects.

The parameter of interest is β. A positive *within* coefficient indicates that on average changes in foreign ownership is associated with changes in productivity, meaning, firms that become foreign owned over time are more productive then firms that stay domestically owned. At this stage we will not be able to make any causality statement and therefore, cannot establish whether after acquisition by foreign-owned companies domestic targets become more productive or whether foreign-owned firms target more productive domestic companies (cherry-picking), see section 3.4 for a discussion on how we address this issue. Firms are quite heterogenous and while most existing literature estimates equations similar to equation (1) by OLS, this is quite inefficient if the variance of the error term differs by firms. We therefore estimate equation (1) by two-step feasible GLS where the first step estimates the equation by OLS, the residuals are calculated, squared and for each firm the squared root of the mean squared predicted residuals is calculated. In the second step the regression is repeated weighting each firm by the inverse of its estimated square root predicted residual.

3.2 Productivity Spillovers

Traditionally the literature on FDI spillovers has estimated an equation of the following type for the sample of domestic firms.[10]

$$\ln(TFP_{i,s,t}) = \beta Spillover_{s,t} + \alpha_i + \delta_t + \epsilon_{i,s,t}\,, \tag{2}$$

where $TFP_{i,s,t}$ refers to total factor productivity of firm i, in sector s, at time t and $Spillover_{s,t}$ is a regressor, to be discussed, which captures the presence of foreign ownership in sector s. α_i represents firm-specific dummies and δ_t represents year dummies. The parameter of interest is β and a positive coefficient indicates positive productivity spillovers from foreign-owned companies to domestic firms. The inclusion of firm-fixed effects are crucial because foreign investors may systematically invest in high productivity firms. When firm-fixed effects are included β captures the correlation between the changes over the sample in the *Spillover* variable and changes in TFP of domestic firms and not cross-sectional patterns. Similarly to equation (1) we estimate equation (2) by two-step feasible GLS.

There are other possible sources of endogeneity. For example, certain sectors may be expected to have high productivity growth (telecommunications due to recent technological advances) and such sectors are likely to attract foreign investment. We can control for such patterns by including sector-year fixed effects. This was not an option in previous studies that estimate equation 2 using variation of the spillover variable at the sector-year level. Many country coverage of our sample allows us to proceed with this estimation strategy. We can still control for certain countries, such as the Baltics, to be in a growth and investment phase by including country-year fixed effects. We estimate the following equation for the sample of domestic firms only:

$$\ln(TFP_{i,s,c,t}) = \beta Spillover_{s,c,t} + \alpha_i + \delta_{c,t} + \phi_{s,t} + \epsilon_{i,s,t}\,, \tag{3}$$

where $TFP_{i,s,c,t}$ refers to total factor productivity of firm i, in sector s, country c, at time t where the terms $\delta_{c,t}$ and $\phi_{s,t}$ represent country-year and sectoral-year fixed effects, respectively.

Studies on FDI spillovers (horizontal and vertical) typically rely on a two-digit industry clas-

[10] Domestic firms are those that were never acquired by foreign-owned investors over the sample period.

sification. Based on recent evidence provided by Alfaro and Charlton (2009) we argue that the two-digit classification is too aggregated to properly identify spillovers and moreover, it may mask important heterogenous effects at a finer level of sectoral aggregation.

First, in the same fashion as most previous literature, we define for each country, a variable intended to capture (horizontal) spillovers in the same industry at a *two-digit* level:

$$Spillover_{s2,t} = \frac{\sum_{i \in s} FO_{i,t} \times Y_{i,t}}{\sum_{i \in s} Y_{i,t}}, \tag{4}$$

where $s2$ refers to the two-digit sector classification and $FO_{i,t}$ indicates the share of foreign ownership of firm i. Second, and new here compared to the existing literature, we define the horizontal spillovers at the *four-digit* classification for each country ("Spillover Competition") are computed as:

$$Spillover\ Competition_{s4,t} = \frac{\sum_{i \in s4} FO_{i,t} \times Y_{i,t}}{\sum_{i \in s4} Y_{i,t}}, \tag{5}$$

where s4 refers to the four-digit sector classification. Finally, we construct "Spillover Knowledge" as:

$$Spillover\ Knowledge_{s4,t} = Spillover_{s2,t} - \frac{\sum_{i \in s4} FO_{i,t} \times Y_{i,t}}{\sum_{i \in s} Y_{i,t}}, \tag{6}$$

where the notation is identical to that of the previous equations, specifically $Spillover_{s2,t}$ is defined as in equation (4). The knowledge spillover variable captures foreign presence in the same two-digit sector but excluding the output produced by foreign-owned companies in the same four-digit sector classification. Hence this variable captures the effect of foreign companies in the same two-digit but in the different four-digit sector than the domestic companies. We expect foreign-owned companies to provide technical assistance and knowledge transfer to domestic suppliers. The vertical spillover literature has usually relied on input-output matrices that provide linkages across two-digit sectors. We do not explore vertical spillovers nor make use of input-output tables. We suggest an alternative new approach to examine if spillovers from supplier-customer relationship may be found in closely-related sectors. In other words, if the foreign-owned company is a car manufacturer (four-digit sector classification 2910) it is possible that suppliers in the same two-digit classification but in different four-digit classification like (2931) "Manufacture of electrical and electronic equipment for

motor vehicles" or (2932) "Manufacture of other parts and accessories for motor vehicles" would establish a business relationship that leads to knowledge transfer.

3.3 Firm Productivity and Market Shares

In order to be able to shed some light on the spillover results and further investigate the possibility of competition effects we explore whether foreign-owned companies have increasing market shares. Increasing market shares of foreign companies do not in themselves imply declining productivity of competitors but if competition effects are important we should be able to observe changing market shares. We estimate the following equation:

$$\ln\left(MS_{i,s,c,t}\right) = \alpha + \beta FO_{i,s,c,t} + \alpha_i + \delta_{c,t} + \phi_{s,t} + \epsilon_{i,s,t}\,, \tag{7}$$

where $MS_{i,s,c,t}$ refers to market share of firm i, in sector s, country c, at time t and $FO_{i,s,c,t}$ is the percentage of firm i's capital owned by foreign investors at time t. the terms $\delta_{c,t}$ and $\phi_{s,t}$ represent country-year and sectoral-year fixed effects, respectively.

3.4 Construction of Instruments

3.4.1 Direct Effect Regressions: TFP and foreign ownership

Consider the structural (causal) relation

$$(Y) \quad Y_{i,t} = \alpha_i + \delta_{c,t} + \phi_{s,t} + \alpha FO_{it} + u_{it}\ ,$$

where FO is foreign ownership, Y is TFP, i is firm, and s and c is the sector and country in which firm i operates, respectively.

Foreign investors may target highly productive firms so there is another direction of causality

$$(F) \quad FO_{i,t} = \gamma_0 + \gamma_1 Y_{it} + v_{it}\ .$$

All the fixed effects in equation (Y) alleviates many endogeneity concerns but IV-estimation may

still be needed for a consistent estimate of α that can be causally interpreted given the unobserved heterogeneity that will come from firm-time changes.

We use instruments with the structure

$$Z_{it} = \widehat{FO}_i W_{cst}\,,$$

where $\widehat{FO}_i$ is a non-time varying measure of predicted foreign ownership of firm i and W_{cst} is a measure correlated with *growth* in foreign ownership that varies by country, sector, and time but not by firm (implicit in the notation is that c and s denotes the country and sector, respectively, in which firm i operates). This instrument needs to be correlated with FO_{it} in equation (Y) ("relevance") and it needs to satisfy the exclusion restriction that it is uncorrelated with the the structural innovation term u_{it}. The relevance condition is intuitive: firms with more predicted foreign ownership increase foreign ownership faster; however, if this condition is not satisfied it will be revealed by insignificant empirical results—the relevance assumption will not lead to bias. We next argue that the exclusion restriction is likely to hold. In the derivations that follow, we ignore the c index and the country $\times$ year fixed effects. These dummies play a role parallel to that of sector $\times$ time, but the treatment is similar and we leave those out as they would complicate notation significantly.

We want the reduced form regression

$$Y_{i,t} = \mu_i + \nu_{st} + \delta Z_{it} + w_{it}$$

to give unbiased estimates of δ. For the purpose of estimating δ, this estimation equation, by the Frisch-Waugh theorem, is equivalent to

$$Y_{i,t} - Y_{i.} - Y_{st} + Y_{s.} = \delta\left[\widehat{FO}_i W_{s,t} - \widehat{FO}_i W_{s.} - \widehat{FO}_s W_{s,t} + \widehat{FO}_s\, W_{s.}\right] + \left(w_{i,t} - w_{i.} - w_{s,t} + w_{s.}\right),$$

where $X_{i.} = \frac{1}{T}\Sigma_{t=1}^{T} X_{it}$, $X_{s,t} = \frac{1}{N_s}\Sigma_{i=1}^{N_s} X_{it}$, where the summation is over all firms i in sector s in year t, $X_{s.} = \frac{1}{N_s}\Sigma_{i=1}^{N_s}\frac{1}{T}\Sigma_{t=1}^{T} X_{it}$, etc. for any variable X.

The structural relation (Y), demeaned, is

$$Y_{i,t} - Y_{i.} - Y_{s,t} + Y_{s.} = \alpha \left[FO_i - FO_i - FO_{st} + FO_{s.} \right] + (u_{i,t} - u_{i.} - u_{s,t} + u_{s.})$$

and the reduced form regression on the instrument will be consistent if the covariance

$$Cov(u_{i,t} - u_{i.} - u_{st} + u_{s.}, \widehat{FO}_i W_{s,t} - \widehat{FO}_i W_{s.} - \widehat{FO}_s W_{s,t} + \widehat{FO}_s W_{s.}) = 0 \ .$$

This will be the case if

$$E\{(u_{i,t} - u_{i.} - u_{s,t} + u_{s.})\widehat{FO}_i W_{s,t}\} = 0 \ .$$

Our $i \times st$ instrument will be consistent as long as the off-diagonal variation $u_{i,t} - u_{i.} - u_{s,t} + u_{s.}$ is uncorrelated with $\widehat{FO}_i$ which is reasonable because $\widehat{FO}_i$ is predicted (see details shortly) and the firm-average innovation $u_{i.}$—which most likely would correlate with firm specific ownership—is subtracted, as long as $u_{it} - u_{i.} - u_{s,t} + u_{s.}$ is uncorrelated with $W_{s,t}$ which is reasonable because sector averages are subtracted, and long as the product of $\widehat{FO}_i$ with $W_{s,t}$ is independent of TFP innovations.

We choose $\widehat{FO}_i$ to be the predicted value from a probit regression of the following type:

$$\begin{aligned} FO_{i,t} \quad = \quad & \beta_0 FO_{i,t-1} + \beta_1 \ln (K/L)_{i,t-1} + \\ & \beta_2 \ln (VA/L)_{i,t-1} + \beta_3 \ln (Assets)_{i,t-1} + \beta_4 \ln (Assets)^2_{i,t-1} + \\ & \beta_5 Age_{i,t} + \beta_6 Age^2_{i,t} + \delta_{ct} + \phi_{s,t} + \epsilon_{i,t} \end{aligned} \tag{8}$$

in the first year the firm is observed ("$\widehat{FO}_{i0}$"). We choose

$$W_{cst} = \frac{1}{N_{s,c}} \Sigma_{i=1}^{N_{s,c}} FO_{i,t} \, ;$$

i.e., as sector-level foreign ownership at time t ($N_{s,c}$ is the number of firms in sector s in country c in year t). For this to be valid it essential that firm and time dummies are included in the IV regressions and because the inclusion of dummies implies that only changes relative to average values affect the results, it is natural to refer to this variable as sector-level growth in foreign ownership.

Substituting equation (Y) into equation (F) and aggregating to the (country and) sectoral level delivers

$$W_{c,s,t} = \xi_0 + \xi_1 u_{c,s,t} + \xi_2 v_{c,s,t}$$

for constant coefficients ξ_0, ξ_1 and ξ_2. The validity of the instrument boils down to whether

$$E\{\widehat{FO}_i W_{c,s,t}(u_{i,t} - u_{i.} - u_{s,t} - u_{c,t} + u_{c,s.})\} = 0 \ ;$$

i.e., whether $\{\widehat{FO}_i W_{c,s,t}$ is relatively high (low) when $(u_{i,t} - u_{i.} - u_{s,t} - u_{c,t} + u_{c,s.})$ is relatively high (low). To appreciate this condition, it helps to consider when it might be violated, namely the case when firms in sectors in countries with high TFP growth (high $u_{c,s,t}$) causing high foreign ownership growth (high $W_{c,s,t}$) via a positive γ_1 in equation (F)) *and* above average predicted foreign ownership (in the initial period), also are the firms with TFP-growth above the sector and country average (high $(u_{it} - u_{i.} - u_{st} - u_{ct} + u_{cs.})$. We assume that such a pattern is not present which seems reasonable because it will not break down even if $(u_{i,t} - u_{i.} - u_{s,t} - u_{c,t} + u_{c,s.})$ is positively correlated with $u_{c,s,t}$ unless these variables are further correlated with predicted initial foreign ownership.

3.4.2 Spillover Regressions: TFP and sectoral spillovers

One of the main advantages of the cross-country nature of our dataset is that we can include sector-year and country-year fixed effects and therefore, take into account the possibility that foreign investors target more productive sectors or more productive countries. However, we cannot rule out the possibility that foreign investors target more productive sectors in particular countries.

In order to address this possibility we propose the following IV strategy. We start from the instrument developed at the firm level, and construct $W_{c,t}$ (defined by summing over all i in c) and $W_{s,t}$ (defined by summing over all i, even in different countries, in s) and aggregate by sector-year or by country-year, respectively.

Next, we aggregate by country-sector to have the same aggregation level as with the spillover. Let's define $\widehat{FO}_{c,s,0}$ as the weighted sum of predicted foreign ownership in country c sector s at period 0, i.e. $\widehat{FO}_{c,s,0} = \sum_{i \in c,s} \frac{\widehat{FO}_{i,0} \times Y_{i,0}}{\sum_{i \in c} Y_{i,0}}$. Using this notation, we have:

$$IVSpillover_{c,s,t} = \widehat{FO}_{c,s,0} \times W_{c,t} \times W_{s,t} \ . \tag{9}$$

By including country-year and sector-year fixed effects the identification is based on the difference between sector-country pairs with high predicted FO and low predicted FO.

4 Data

4.1 Samples

We use the comprehensive firm-level worldwide database from **ORBIS**, compiled by BvD, who specializes in gathering and providing company information. An advantage of ORBIS is the inclusion of private companies compared to the widely-used databases of listed companies COMPUSTAT for the U.S. and COMPUSTAT GLOBAL. ORBIS covers around 100 million listed and private companies from around the world. Only 1 percent of the database are listed companies.

The data in ORBIS includes company financials in a standardized and internationally comparable format together with very detailed company ownership information. For example, if a company in Germany is partially owned by a foreign entity, we know if the foreign entity is a U.S. bank or a Belgian company operating in the same or different sector than the target German company and we also know the exact amount of investment; i.e., the voting stakes of company equity being bought. With such detailed ownership information, it is possible to construct continuous measures of foreign or domestic ownership, including the split by the type of the investor, such as financial or industrial types. Using a continuous measure allows to estimate the marginal effects of foreign ownership more precisely than with the binary "yes/no" variables accounting for the heterogeneity in firm-level FDI.

We focus on a subset of ORBIS covering European companies during the last decade (roughly half of the entire ORBIS universe). After a detailed data cleaning procedure which requires firms

with certain variables to be present most of our sample period we have left with the information for 740,000 firms in 30 countries (15 developed countries and 15 emerging markets) during the period 1999–2008.[11] In spillover regressions we have to go down to a sample of 336 thousand firms since we need to know the detailed sector information of domestic and foreign firms. Panel A in Table 2 shows the number of observations and firms. Since we need materials for the TFP estimation, we go further down in the number of firms as shown in Panel B in Table 2. As seen, the firm coverage differs a lot from country-to country, and industrialized countries do not necessarily have better coverage. Figure 2 shows the average percentage of observations by sectoral categories. Manufacturing is the largest sector in both developed and emerging countries, with roughly 40 percent of observations belonging to this sector. This sector is followed by the retail and services sectors (20 percent of observations each in both groups of countries) and construction (12 percent). If we want to focus only on manufacturing, then we have 80 to 134 thousand firms, depending on the control variables.[12]

4.2 Variables

The main *financial variables* used in the analysis are total assets, operating revenue, tangible fixed assets, and expenditure on materials, all measured in PPP dollars with 2005 base year. Employment measured in persons. We convert financial variables in nominal local currencies into "PPP dollars with 2005 base" by using country-year specific GDP deflators (2005 base) and then convert into dollars using the U.S. dollar exchange rate as of the end of 2005. The distribution of these (logged) variables does not change much over time and is very close to normal; i.e., the distribution of the data before the log-transformation is very close to log-normal. The distribution of employment is skewed with many firms having a minimum allowed number of employees (15 in our case since we limit to that).

Firm productivity.

Traditionally, the literature estimates firm productivity as a residual from a Cobb-Douglas

[11] See the section Appendix: Data for a full description of the data and the cleaning procedures.

[12] See Appendix Table A-2 for NACE 2 sector classification. Manufacturing sectors are sectors 10–18, 20–33. We drop sector 19 "Manufacture of coke and refined petroleum products" since there are not enough observations per country to estimate TFP.

production function. The debate is over how to estimate the elasticity of inputs if productivity is known by the firm but unobserved by the econometrician. If the firm knowing its own productivity chooses inputs accordingly, OLS will deliver a biased estimate. The direction of the bias will depend on the correlation between inputs and productivity. In general, if more productive firms tend to hire more workers, buy more materials or invest more in capital, OLS may lead to an upward bias of the input coefficients. Olley and Pakes. (1996) (OP for short) and Levinsohn and Petrin (2003) (LP for short) propose to use proxy variables to controlling for unobserved productivity. The estimation in both methods is based on a two-step procedure to achieve consistency of the coefficient estimates for the inputs of the production function. Wooldridge (2009) instead suggests using a generalized method of moments (GMM) estimation with the moment conditions outlined in LP (2003) and some extensions, to overcome some of the limitations of OP and LP. According to Petrin and Levinsohn (2012) the advantages of the Wooldridge, Levinsohn and Petrin (WLP) estimator include correction for the simultaneous determination of inputs and productivity, does not maintain constant returns to scale or require costs minimization without input adjustment costs to identify production function parameters and, is robust to the Ackerberg, Caves, and Frazer (2008) critique.[13] In this paper we use a measure of productivity estimated by the WLP method (see Appendix for more details of the TFP estimation). Specifically, we construct TFP as a residual from a Cobb-Douglas production function with capital and labor: $\ln(TFP_{i,t}) = \ln(Y_{i,t} - M_{i,t}) - \alpha_1 \ln(L_{i,t}) - \alpha_2 \ln(K_{i,t})$, where the parameters are estimated following the non-parametric control function approach described in Levinsohn and Petrin (2003) and corrected for the Ackerberg, Caves, and Frazer (2008) critique following the methodology suggested by Wooldridge (2009).

Explanatory variables.

Ownership section of ORBIS contains detailed information on owners of both listed and private firms including name, country of residence, and type (e.g., bank, industrial company, fund, individual, and so on). The database refers to each record of ownership as an "ownership link." An ownership link indicating that an entity A owns a certain percentage of firm B is referred as a "direct" ownership link. BvD traces a direct link between two entities even when the ownership percentage is very small (sometimes less than 1 percent). For listed firms, very small stock holders

[13] Ackerberg, Caves, and Frazer (2008) highlight that if the variable input (labor) is chosen prior to the time when production takes place then the coefficient on the variable input is not identified.

are typically unknown.[14] In addition, ORBIS contains information on so called "ultimate" owners (UO) of the company by attempting to trace the entire ownership pyramid beyond the direct owners, including the "global ultimate owners". UO focuses on identifying owners which exercise a greater degree of control over the company, if any.

We prefer *direct ownership* because of the following considerations. First, UO links are calculated by BvD and not reported by the original sources. BvD focuses on targets where all owners have less than 25 percent of direct ownership. The ones with one owner that has more than 25 percent become ultimately owned by that owner. BvD looks for the owner with the highest direct ownership stake. If this shareholder is itself independent (being owned less than 25 percent by a single owner), it is defined as the UO of the company. If the highest shareholder is not independent, the same process is repeated until BvD finds an UO. BvD admits that "even if the scope of the BvD ownership database is very wide, BvD cannot absolutely assert that all the existing links are recorded in the database. More importantly, because certain ownership structures can be very complex, trying to evaluate a controlling ultimate owner could be misleading (van Dijk (2010)). Second, it is not possible to compute a satisfactory continuous ownership variable over time out of the ultimate ownership links, precisely because of the larger uncertainty. The best one can hope to do is to use a binary variable. In contrast, we can always identify large owners from our direct ownership variable.

We compute *Foreign Ownership* (FO) variable as follows. For a firm i, FO_i is the sum of all percentages of *direct* ownership by foreigners. For example, if a Company A has three foreign owners with stakes 10 percent, 15 percent, and 35 percent, respectively, FO for this company is then 60 percent. Owners of unknown origin (typically small) are assigned to the home country. A financial owner is a bank, a financial company, an insurance company, mutual and pension funds, other financial institutions and private equity firms. We explore the richness of our ownership data and separate foreign ownership by industrial investors and financial investors to explore the differential effects by the type of a FDI investor, in addition to "total" foreign ownership variable,

[14] Countries have different rules for when the identity of a minority owner needs to be disclosed; for example, France, Germany, the Netherlands, and Sweden demand that listed firms disclose all owners with more than a five percent stake, while disclosure is required at three percent in the UK, and at two percent in Italy. See Schouten and Siems (2009). Information regarding US companies taken from the SEC Edgar Filings and the NASDAQ, however, stops at one percent (van Dijk (2010)) BvD collects its ownership data from the official registers (including SEC filings and stock exchanges), annual reports, private correspondence, telephone research, company websites, and news wires.

constructed by summing the percentage stakes of all foreign owners of a firm. Thus, we obtain two variables $FO^{I}_{i,s,c,t}$ (or *Industrial-FDI*), which represents the share of capital owned by foreign industrial investors, and $FO^{F}_{i,s,c,t}$ (or *Financial-FDI*), which represents the share of capital owned by foreign financial investors. The sum of these two variables do not necessarily add up to 100 percent ownership for a given company because we omit other ownership types, such as government/state, employees, private individuals, unknown owners, etc. Keeping in mind the possibility of having such other types of owners we define firm to be "domestic" only if it never had *any* type of foreign owner over the sample period.

Descriptive statistics.

Panel A in Table 3, using the sample of firms in Panel A of Table 2 from all sectors but with available data for computing TFP, shows that FDI is relatively high in the manufacturing and retail sectors. Also, the share of output of firms with foreign financial owners is an order of magnitude smaller than that of firms with foreign industrial owners. Overall, foreign-owned firms constitute a minority of firms, having a share of about 6–7 percent of output in the universe of our firms across available years.

Panel B in Table 3 explores the relative importance of foreign-owned companies across developed and emerging countries as well as distinguishing between industrial and financial foreign ownership, and ownership concentration. First two columns of Panel B confirm that 6.2 percent of our observations are classified as Industry-FDI and 0.4 percent as Financial-FDI, a small part of all firms. Focusing of firms with positive industrial or financial FDI in at least one year in the rest of the Panel B, we observe that the number of observations with positive industrial-FDI is slightly higher in emerging countries, while financial FDI "prefers" firms in developed countries a bit more. The distribution of controlling (i.e., more or equal to 50 percent of company equity) ownership follows the total ownership ranking among the country groups and FDI type but the differences in industrial FDI between country groups are much more drastic. While around 74 percent of the observations in emerging markets with some foreign ownership refer to controlling foreign ownership only 63 percent of the observations in developed countries refer to controlling industrial-FDI. Figure 3 shows the distribution of industrial and financial FDI within developed countries, whereas Figure 4 presents same figures for the emerging markets from the same sample.

In developed countries there is a bi-polar distribution for Industry-FDI and whereas in emerging markets Industry-FDI is skewed towards full ownership, i.e., multinationals. In both groups of countries the participation of Financial-FDI is concentrated in the smaller stakes, with more than 2/3 of the firms having less than 20 percent stakes held by foreign financial owners. One can also clearly see a spike in the number of firms around 50 percent ownership level. This reflects the desire by foreign owners to acquire the majority ownership stake (50 percent of voting shares + 1 share).

Table 4 provides basic summary statistics of the variables used in the regression analysis in the limited sample of manufacturing firms.[15] Notably, the firms in developed countries are on average more productive, regardless of the measure, while the industrial FO is somewhat larger, on average, for the emerging-market firms. The average value of financial FO is smaller than that of industrial FO in both samples, and the variation of the former is also smaller. With respect to output and employment market shares at 2-(4-)digit level (the variables $MS2(4)dig--Output$ and $MS2(4)dig--Employment$), we observe much higher concentration in emerging markets, especially at 4-digit level, suggesting less competitive market environment there. Panel B and D of Table 4 report the features of the spillover variables in the sub-samples of purely domestic firms from developed and emerging-market countries. Here, as well as in all of the following empirical analysis, the domestic sample refers to firms that never had foreign owners (industrial, financial, or other possible types, such as state or individuals) over the period of analysis. As seen, the industrial spillover at 2-digit level (the variable $Industrial\ Spillover$) has a larger value in developed countries than in emerging markets, and the same is true about the industrial spillover at 4-digit level (the variable $Industrial\ SpilloverCompetition$ and $Industrial\ SpilloverKnowledge$), both implying a possibility of higher effect on domestic productivity from foreign presence in, correspondingly, same 2- or 4-digit sectors, or between 2- and 4-digit sectors where the firms operate. It is hard to see the material difference in Financial spillovers variables, however, interestingly the maximum of the and $Financial\ SpilloverKnowledge$ in emerging markets is much larger than in developed markets. Overall, there is a lot of variation in the variables in both samples which we exploit in the following empirical analysis.

[15] Notice the number of observations is somewhat smaller than that in Panel B of Table 2 but remember the analysis is only done for the sample of manufacturing firms. To limit the potential impact of outliers, we winsorize variables before performing our empirical analysis.

5 Results

5.1 Are Foreign Firms More Productive?

Before we analyze spillover effects from foreign-owned companies to domestic firms, we explore whether foreign-owned firms are indeed more productive.[16] As already stated in the introduction, traditionally foreign-owned firms have been characterized as having non-tangible assets which contribute to higher productivity relative to domestic firms. This idea has been formally conceptualized in the recent trade literature which proposes theoretical models where only the most productive firms become multinationals. Table 5 shows the relationship between FDI and firm productivity. Firm productivity is estimated following the non-parametric control function approach described in Levinsohn and Petrin (2003) and corrected for the Ackerberg, Caves, and Frazer (2008) critique following the methodology suggested by Wooldridge (2009).[17] Panel A focuses on the sample of firms operating in developed countries while Panel B focusses on the sample of firms operating in emerging countries. We opt to differentiate between developed and emerging countries given the different results found in the previous literature.[18]

For developed countries, column (1) of Panel A shows that foreign-owned companies are more productive than their domestic counterparts. Columns (2) and (3) consider the possibility that foreign investors target more productive sectors leading to a biased estimate of the effect of FDI on firm productivity. Both columns show that results are robust to the inclusion of sector-year fixed effects that control for sectoral growth. Therefore, FDI is associated with higher firm productivity; however, this effect does not seem to be economically relevant. A ten percent increase in FDI will be associated with a 0.08 percent increase in firm productivity. Only considerable increases in firm ownership (of the order of 100 percent change) would lead to a substantial increase in firms' productivity of around 1 percent. In columns (4) and (5) we distinguish between industrial and

[16] Domestic firms are those with no foreign ownership at any point in time.

[17] We use the Stata routine suggested in Petrin, Reiter, and White (2011). We estimate TFP by country and sector and winsorize the resulting distribution at 1 and 99 by country. However, similar results are obtained if TFP is estimated by country, or by Levinsohn and Petrin (2003), and regardless of the level of winsorizing chosen (i.e., total sample at the 1 and 99 percentiles, by country at the 1 and 99 percentiles and at the 5 and 95 percentiles, and by sector at the 1 and 99 percentiles and at the 5 and 95 percentiles).

[18] See Aitken and Harrison (1999), Javorcik (2004), Haskel, Pereira, and Slaughter (2007) and Keller and Yeaple (2009) among others.

financial FDI and show that the results in column (3) are driven by industrial FDI with no effect from financial FDI.

The relatively small productivity gap between foreign-owned and domestic companies shown in Panel A might be particular to the sample of developed countries where the technology gap between foreign-owned companies and domestic companies might be smaller. Panel B considers the productivity differential of foreign-owned companies in emerging countries. Column (1) shows that FDI is associated with higher firm productivity although the size of the coefficient is slightly attenuated once sector-year fixed effects are included in columns (2) and (3). According to column (3), a 10 percent increase in foreign ownership in emerging countries will be associated with a 0.35 percent increase in firm productivity. In addition, columns (4) and (5) show that both industrial and financial FDI are positively associated with higher firm productivity.

It is worth noting at this point that the results in Table 5 are obtained in regressions that include firm-fixed effects. Early studies (see Aitken and Harrison (1999) or Javorcik (2004)) find a positive and significant correlation between foreign ownership and firm productivity but find no statistically significant effects once firm fixed effects are included. Therefore, these early studies find a positive correlation between foreign ownership and productivity *levels* but not with productivity *growth*. This indicates that foreign investors might acquire shares in the most productive domestic companies. Our set of control dummy variables guarantees that results in Table 5 are not driven by foreign investors targeting growing countries, growing sectors, or firms with constant higher productivity. However, it is probable that firm productivity changes over time and therefore, we still need to correct for the fact that foreign investors target firms with increasing productivity. We analyze this possibility in subsection 5.3. For now, we keep in mind that foreign-owned companies are associated with higher productivity in both developed and emerging countries and turn to the study of spillover effects.

5.2 Are There Spillover Effects from FDI?

We explore potential productivity spillovers to domestic firms from foreign-owned companies operating in the same two-digit sector. Traditionally, the empirical literature has found the puzzling result of positive horizontal productivity spillovers in developed countries and negative productivity

spillovers in developing countries. We explore this issue in Table 6, where Panel A and Panel B report results for the sample of developed and emerging countries, respectively. We also distinguish between horizontal spillovers from foreign-owned industrial companies and financial companies. Column (1) in Panel A shows that foreign-owned companies have a significant impact on the productivity of the typical domestic firm in the same two-digit sector. Column (3) in Panel A shows that these results are driven both by industrial and financial FDI. Previous studies have found evidence of significant positive horizontal spillovers in developed countries; however, these studies could not differentiate between industrial and financial FDI. Our findings indicate that the results were driven by both foreign-owned financial and industrial companies. Financial companies can be expected to invest in order to diversify income streams and are *a priori* less likely to engender knowledge spillovers. Researchers who are sceptical about the role of FDI in transferring knowledge and technology argue that results in column (1) are likely the result of foreign-owned companies targeting more productive sectors. The previous empirical literature focused on the experience of one country at a time and, without suitable instruments, was not able to properly address this issue.[19] One of the main advantages of our dataset is its broad coverage across countries and time: having a substantial number of countries is particularly helpful in this case since it allows us to include two-digit sector-year fixed effects that capture differential trends in sector growth over time and can account for the possibility of foreign-owned companies targeting more productive sectors. Column (2) in Panel A shows the results of controlling for sector-year fixed effects. Since they control for effects that are common across countries, the results in this column are driven by local effects in the country of FDI. There is a reduction in the size of the coefficient of about 50 percent. Columns (3) and (4) show an identical reduction in the size of the coefficients related to industrial and financial FDI. The lack of significance when sector-year dummies are included means that if spillovers were present they would be global for typical firms in the relevant sectors and while we cannot literally rule this out, spillovers are more likely to be local (and much of the policy relevance of this issue revolves around the issue of local spillovers). These results highlight the importance of controlling for sector-year trends as we do not find evidence of *local* horizontal spillovers in developed countries contrary to previous studies in the literature.

[19] One exception is Haskel, Pereira, and Slaughter (2007) who use an instrumental variable approach to tackle this concern.

Panel B in Table 6 repeats the analysis for the sample of emerging countries. Contrary to our findings for developed countries, column (1) reveals a negative and significant effect from foreign-owned companies in the same two-digit sector—a finding in line with previous results of Aitken and Harrison (1999) who use firm-level panel data for Venezuela. They argue that potential positive knowledge spillovers may be overturned by negative competition effects. Column (2) in panel B confirms that the negative spillover effect prevails even after controlling for sector-year fixed effects. The negative effect, as expected from a direct competition explanation is therefore, predominantly local. Columns (3) and (4) explore the role of industrial and financial FDI and confirm that the negative spillover results found in columns (1) and (2) are mainly driven by industrial FDI.

Table 6 focuses on the role of foreign presence in the same two-digit sector and provides some new evidence on horizontal spillovers in developed countries. However, it is not obvious why foreign competition does not lead to negative effects in developed countries. It has been argued that the technology gap between domestic and foreign companies in developed countries is smaller (Girma (2005)). Similarly, developed countries are thought to have the human capital and/or institutional and financial necessary preconditions to better compete with foreign-owned companies. At the same time, the literature on FDI spillovers acknowledging the potential negative competition effects from foreign-owned companies has recently explored the role of vertical spillovers. While there could be negative competition effects from foreign-owned companies operating in the same sector, domestic suppliers to foreign companies might benefit through vertical linkages. The linkages literature has made used of country-level input-output matrices in order to quantify demand across sectors. As outlined in the methodology section, we propose an alternative approach based on a thinner sector classification. We expect competition effects to be dominant within the same four-digit sector classification, while potential technology and knowledge transfers should come from the foreign presence in the same two-digit sector excluding the four-digit sector where FDI takes place. We call this latter case knowledge spillovers. Table 7 presents the main results for the sample of developed countries.

In Table 7, column (1) shows that once we focus on effects within the thinner 4-digit sector classification, negative competition effects are also present in the sample of developed countries. At the same time there are positive and significant knowledge spillovers—the positive knowledge spillovers outweigh the negative competition spillovers when sector-year trends are not included

and therefore, explain the positive significant spillover results found in column (1) of Table 6. The positive knowledge spillovers is a new result in the literature which previous research have overlooked due to a higher sectoral aggregation. In line with vertical linkages theories, we find that there is scope for positive productivity spillovers from foreign-owned companies to domestic companies that are not direct competitors.

Columns (2) and (3) again address the possibility that foreign-owned companies target more productive sectors by including two-digit and four-digit sector-year fixed effects, respectively. The results show a robust negative competition spillover effect from FDI within the targeted four-digit sector and a positive and significant effect of the knowledge spillovers to other four-digit sectors within the same two-digit sector. However, notice that the size of the knowledge spillover coefficient decreases by almost a half in column (2) which explains the insignificant results that we were finding in column (2) of Panel A in Table 6. Our economic interpretation of these results is: competition is local so that we do not observe significant changes in the size of the spillover competition coefficient after including sector-year fixed effects; on the other hand, knowledge transfer might be global. In other words, the technology transfer from foreign-owned companies is not only country-sector specific but it is universally available within the same intra-sector for those domestic firms in contact with foreign-owned companies. Strictly speaking, "global" in this regression refers to other developed countries where it is reasonable that, say, all car manufactures benefit from large global investments in, say, fuel systems and we do not examine global spillovers from developed to emerging countries. Columns (4) and (5) show that the spillover results are driven by industrial FDI rather than financial FDI. Finally, columns (6) and (7) of Table 7 consider a balanced panel of firms, these are firms observed over the period 2000-2007. The idea is to explore the possibility of competition being driven by new highly productive firms entering the sample leading to the Schumpeterian creative-destruction hypothesis. By focusing on a permanent sample of firms we rule out this hypothesis and results in column (7) confirm that the negative competition effect from industrial FDI is not solely the result of entry and exit.

The results in Table 7 highlight the importance of competition within the same four-digit sector that translate into negative competition productivity spillovers versus positive knowledge spillovers derived from vertical linkages within the same two-digit industry. In Table 8, we explore if foreign investment is indeed associated with recipients of FDI showing relatively faster increases in market

shares.The dependent variable is market shares. If the negative four-digit spillover results in Table 7 are truly competition effects, we should observe that foreign-owned companies increase their market shares. Columns (1) to (4) consider as dependent variables the share of firm i's output in total sectoral output at different sectoral classifications. Columns (1) and (2) show that companies that receive investments from foreign investors experience increases in market shares when considering total sectoral output in the same two as well as four-digit sector. Columns (3) and (4) confirm our intuition that it is industrial foreign-owned companies that exhibit higher output market shares. Together these results indicate that foreign owned firms grow faster at the expense of firms in the same 4-digit sector. For completeness columns (5) to (8) consider employment growth. Foreign-owned companies in developed countries tend to employ a growing number of employees compared to their domestic counterparts in the same sector.

Our findings for developed countries suggest a strong negative competition effect from industrial FDI and positive knowledge spillover effects. Focusing on a thinner sector classification allows us to unmask negative competition effects in developed countries that have been previously overlooked even if negative spillovers were a well-known finding in emerging countries.

Tables 9 and 10 repeat the analysis for emerging markets. Columns (1) to (3) in Table 9 show that there are negative productivity spillovers from industrial foreign-owned companies operating in the same four-digit sector. Unexpectedly, we also find that in emerging markets there are negative knowledge spillovers. Again as in the case of developed countries results are driven by industrial FDI (see columns (4) and (5)). Similar results are found in columns (6) and (7) when a permanent sample of firms (i.e., firm we observe from 2000-2007) is considered. Similar to the results in the developed sample, we find that the negative competition finding is not solely the result of entry/exit.

In Table 10, we explore the background for these results and columns (1) to (4) show that foreign-owned companies have growing output market shares whether compared to firms in their own 4-digit industry of compared their 2-digit industry. Columns (5) to (8) show that foreign firms do employ a significant increasing share of workers in emerging economies. We believe this may the root of the negative spillovers uncovered in the previous table. If emerging markets have a *limited* pool of workers with appropriate training for modern firms, domestic firms may be hurt by those worker being hired away to firms with foreign ownership.

5.3 Self-Selection or Causal effect?

In Table 11, we further exploit the possibility that foreign-owned firms self-select into cross-country activities based on their productivity and/or market shares.[20] In Tables 5, 8 and 10 we showed that foreign-owned firms are associated with higher productivity and market shares in terms of output and employment both in developed and in emerging countries. However, these findings can be the result of foreign-owned firms targeting firms with high productivity growth and growing market shares. In order to account for this possibility, Table 11 provides the results from instrumental variable estimation conducted according to the methodology outlined in section 3. Columns (1) to (3) focus on the sample of developed countries while columns (4) to (6) report the results for the sample of emerging countries. Given the lack of findings for Financial-FDI we constrain the analysis to the role of total FDI (i.e., the sum of industrial and financial FDI). Panel A in Table 11 shows the second stage while Panel B considers the first stage. It is clear from Panel B that the instrument and the endogenous variable (i.e., FDI) are highly correlated both in developed and in emerging markets. However there are substantial differences among developed and emerging markets regarding the second stage results shown in Panel A. In emerging markets foreign-owned firms are more productive and have higher market shares at the four-digit level both in terms of output and employment even after controlling for the corresponding country-four digit sector-year fixed effects. In developed countries, foreign-owned firms can be shown to have higher market shares in terms of output however, there is no evidence of a causal impact of FDI on firm productivity. The fact that foreign-owned firms target the most productive domestic firms in developed countries might reflect the possibility that foreign-owned companies have different investment motives and risk diversification can be one of them. The risk diversification motive does not need to involve transfer of technology and therefore, can explain the results in Table 11.

5.4 Firm Heterogeneity, Foreign Ownership and Spillovers

In a recent paper, Bernard, Jensen, Redding, and Schott (2011) review the empirical evidence on firm heterogeneity in international trade. One of the main insights of the first wave of empirical

[20] Alfaro and Chen (2012) has an alternative methodology based on a structural model to separate out the selection effects from spillovers.

findings from micro data is that firms are heterogeneous resulting in challenges for existing models of international trade and inspiring the development of new theories emphasizing firm heterogeneity (see Melitz (2003), Bernard and Kortum (2003) and Helpman, Melitz, and Yeaple (2004) among others). These early findings postulated that only a small fraction of firms engage in export activities and an even smaller fraction of firms become multinational companies. The theoretical models developed to accommodate these empirical findings had implications for within and between sectoral allocation of resources. Within-industry reallocation effects are supposed to contribute to overall higher productivity of the sector. The mechanism assumes that greater competition by exporting firms will drive low productive firms out of the market. Therefore, it is reasonable to assume that not all domestic firms will be equally affected by the presence of foreign-owned firms in their same sector of activity or related sectors. A somewhat less explored aspect of firm heterogeneity, at least in the international trade field,is differences in firm productivity arising from varying degrees of foreign ownership.

We take advantage of the firm-level nature of our dataset and explore the implications of firm heterogeneity for our results. We consider two dimensions: the percentage of firm capital owned by foreign investors and differences in the productivity of domestic firms. First, regarding foreign ownership heterogeneity, figure 5 shows the TFP distribution of foreign-owned and domestic companies in developed and emerging countries. In both set of countries, the distribution of foreign-owned companies is to the right of that of domestic companies. This is the case regardless of whether we define foreign ownership in terms of majority control (subfigures b and d) or based on any percentage owned by a foreign investor (figures a and c). However, interestingly the average productivity difference between foreign-owned and domestic companies is greater in the case of emerging countries when we define foreign ownership as majority control (see subfigure d). The graphical evidence is confirmed by the results shown in columns (1) and (3) of Table 12. Foreign-owned companies in developed countries are always more productive than domestic companies regardless of the ownership stake. In contrast, only majority owned foreign-owned companies in emerging countries are more productive than their domestic counterparts. These results have obvious implications in terms of spillovers to domestic companies as shown in columns (2) and (4). In developed countries, all types of foreign ownership have a negative competition effect on the productivity of domestic firms. Only majority owned foreign companies have positive knowledge

spillovers (see column (2)). This result confirms firm organization theories that postulate that due to verification costs and weak investor protection only majority owned affiliates will transfer technology to their affiliates (see Antras, Desai and Foley (2009)). In the case of emerging markets, consistent with the fact that foreign-owned companies with less than 50 percent ownership are not more productive than domestic companies themselves, column (4) shows no significant effect from these companies on the productivity of domestic companies.

Second, we study whether differences in the ex-ante distribution of firm productivity has implications for the extent of competition and knowledge spillovers. In order to do so, we consider firms' total factor productivity on the first year we observe them in the sample (our measure of ex-ante productivity) and we split firms based on whether they are above or below the median total factor productivity in each country-sector-year cell. In addition, we follow a similar approach and split firms according to whether they are in the first, second, third or fourth quartile of the total factor productivity distribution in each country-sector-year cell. Once firms are categorized according to their ex-ante productivity we replicate the results in column (3) of Tables 7 and 9 for these different quantiles. Table 13 shows the results. The dependent variable is firm total factor productivity and we focus again on the sample of domestic firms. Columns (1) and (2) consider the sample of developed countries while columns (3) and (4) refer to the sample of emerging countries. In the sample of developed countries, column (1) shows that the negative competition effect is present for *all* firms; on the other hand, the positive knowledge spillover effect is concentrated among the firms with total factor productivity above the median. This is consistent with the idea that only the better firms have enough absorptive capacities to benefit from the activities of foreign-owned firms. The result is very similar when we split the sample into four different quartiles. In that case, again the negative competition spillover effects are present along the full distribution of firm total factor productivity however, only domestic firms at the top of the total factor productivity distribution can capture the knowledge spillover benefits from the foreign-owned presence in related sectors. Finally, when we focus on the sample of emerging countries the competition results are similar to those of the developed countries sample (see column (3)). The negative spillover competition effect is present for *all* domestic firms regardless of their ex-ante total factor productivity. Furthermore, when domestic firms are split into below and above median total factor productivity there is evidence of a negative knowledge effect for *all* firms. On the other hand, when we decompose

domestic firms based on their productivity according to the quantiles we find non-significant results for the top and bottom quartile. The domestic firms that are hurt the most from the presence of foreign-owned companies in related sectors are firms at the second and third quartile. These firms suffer both from a negative direct competition effect in the output market as well as an indirect competition effect from foreign-owned firms in related sectors that compete in inputs (i.e., employment and capital). Results in column (4) of Table 13 seem to indicate that only the very top domestic firms have enough absorptive capacities to offset the negative effects from competing on the inputs market. Domestic firms at the lower end of the distribution are not negatively affected either since probably they are not direct competitors on inputs with the higher-end foreign-owned companies.

5.5 IV Spillovers

Table 14 reports on IV-estimation of spillovers. As previously discussed, foreign ownership may be endogenous to firm characteristics, such as growth-prospect, that are unobservable by econometricians. Possibly, such unobserved features might correlate with productivity in firms which are not themselves targeted by foreigners. From the first row of results, we observe a stronger competition effect of spillovers using IV-estimation of the same sign as the OLS results. It is comforting that the sign and significance of the results is robust but the change in magnitude needs discussion. There are several reason why the IV results may be stronger: the obvious explanation is that OLS is bias due to endogeneity of sectoral investment and the coefficients differ because IV is not subject to such bias, another that comes to mind is the classical results that measurement error in a regressor leads to bias towards zero in OLS. In our case, the change in competition that is caused by changes in foreign ownership in the same 4-digit sector which is inherently unmeasurable. The change in ownership is not but it is possible that actual foreign ownership within the fairly small 4-digit sectors is a more noisy indicator of competition than the less volatile instrument. Another potential explanation could be that the instrument correlates more with some country-sector-year cells and these cells at the same time are the ones where competition spill-overs matter more.[21] We believe that the first two explanations are the more likely. For knowledge spillovers the sign and

[21] In the literature on labor and education such Local Average Treatment Effects (LATE) has become the focus of a large literature.

significance are also robust to OLS versus IV estimation but here the IV-coefficient is more than ten times the size of the OLS-coefficient. This large discrepancy is more puzzling. Endogeneity bias of OLS is likely not severe for knowledge spillovers as the regressor involves foreign investment in other 4-digit sectors, therefore, the large difference between OLS and IV is probably not mainly due to endogeneity bias. LATE effects are not easily surmised in the present setting which leaves measurement error, in the general sense just used, as the likely explanation. Simply put, the instrument may be much better measure of available knowledge that the OLS regressor. The instrument is based partly on world-wide investment in the relevant sectors and possibly our interpretation of local knowledge spillovers is too narrow.

6 Conclusion

TO BE ADDED

References

Ackerberg, D., K. Caves, and G. Frazer (2008): "Structural Identification of Production Functions," .

Aitken, B., and A. Harrison (1999): "Do Domestic Firms Benefit from Direct Foreign Investment?," *American Economic Review*, 89, 605–618.

Alfaro, L., A. Chandra, S. Kalemli-Ozcan, and S. Sayek (2004): "FDI and Economic Growth: the Role of Local Financial Markets," *Journal of International Economics*, 64, 89–112.

Alfaro, L., and A. Charlton (2009): "Intra-Industry Foreign Direct Investment," *Journal of Political Economy*, 99(5), 2096–2119.

Alfaro, L., and M. Chen (2012): "Selection, Market Reallocation, and Knowledge Spillover: Identifying the Sources of Productivity Gains from Multinational Activity," .

Arnold, J., and B. Javorcik (2009): "Gifted Kids or Pushy Parents? Foreign Direct Investment and Plant Productivity in Indonesia," *Journal of International Economics*, 79, 42–53.

Barba-Navaretti, G., and A. Venables (2004): *Multinational Firms in the World Economy*. Princeton University Press.

Bernard, A., J. Jensen, S. Redding, and P. Schott (2011): "The Empirics of Firm Heterogeneity and International Trade," *National Bureau Of Economic Research, Cambridge, MA. Working Paper No. 17627*.

Bernard, A. B., J. E. J. B. J., and S. Kortum (2003): "Plants and Productivity in International Trade," *American Economic Review*, 93(4), 1268–1290.

Bloom, N., R. Sadun, and J. Van Reenen (2009): "The Organization of Firms Across Countries," *National Bureau Of Economic Research, Cambridge, MA. Working Paper No. 15129*, July.

Borensztein, E., J. De Gregorio, and J.-W. Lee (1998): "How Does Foreign Direct Investment Affect Economic Growth?," *Journal of International Economics*, 45, 115–135.

De Haas, R., and I. Van Lelyveld (2006): "Foreign banks and credit stability in Central and Eastern Europe. A panel data analysis," *Journal of Banking and Finance*, 30(3), 1927–1952.

Desai, M., C. Foley, and K. Forbes (2007): "Financial Constraints and Growth: Multinational and Local Firm Responses to Currency Depreciations," *Review of Financial Studies*, 21(6), 2857–2888.

Girma, S. (2005): "Absorptive Capacity and Produtivity Spillovers from FDI: A Threshold Regression Analysis," *Oxford Bulletin of Economics and Statistics*, 67(3), 281–306.

Harrison, A., I. Love, and M. McMillan (2004): "Global Capital Flows and Financing Constraints," *Journal of Development Economics*, 75(3), 269–301.

Haskel, J., S. Pereira, and M. Slaughter (2007): "Does Inward Foreign Direct Investment Boost the Productivity of Domestic Firms?," *The Review of Economics and Statistics*, 89(3), 482–496.

Helpman, E. (1984): "A Simple Theory of International Trade and Multinational Corporations," *Journal of Political Economy*, 92, 451–471.

——— (2006): "Trade, FDI, and Organization of Firms," *Journal of Economic Literature*, 44(4), 589–630.

Helpman, E., and P. Krugman (1985): *Market Structure and Foreign Trade: Increasing Returns, Imperfect Competition, and the International Economy*. MIT Press.

Helpman, E., M. Melitz, and S. Yeaple (2004): "Export vs. FDI with Heterogenous Firms," *American Economic Review*, 94(1), 300–316.

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

Keller, W., and S. Yeaple (2009): "Multinational Enterprises, International Trade, and Productivity Growth: Firm-Level Evidence from the United States," *The Review of Economics and Statistics*, 91(4), 821–831.

Kose, A., E. Prasad, K. Rogoff, and S. Wei (2009): "Financial Globalization: A Reappraisal," *IMF Staff Papers*, 56(1), 8–62.

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

Markusen, J. (1984): "Multinationals, Multi-plant Economies, and the Gains from Trade," *Journal of International Economics*, 16, 205–226.

Melitz, M. (2003): "The Impact of Trade on Intra-Industry Reallocations and Aggregate Industry Productivity," *Econometrica*, 71(6), 1695–1725.

Olley, S., and A. Pakes. (1996): "The Dynamics of Productivity in the Telecommu- nications Equipment Industry," *Econometrica*, 64, 1263–98.

Petrin, A., j. Reiter, and K. White (2011): "The Impact of Plant-level Resource Reallocations and Technical Progress on U.S. Macroeconomic Growth," *Review of Economic Dynamics*, 14(1), 3–26.

van Dijk, B. (2010): "BvD Ownership Database," .

Villegas-Sanchez, C. (2010): "FDI Spillovers and the Role of Financial Development: Evidence from Mexico," .

Wooldridge, J. (2009): "On Estimating Firm-Level Production Functions Using Proxy Variables to Control for Unobservables," *Economics Letters*, 104(3), 112–114.

7 Tables

Table 2: Number of Observations per Country

Panel A: Total Number of Firms

Developed					Emerging				
Country	Obs.	Number Firms	Average Time	Firms per mill. Pop	Country	Obs.	Number Firms	Average Time	Firms per mill. Pop
AUSTRIA	2140	1142	1.87	140	BOSNIA AND HERZEGOVINA	1536	228	6.74	61
BELGIUM	67674	9642	7.02	922	BULGARIA	22236	3564	6.24	457
DENMARK	11403	2997	3.80	554	CROATIA	19628	2169	9.05	489
FINLAND	37219	5019	7.42	958	CZECH REPUBLIC	60444	10322	5.86	1004
FRANCE	357607	56600	6.32	935	ESTONIA	17705	2213	8.00	1637
GERMANY	41067	14880	2.76	181	HUNGARY	4997	2128	2.35	210
GREECE	66763	7567	8.82	684	LATVIA	10913	1480	7.37	431
ITALY	230802	34447	6.70	592	LITHUANIA	10996	1872	5.87	809
NETHERLANDS	8671	2077	4.17	128	POLAND	83085	12669	6.56	331
NORWAY	54058	7155	7.56	1552	ROMANIA	34407	4097	8.40	188
PORTUGAL	18484	6864	2.69	656	RUSSIAN FEDERATION	244018	57474	4.25	399
SPAIN	331651	42345	7.83	990	SERBIA	22421	2855	7.85	383
SWEDEN	80424	9185	8.76	1019	SLOVAKIA	9547	1938	4.93	360
SWITZERLAND	1712	255	6.71	34	SLOVENIA	10516	1797	5.85	898
UNITED KINGDOM	179929	26864	6.70	448	UKRAINE	27207	3709	7.34	78
TOTAL	1489604	227039	6.56	–	TOTAL	579656	108515	5.34	–

Panel B: Number of Firms with available data for TFP construction

Developed					Emerging				
Country	Obs.	Number Firms	Average Time	Firms per mill. Pop	Country	Obs.	Number Firms	Average Time	Firms per mill. Pop
AUSTRIA	1415	871	1.62	107	BOSNIA AND HERZEGOVINA	1521	226	6.73	60
BELGIUM	49093	6581	7.46	630	BULGARIA	21054	3432	6.13	440
DENMARK	–	–	–	–	CROATIA	19027	2123	8.96	479
FINLAND	34162	4673	7.31	892	CZECH REPUBLIC	36074	7660	4.71	745
FRANCE	325609	51953	6.27	858	ESTONIA	14766	2040	7.24	1509
GERMANY	38349	13985	2.74	170	HUNGARY	4855	2089	2.32	206
GREECE	–	–	–	–	LATVIA	301	53	5.68	15
ITALY	225524	33675	6.70	578	LITHUANIA	–	–	–	–
NETHERLANDS	419	75	5.59	5	POLAND	61647	11051	5.58	289
NORWAY	16374	2108	7.77	457	ROMANIA	33991	4029	8.44	185
PORTUGAL	12070	4787	2.52	458	RUSSIAN FEDERATION	–	–	–	–
SPAIN	315079	40346	7.81	943	SERBIA	22306	2836	7.87	381
SWEDEN	46666	6436	7.25	714	SLOVAKIA	7857	1841	4.27	342
SWITZERLAND	498	75	6.64	10	SLOVENIA	10350	1778	5.82	888
UNITED KINGDOM	–	–	–	–	UKRAINE	26720	3672	7.28	77
TOTAL	1065258	165565	6.43	–	TOTAL	260469	42830	6.08	–

Notes: Sample in Panel A includes firms with available reliable data for output, employment, ownership, with varying coverage over 1999–2008, as well as, sectoral information; we focus on firms of more then 15 employees and total assets more than $1000, 2005 base. Sample in Panel B requires firms to have data for computing TFP. See Data Appendix for more details on sample selection. Firms per mill. Pop reports the average number of firms per million of average population over bi-annual intervals from 2000 to 2008 from the World Bank.

Table 3: Relative Importance of Foreign Ownership across Sectors and Samples

Panel A: Average Share of Foreign Output in Total Sectoral Output (Percent)

Sample	Developed		Emerging	
FDI measure	Industry-FDI	Financial-FDI	Industry-FDI	Financial-FDI
Industry				
Agric. and Mining	4.3	0.3	2.3	0.1
Construction	1.4	0.1	1.9	0.2
Manufacturing	8.1	0.5	9.5	0.5
Retail	8.8	0.4	7.4	0.3
Services	4.8	0.5	5.8	0.4
TOTAL	6.6	0.4	6.9	0.4

Panel B: Percentage of Observations by Ownership Category

Sample	All Firms		Foreign-owned Firms			
	Industry-FDI	Financial-FDI	Industry-FDI	Financial-FDI	Industry-FDI> 50%	Financial-FDI> 50%
Emerging	6.9	0.4	97.2	5.2	71.1	1.2
Developed	6.6	0.4	96.2	6.0	61.5	1.4
TOTAL	6.2	0.4	96.4	5.8	63.4	1.3

Notes: The distributions in this table are drawn from the sample with available data for TFP construction (panel B of Table 2). *Panel A* reports the percentage of all firms in all available years (observations) in a given industry. Agric. and Mining refers to Agriculture and Mining and corresponds to NACE 2-digit sector classification: 01, 02, 03, 05, 06, 07, 08, 09. Manufacturing: 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33. Construction: 41, 42, 43. Services: 49, 50, 51, 52, 53, 55, 56, 58, 59, 60, 61, 62, 63, 69, 70, 71, 72, 73, 74, 75, 77, 78, 79, 80, 81, 82, 85, 86, 87, 88, 90, 91, 92, 93, 94, 95, 96. Retail: 45, 46, 47. See Table A-2 for the industry classification. "TOTAL" sample shows the distribution in the entire sample of firms with available data for TFP construction. *Panel B* reports the percentage of observations by ownership category in emerging and developed countries. All Firms sample is the sample of firms with available data for TFP construction. Foreign-owned Firms sample includes a subset of firms with either Industrial-FDI or Financial-FDI positive in at leas one year. Count under FDI> 50% refers to firms with controlling foreign ownership, where Industial-FDI or Financial-FDI is higher than 50% of voting shares. "TOTAL" sample shows the distribution in the sample combining firms from emerging markets and developed countries.

Table 4: Summary Statistics

Variable	Mean	Median	St. dev.	Min	Max
Panel A: All Firms from Developed Countries (418,736 obs., 61,131 firms)					
log(VA/L)	11.43	11.44	0.53	7.26	12.91
log(TFP)	11.71	11.68	0.75	3.81	16.01
Industrial FDI	0.05	0.00	0.20	0	1
Financial FDI	0.00	0.00	0.03	0	1
MS2dig–Output	0.00	0.00	0.02	0	1
MS2dig–Employment	0.00	0.00	0.02	0.00004	1
MS4dig–Output	0.03	0.01	0.10	0.00001	1
MS4dig–Employment	0.03	0.01	0.10	0.00005	1
Panel B: Domestic Firms from Developed Countries (363,354 obs., 53,642 firms)					
Industrial Spillover	0.12	0.09	0.10	0	0.98
Financial Spillover	0.01	0.00	0.02	0	0.71
Industrial Spillover Competition	0.09	0.04	0.13	0	0.99
Financial Spillover Competition	0.00	0.00	0.02	0	0.96
Industrial Spillover Knowledge	0.10	0.07	0.09	0	0.98
Financial Spillover Knowledge	0.00	0.00	0.02	0	0.62
Panel C: All Firms from Emerging Countries (96,354 obs., 15,663 firms)					
log(VA/L)	9.70	9.71	0.99	7.19	12.90
log(TFP)	9.65	9.75	1.99	3.23	23.06
Industrial FDI	0.07	0.00	0.23	0	1
Financial FDI	0.00	0.00	0.03	0	1
MS2dig–Output	0.02	0.00	0.05	0.00001	1
MS2dig–Employment	0.02	0.01	0.05	0.00005	1
MS4dig–Output	0.13	0.04	0.22	0.00010	1
MS4dig–Employment	0.13	0.04	0.21	0.00047	1
Panel D: Domestic Firms from Emerging Countries (77,362 obs., 12,896 firms)					
Industrial Spillover	0.15	0.11	0.15	0	0.98
Financial Spillover	0.01	0.00	0.03	0	0.88
Industrial Spillover Competition	0.10	0.00	0.17	0	1.00
Financial Spillover Competition	0.00	0.00	0.03	0	0.99
Industrial Spillover Knowledge	0.12	0.07	0.13	0	0.98
Financial Spillover Knowledge	0.00	0.00	0.03	0	0.88

Notes: The distributions in this table are drawn from the regression samples of firms in manufacturing sector with available data for the main regressions (see Data Appendix). Domestic sample refers to firms that never had foreign owners over the period of analysis. $log(VA/L)$ is the firm value added, defined as the difference between operating revenue and expenditure on materials in PPP $ 2005 base, divided by firm employment. $log(TFP)$ is the natural logarithm of the total factor productivity (in PPP $ 2005 base) which is computed following Wooldridge-Levinsohn-Petrin methodology (WLP). $Industrial\ FDI$ ($Financial\ FDI$) is the share of firm's voting equity owned by industrial (financial) foreign owners. *MS2dig–Output* (*MS2dig–Employment*) is the firm's output (employment) market share in total 2-digit sector output (employment) to which the firm belongs, by country; *MS4dig–Output* and *MS4dig–Employment* are the firm's market shares in the firm's 4-digit sector, by country.The spillover variables account for the share of foreign output in total sectoral output and distinguish between Industrial FDI and Financial FDI. The *Industrial Spillover* and *Financial Spillover* variables are constructed at the 2-digit sector classification level; the other spillover variables are constructed at the 4-digit sector classification level. In particular, $IndustrialSpilloverCompetition = \sum_{i \in s} IndustrialFDI_{i,s,c,t} \times Y_{i,s,c,t} / \sum_{i \in s} Y_{i,s,c,t}$ where $IndustrialFDI_{i,s,c,t}$ refers to the share of ownership by foreign industrial companies in firm i, four-digit sector s, in country c at time t. At the same time, $Y_{i,s,c,t}$ refers to output of firm i, in four-digit sector s, in country c at time t. Similarly, $FinancialSpilloverCompetition = \sum_{i \in s} FinancialFDI_{i,s,c,t} \times Y_{i,s,c,t} / \sum_{i \in s} Y_{i,s,c,t}$ where $FinancialFDI_{i,s,c,t}$ refers to the share of ownership by foreign financial companies in firm i, four-digit sector s, in country c at time t. "Knowledge Spillover" refers to the output produced by foreign companies in the same two-digit sector as the domestic firm but excluding the corresponding output produced by foreign companies operating in the same four-digit sector as the domestic firm. $IndustrialSpilloverKnowledge = IndustrialSpilloverCompetition - \left(\sum_{i \in s4} IndustrialFDI_{i,s4,c,t} \times Y_{i,s4,c,t}\right) / \sum_{i \in s2} Y_{i,s2,c,t}$ where in the second term, the numerator refers to output produced in the 4-digit sector by foreign-owned industrial companies and the denominator is total two-digit sectoral output. Regarding sector classification, s2 refers to two-digit sector classification and s4 refers to 4-digit sector classification. See Table A-2 for the industry classification and Sections 3 and 4 for the details on construction of variables.

Table 5: Total Factor Productivity and Foreign Ownership: Are Foreign Firms more Productive?

Dependent Variable: Firm Productivity					
	Panel A: Developed Countries				
	(1)	(2)	(3)	(4)	(5)
FDI	0.011***	0.008**	0.008**		
	(0.002)	(0.002)	(0.002)		
$IndustrialFDI$				0.008**	0.008**
				(0.002)	(0.002)
$FinancialFDI$				0.011	0.009
				(0.011)	(0.011)
Observations	418,736	418,736	418,736	418,736	418,736
Firms	61,131	61,131	61,131	61,131	61,131
Firm Fixed Effects	yes	yes	yes	yes	yes
Country-Year Fixed Effects	yes	yes	yes	yes	yes
Sector2dig-Year Fixed Effects	no	yes	N/A	yes	N/A
Sector4dig-Year Fixed Effects			yes		yes
Cluster	country-2dig-year	country-2dig-year	country-4dig-year	country-2dig-year	country-4dig-year
	Panel B: Emerging Countries				
	(1)	(2)	(3)	(4)	(5)
FDI	0.038***	0.035***	0.035***		
	(0.008)	(0.008)	(0.008)		
$IndustrialFDI$				0.034***	0.034***
				(0.008)	(0.008)
$FinancialFDI$				0.085**	0.076*
				(0.032)	(0.040)
Observations	96,354	96,354	96,354	96,354	96,354
Firms	15,663	15,663	15,663	15,663	15,663
Firm Fixed Effects	yes	yes	yes	yes	yes
Country-Year Fixed Effects	yes	yes	yes	yes	yes
Sector2dig-Year Fixed Effects	no	yes	N/A	yes	N/A
Sector4dig-Year Fixed Effects			yes		yes
Cluster	country-2dig-year	country-2dig-year	country-4dig-year	country-2dig-year	country-4dig-year

Estimation performed by Generalized Least Squares (GLS) where weights are the square root of the firm mean squared predicted residuals. Standard errors clustered at the corresponding level specified in the table are reported in parentheses. The dependent variable is the log of total factor productivity which is computed following Wooldridge-Levinsohn-Petrin methodology (WLP). Panel A focuses on the sample of developed countries while Panel B repeats the analysis for the sample of Emerging countries. $FDI_{i,s,c,t}$ is the log of one plus the percent share of foreign ownership in firm i capital structure. $IndustrialFDI_{i,s,c,t}$ refers to the log of one plus the share of ownership by foreign industrial companies in firm i, two-digit sector s, in country c at time t. $FinancialFDI_{i,s,c,t}$ refers to the log of one plus the share of ownership by foreign financial companies in firm i, two-digit sector s, in country c at time t. *** , **, *, denote significance at 1%, 5%, 10% levels. See Sections 3 and 4 for the details on construction of variables.

Table 6: Two Digit Sectoral Spillovers: Are There Positive Spillover Effects from Foreign Ownership?

Dependent Variable: Firm Productivity Sample: Domestic Firms				
	Panel A: Developed Countries			
	(1)	(2)	(3)	(4)
Spillover	0.026** (0.010)	0.014 (0.009)		
IndustrialSpillover			0.024** (0.010)	0.013 (0.009)
FinancialSpillover			0.066* (0.037)	0.038 (0.024)
Observations	363,354	363,354	363,354	363,354
Firms	53,642	53,642	53,642	53,642
Firm Fixed Effects	yes	yes	yes	yes
Country-Year Fixed Effects	yes	yes	yes	yes
Sector2dig-Year Fixed Effects	no	yes	no	yes
Cluster	country-2dig-year	country-2dig-year	country-2dig-year	country-2dig-year
	Panel B: Emerging Countries			
	(1)	(2)	(3)	(4)
Spillover	-0.061*** (0.015)	-0.067*** (0.015)		
IndustrialSpillover			-0.063*** (0.016)	-0.072*** (0.016)
FinancialSpillover			-0.002 (0.034)	0.005 (0.041)
Observations	77,362	77,362	77,362	77,362
Firms	12,896	12,896	12,896	12,896
Firm Fixed Effects	yes	yes	yes	yes
Country-Year Fixed Effects	yes	yes	yes	yes
Sector2dig-Year Fixed Effects	no	yes	no	yes
Cluster	country-2dig-year	country-2dig-year	country-2dig-year	country-2dig-year

Estimation performed by Generalized Least Squares (GLS) where weights are the square root of the firm mean squared predicted residuals. Standard errors clustered at the corresponding level specified in the table are reported in parentheses. Results are obtained based on the sample of firms with no foreign ownership (i.e., firms that were never acquired (in any percentage) by a foreign-owned investor over the period of analysis). The dependent variable is the log of total factor productivity which is computed following Wooldridge-Levinsohn-Petrin methodology (WLP). Panel A focuses on the sample of developed countries while Panel B repeats the analysis for the sample of Emerging countries. The spillover variables are constructed at the 2-digit sector classification level. The spillover variables account for the share of foreign output in total sectoral output and distinguish between Industrial FDI and Financial FDI. In particular, $IndustrialSpillover = \sum_{i \in s} IndustrialFDI_{i,s,c,t} \times Y_{i,s,c,t} / \sum_{i \in s} Y_{i,s,c,t}$ where $IndustrialFDI_{i,s,c,t}$ refers to the share of ownership by foreign industrial companies in firm i, two-digit sector s, in country c at time t. At the same time, $Y_{i,s,c,t}$ refers to output of firm i, in two-digit sector s, in country c at time t. Similarly, $FinancialSpillover = \sum_{i \in s} FinancialFDI_{i,s,c,t} \times Y_{i,s,c,t} / \sum_{i \in s} Y_{i,s,c,t}$ where $FinancialFDI_{i,s,c,t}$ refers to the share of ownership by foreign financial companies in firm i, two-digit sector s, in country c at time t. ***, **, *, denote significance at 1%, 5%, 10% levels. See Sections 3 and 4 for the details on construction of variables.

Table 7: Competition and Spillovers Within and Between Four Digit Sectors: Developed Countries

Dependent Variable: Firm Productivity
Sample: Domestic Firms

	Unbalanced Panel of Firms					Permanent Panel of Firms	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Spillover Competition	-0.024***	-0.026***	-0.029***			-0.030***	
	(0.004)	(0.004)	(0.004)			(0.006)	
Spillover Knowledge	0.035***	0.016**	0.022***			0.019*	
	(0.007)	(0.007)	(0.006)			(0.010)	
Industrial Spillover Competition				-0.027***	-0.030***		-0.031***
				(0.004)	(0.004)		(0.006)
Industrial Spillover Knowledge				0.016**	0.023***		0.019*
				(0.007)	(0.007)		(0.010)
Financial Spillover Competition				-0.009	-0.021		-0.016
				(0.015)	(0.014)		(0.020)
Financial Spillover Knowledge				0.019	0.026		0.025
				(0.025)	(0.020)		(0.039)
Observations	363354	363354	363354	363354	363354	166792	166792
Firms	53,642	53,642	53,642	53,642	53,642	20,849	20,849
Firm Fixed Effects	yes	yes	yes	yes	yes	yes	yes
Country-Year Fixed Effects	yes	yes	yes	yes	yes	yes	yes
Sector2dig-Year Fixed Effects	no	yes	N/A	yes	N/A	N/A	N/A
Sector4dig-Year Fixed Effects			yes		yes	yes	yes
Cluster	country-2dig-year	country-2dig-year	country-4dig-year	country-2dig-year	country-4dig-year	country-4dig-year	country-4dig-year

Estimation performed by Generalized Least Squares (GLS) where weights are the square root of the firm mean squared predicted residuals. Standard errors clustered at the corresponding level specified in the table are reported in parentheses. Results are obtained based on the sample of firms with no foreign ownership (i.e., firms that were never acquired (in any percentage) by a foreign-owned investor over the period of analysis). The dependent variable is the log of total factor productivity which is computed following Wooldridge-Levinsohn-Petrin methodology (WLP). Columns (1) to (5) report the results from an unbalanced sample of firms while columns (6) and (7) report the results from a permanent sample of firms (i.e., firms that we observe from 2000 to 2007 in our sample). The spillover variables are constructed at the 2-digit sector classification level. The spillover variables are constructed at the 4-digit sector classification level. The spillover variables account for the share of foreign output in total sectoral output and distinguish between Industrial FDI and Financial FDI. In particular, $IndustrialSpillover_Competition = \sum_{i\in s} IndustrialFDI_{i,s,c,t} \times Y_{i,s,c,t} / \sum_{i\in s} Y_{i,s,c,t}$ where $IndustrialFDI_{i,s,c,t}$ refers to the share of ownership by foreign industrial companies in firm i, four-digit sector s, in country c at time t. At the same time, $Y_{i,s,c,t}$ refers to output of firm i, in four-digit sector s, in country c at time t. Similarly, $FinancialSpillover_Competition = \sum_{i\in s} FinancialFDI_{i,s,c,t} \times Y_{i,s,c,t} / \sum_{i\in s} Y_{i,s,c,t}$ where $FinancialFDI_{i,s,c,t}$ refers to the share of ownership by foreign financial companies in firm i, four-digit sector s, in country c at time t. $KnowlegeSpillover$ refers to the output produced by foreign companies in the same two-digit sector as the domestic firm but excluding the corresponding output produced by foreign companies operating in the same four-digit sector as the domestic firm. $IndustrialSpilloverKnowledge = IndustrialSpilloverCompetition - \frac{\sum_{i\in s4} IndustrialFDI_{i,s4,c,t} \times Y_{i,s4,c,t}}{\sum_{i\in s2} Y_{i,s2,c,t}}$ where in the second term, the numerator refers to output produced in the 4-digit sector by foreign-owned industrial companies and the denominator is total two-digit sectoral output. Regarding sector classification, s2 refers to two-digit sector classification and s4 refers to 4-digit sector classification. *** , **, *, denote significance at 1%, 5%, 10% levels. See Sections 3 and 4 for the details on construction of variables.

Table 8: Channels in Developed Countries

Total Sample of Firms in Developed Countries

	Output				Employment			
	(1) ln(MS2dig)	(2) ln(MS4dig)	(3) ln(MS2dig)	(4) ln(MS4dig)	(5) ln(MS2dig)	(6) ln(MS4dig)	(7) ln(MS2dig)	(8) ln(MS4dig)
FDI	0.017***	0.020***			0.007**	0.008**		
	(0.004)	(0.004)			(0.003)	(0.003)		
IndustrialFDI			0.017***	0.020***			0.009**	0.009**
			(0.004)	(0.004)			(0.003)	(0.003)
FinancialFDI			-0.005	0.014			-0.045**	-0.023
			(0.018)	(0.020)			(0.014)	(0.015)
Obsservations	418,736	418,736	418,736	418,736	418,736	418,736	418,736	418,736
Firms	61,131	61,131	61,131	61,131	61,131	61,131	61,131	61,131
Firm Fixed Effects	yes	yes	yes	yes	yes	yes	yes	yes
Country-Year Fixed Effects	yes	yes	yes	yes	yes	yes	yes	yes
Sector2dig-Year Fixed Effects	yes	N/A	yes	N/A	yes	N/A	yes	N/A
Sector4dig-Year Fixed Effects		yes		yes		yes		yes
Cluster	country-2dig-year	country-4dig-year	country-2dig-year	country-4dig-year	country-2dig-year	country-4dig-year	country-2dig-year	country-4dig-year

Estimation performed by Generalized Least Squares (GLS) where weights are the square root of the firm mean squared predicted residuals. Standard errors clustered at the corresponding level specified in the table are reported in parentheses. In columns (1) and (3) the dependent variable is the share of firm i output in total two-digit sectoral output (columns (5) and (7) refer to the share of firm i employment in total two-digit sectoral employment). In columns (2) and (4) the dependent variable is the share of firm i output in total four-digit sectoral output (columns (6) and (8) refer to the share of firm i employment in total four-digit sectoral employment). $FDI_{i,s,c,t}$ is the log of one plus the percent share of foreign ownership in firm i capital structure. $IndustrialFDI_{i,s,c,t}$ refers to the log of one plus the share of ownership by foreign industrial companies in firm i, two-digit sector s, in country c at time t. $FinancialFDI_{i,s,c,t}$ refers to the log of one plus the share of ownership by foreign financial companies in firm i, two-digit sector s, in country c at time t. *** , **, *, denote significance at 1%, 5%, 10% levels. See Sections 3 and 4 for the details on construction of variables.

Table 9: Competition and Spillovers Within and Between Four Digit Sectors: Emerging Countries

Dependent Variable: Firm Productivity
Sample: Domestic Firms

	Unbalanced Panel of Firms					Permanent Panel of Firms	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Spillover Competition	-0.076***	-0.083***	-0.066***			-0.065***	
	(0.009)	(0.009)	(0.010)			(0.018)	
Spillover Knowledge	-0.042**	-0.054***	-0.069***			-0.050*	
	(0.013)	(0.013)	(0.015)			(0.026)	
Industrial Spillover Competition				-0.084***	-0.065***		-0.065***
				(0.009)	(0.010)		(0.018)
Industrial Spillover Knowledge				-0.061***	-0.074***		-0.055**
				(0.014)	(0.015)		(0.027)
Financial Spillover Competition				-0.054	-0.071		-0.124
				(0.038)	(0.043)		(0.106)
Financial Spillover Knowledge				0.026	-0.015		-0.002
				(0.036)	(0.035)		(0.066)
Observations	77,362	77,362	77,362	77,362	77,362	26,552	26,552
Firms	12,896	12,896	12,896	12,896	12,896	3,319	3,319
Firm Fixed Effects	yes	yes	yes	yes	yes	yes	yes
Country-Year Fixed Effects	yes	yes	yes	yes	yes	yes	yes
Sector2dig-Year Fixed Effects	no	yes	N/A	yes	N/A	N/A	N/A
Sector4dig-Year Fixed Effects			yes		yes	yes	yes
Cluster	country-2dig-year	country-2dig-year	country-4dig-year	country-2dig-year	country-4dig-year	country-4dig-year	country-4dig-year

Estimation performed by Generalized Least Squares (GLS) where weights are the square root of the firm mean squared predicted residuals. Standard errors clustered at the corresponding level specified in the table are reported in parentheses. Results are obtained based on the sample of firms with no foreign ownership (i.e., firms that were never acquired (in any percentage) by a foreign-owned investor over the period of analysis). The dependent variable is the log of total factor productivity which is computed following Wooldridge-Levinsohn-Petrin methodology (WLP). Columns (1) to (5) report the results from an unbalanced sample of firms while columns (6) and (7) report the results from a permanent sample of firms (i.e., firms that we observe from 2000 to 2007 in our sample). The spillover variables are constructed at the 2-digit sector classification level. The spillover variables are constructed at the 4-digit sector classification level. The spillover variables account for the share of foreign output in total sectoral output and distinguish between Industrial FDI and Financial FDI. In particular, $IndustrialSpillover_Competition = \sum_{i \in s} IndustrialFDI_{i,s,c,t} \times Y_{i,s,c,t} / \sum_{i \in s} Y_{i,s,c,t}$ where $IndustrialFDI_{i,s,c,t}$ refers to the share of ownership by foreign industrial companies in firm i, four-digit sector s, in country c at time t. At the same time, $Y_{i,s,c,t}$ refers to output of firm i, in four-digit sector s, in country c at time t. Similarly, $FinancialSpillover_Competition = \sum_{i \in s} FinancialFDI_{i,s,c,t} \times Y_{i,s,c,t} / \sum_{i \in s} Y_{i,s,c,t}$ where $FinancialFDI_{i,s,c,t}$ refers to the share of ownership by foreign financial companies in firm i, four-digit sector s, in country c at time t. $KnowlegeSpillover$ refers to the output produced by foreign companies in the same two-digit sector as the domestic firm but excluding the corresponding output produced by foreign companies operating in the same four-digit sector as the domestic firm. $IndustrialSpilloverKnowledge = IndustrialSpilloverCompetition - \frac{\sum_{i \in s4} IndustrialFDI_{i,s4,c,t} \times Y_{i,s4,c,t}}{\sum_{i \in s2} Y_{i,s2,c,t}}$ where in the second term, the numerator refers to output produced in the 4-digit sector by foreign-owned industrial companies and the denominator is total two-digit sectoral output. Regarding sector classification, s2 refers to two-digit sector classification and s4 refers to 4-digit sector classification. *** , **, *, denote significance at 1%, 5%, 10% levels. See Sections 3 and 4 for the details on construction of variables.

Table 10: Channels in Emerging Countries

Total Sample of Firms in Emerging Countries

	Output				Employment			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	ln(MS2dig)	ln(MS4dig)	ln(MS2dig)	ln(MS4dig)	ln(MS2dig)	ln(MS4dig)	ln(MS2dig)	ln(MS4dig)
FDI	0.112***	0.100***			0.066***	0.071***		
	(0.011)	(0.010)			(0.008)	(0.008)		
IndustrialFDI			0.109***	0.101***			0.067***	0.073***
			(0.011)	(0.010)			(0.008)	(0.008)
FinancialFDI			0.201***	0.051			-0.004	-0.016
			(0.047)	(0.053)			(0.038)	(0.045)
Observations	96,354	96,354	96,354	96,354	96,354	96,354	96,354	96,354
Firms	15,663	15,663	15,663	15,663	15,663	15,663	15,663	15,663
Firm Fixed Effects	yes	yes	yes	yes	yes	yes	yes	yes
Country-Year Fixed Effects	yes	yes	yes	yes	yes	yes	yes	yes
Sector2dig-Year Fixed Effects	yes	N/A	yes	N/A	yes	N/A	yes	N/A
Sector4dig-Year Fixed Effects		yes		yes		yes		yes
Cluster	country-2dig-year	country-4dig-year	country-2dig-year	country-4dig-year	country-2dig-year	country-4dig-year	country-2dig-year	country-4dig-year

Estimation performed by Generalized Least Squares (GLS) where weights are the square root of the firm mean squared predicted residuals. Standard errors clustered at the corresponding level specified in the table are reported in parentheses. In columns (1) and (3) the dependent variable is the share of firm i output in total two-digit sectoral output (columns (5) and (7) refer to the share of firm i employment in total two-digit sectoral employment). In columns (2) and (4) the dependent variable is the share of firm i output in total four-digit sectoral output (columns (6) and (8) refer to the share of firm i employment in total four-digit sectoral employment). $FDI_{i,s,c,t}$ is the log of one plus the percent share of foreign ownership in firm i capital structure. $IndustrialFDI_{i,s,c,t}$ refers to the log of one plus the share of ownership by foreign industrial companies in firm i, two-digit sector s, in country c at time t. $FinancialFDI_{i,s,c,t}$ refers to the log of one plus the share of ownership by foreign financial companies in firm i, two-digit sector s, in country c at time t. *** , **, *, denote significance at 1%, 5%, 10% levels. See Sections 3 and 4 for the details on construction of variables.

Table 11: Instrumental Variable Approach

Panel A: Second Stage

	Developed			Emerging		
	(1)	(2)	(3)	(4)	(5)	(6)
	TFP	$\ln(MS4dig_Y)$	$\ln(MS4dig_L)$	TFP	$\ln(MS4dig_Y)$	$\ln(MS4dig_L)$
FDI	0.005	0.074**	0.052	0.475***	0.741***	0.470***
	(0.036)	(0.029)	(0.036)	(0.097)	(0.129)	(0.110)
Observations	377,281	377,281	377,280	79,838	79,838	79,838
Firms	52,808	52,808	52,808	12,907	12,907	12,907
Firm Fixed Effects	yes	yes	yes	yes	yes	yes
Country-Year Fixed Effects	yes	yes	yes	yes	yes	yes
Sector4dig-Year Fixed Effects	yes	yes	yes	yes	yes	yes
Country-Sector4dig-Year Fixed Effects	yes	yes	yes	yes	yes	yes
Cluster	country-4dig-year	country-4dig-year	country-4dig-year	country-4dig-year	country-4dig-year	country-4dig-year

Panel B: First Stage

	Developed			Emerging		
	(1) FDI	(2) FDI	(3) FDI	(4) FDI	(5) FDI	(6) FDI
$\hat{FO_0} \times IndustryFDI_{sector,t}$	0.257***	0.525***	0.3122***	0.446***	0.384***	0.062*
	(0.055)	(0.052)	(0.048)	(0.038)	(0.039)	(0.035)
F	21.9	101.68	41.93	137.03	95.64	3.13
Observation	377,281	377281	377,280	79,838	79,838	79,838
Firms	52,808	52,808	52,808	12,907	12,907	12,907
Firm Fixed Effects	yes	yes	yes	yes	yes	yes
Country-Year Fixed Effects	yes	yes	yes	yes	yes	yes
Sector4dig-Year Fixed Effects	yes	yes	yes	yes	yes	yes
Country-Sector4dig-Year Fixed Effects	yes	yes	yes	yes	yes	yes
Cluster	country-4dig-year	country-4dig-year	country-4dig-year	country-4dig-year	country-4dig-year	country-4dig-year

Estimation performed by Generalized Least Squares (GLS) where weights are the square root of the firm mean squared predicted residuals. Standard errors clustered at the corresponding level specified in the table are reported in parentheses. In columns (1) and (3) the dependent variable is the log of total factor productivity which is computed following Wooldridge-Levinsohn-Petrin methodology (WLP). In columns (2) and (5) the dependent variable is the share of firm i output in total four-digit sectoral output (columns (3) and (6) refer to the share of firm i employment in total four-digit sectoral employment). $FDI_{i,s,c,t}$ is the log of one plus the percent share of foreign ownership in firm i capital structure. We obtain $\hat{FO_0}$ as the initial predicted foreign ownership value from a probit regression of the following type: $FO_{i,t} = \beta_0 FO_{i,t-1} + \beta_1 ln(K/L)_{i,t-1} + \beta_2 ln(VA/L)_{i,t-1} + \beta_3 ln(Assets)_{i,t-1} + \beta_4 ln(Assets)^2_{i,t-1} + \beta_5 Age_{i,t} + \beta_6 Age^2_{i,t}$. $FDI_{country,sector,t} = \sum_{i \in s4} FO_{i,t} \times Y_{i,0} / \sum_{i \in c,s4} Y_{i,0}$ where $Y_{i,0}$ refers to initial output. *** , **, *, denote significance at 1%, 5%, 10% levels. See Sections 3 and 4 for the details on construction of variables.

Table 12: Foreign Ownership Heterogeneity, Firm Productivity and Spillovers

Dependent Variable: Firm Productivity
Sample: Domestic Firms

	Developed		Emerging	
Sample	All	Domestic	All	Domestic
	(1)	(2)	(3)	(4)
$Foreign > 50$	0.004**		0.015**	
	(0.002)		(0.006)	
$Foreign < 50$	0.005**		0.008	
	(0.002)		(0.007)	
$CompetitionFO > 50$		-0.039***		-0.031*
		(0.005)		(0.018)
$CompetitionFO < 50$		-0.022***		-0.018
		(0.005)		(0.016)
$KnowledgeFO > 50$		0.025**		-0.062***
		(0.008)		(0.019)
$KnowledgeFO < 50$		-0.002		-0.023
		(0.006)		(0.019)
Observations	392570	363354	85555	77362
Firm Fixed Effects	yes	yes	yes	yes
Country-Year Fixed Effects	yes	yes	yes	yes
Sector2dig-Year Fixed Effects	N/A	N/A	N/A	N/A
Sector4dig-Year Fixed Effects	yes	yes	yes	yes
Cluster	country-4dig-year	country-4dig-year	country-4dig-year	country-4dig-year

Estimation performed by Generalized Least Squares (GLS) where weights are the square root of the firm mean squared predicted residuals. Standard errors clustered at the corresponding level specified in the table are reported in parentheses. In columns (2) and (4) results are obtained based on the sample of firms with no foreign ownership (i.e., firms that were never acquired (in any percentage) by a foreign-owned investor over the period of analysis). The dependent variable is the log of total factor productivity which is computed following Wooldridge-Levinsohn-Petrin methodology (WLP). Columns (1) and (2) report the results from the sample of developed countries while columns (3) and (4) report the results from the emerging countries sample. The spillover variables are constructed at the 4-digit sector classification level. The spillover variables account for the share of foreign output in total sectoral output. In particular, $Spillover_Competition = \sum_{i \in s} FDI_{i,s,c,t} \times Y_{i,s,c,t} / \sum_{i \in s} Y_{i,s,c,t}$ where $FDI_{i,s,c,t}$ refers to the share of ownership by foreign-owned companies in firm i, four-digit sector s, in country c at time t. At the same time, $Y_{i,s,c,t}$ refers to output of firm i, in four-digit sector s, in country c at time t. $KnowlegeSpillover$ refers to the output produced by foreign-owned companies in the same two-digit sector as the domestic firm but excluding the corresponding output produced by foreign companies operating in the same four-digit sector as the domestic firm. $SpilloverKnowledge = SpilloverCompetition - \frac{\sum_{i \in s4} FDI_{i,s4,c,t} \times Y_{i,s4,c,t}}{\sum_{i \in s2} Y_{i,s2,c,t}}$ where in the second term, the numerator refers to output produced in the 4-digit sector by foreign-owned companies and the denominator is total two-digit sectoral output. Regarding sector classification, s2 refers to two-digit sector classification and s4 refers to 4-digit sector classification. $Foreign > 50$ is a dummy variable that takes the value of one if the firms is majority owned by a foreign-owned investor and zero otherwise. $Foreign < 50$ takes the value of one if foreign-owned investors own less than 50 percent of the firm capital and zero otherwise. $CompetitionFO > 50$ and $CompetitionFO < 50$ are based on $Foreign > 50$ and $Foreign < 50$ respectively. Similarly, $KnowledgeFO > 50$ and $KnowledgeFO < 50$ are based on $Foreign > 50$ and $Foreign < 50$ respectively. *** , **, *, denote significance at 1%, 5%, 10% levels. See Sections 3 and 4 for the details on construction of variables.

Table 13: Firm Heterogeneity and Spillovers

Dependent Variable: Firm Productivity Sample: Domestic Firms	Developed		Emerging	
	(1)	(2)	(3)	(4)
Spillover Competition Below Median	-0.028*** (0.008)		-0.075*** (0.015)	
Spillover Competition Above Median	-0.031*** (0.008)		-0.055** (0.018)	
Spillover Knowledge Below Median	0.016 (0.015)		-0.067** (0.022)	
Spillover Knowledge Above Median	0.027** (0.013)		-0.071** (0.023)	
Spillover Competition 1st Quartile		-0.042** (0.014)		-0.080*** (0.023)
Spillover Competition 2nd Quartile		-0.017** (0.006)		-0.070*** (0.015)
Spillover Competition 3rd Quartile		-0.020*** (0.006)		-0.039** (0.016)
Spillover Competition 4th Quartile		-0.053** (0.017)		-0.082** (0.032)
Spillover Knowledge 1st Quartile		0.014 (0.026)		-0.034 (0.034)
Spillover Knowledge 2nd Quartile		0.017 (0.010)		-0.096*** (0.023)
Spillover Knowledge 3rd Quartile		0.011 (0.012)		-0.093*** (0.022)
Spillover Knowledge 4th Quartile		0.044** (0.019)		-0.032 (0.043)
Observations	363,354	363,354	77,362	77,362
Firm Fixed Effects	yes	yes	yes	yes
Country-Year Fixed Effects	yes	yes	yes	yes
Sector2dig-Year Fixed Effects	N/A	N/A	N/A	N/A
Sector4dig-Year Fixed Effects	yes	yes	yes	yes
Cluster	country-4dig-year	country-4dig-year	country-4dig-year	country-4dig-year

Estimation performed by Generalized Least Squares (GLS) where weights are the square root of the firm mean squared predicted residuals. Standard errors clustered at the corresponding level specified in the table are reported in parentheses. Results are obtained based on the sample of firms with no foreign ownership (i.e., firms that were never acquired (in any percentage) by a foreign-owned investor over the period of analysis). The dependent variable is the log of total factor productivity which is computed following Wooldridge-Levinsohn-Petrin methodology (WLP). Columns (1) and (2) report the results from the sample of developed countries while columns (3) and (4) report the results from the emerging countries sample. The spillover variables are constructed at the 4-digit sector classification level. The spillover variables account for the share of foreign output in total sectoral output. In particular, $Spillover_Competition = \sum_{i \in s} FDI_{i,s,c,t} \times Y_{i,s,c,t} / \sum_{i \in s} Y_{i,s,c,t}$ where $FDI_{i,s,c,t}$ refers to the share of ownership by foreign-owned companies in firm i, four-digit sector s, in country c at time t. At the same time, $Y_{i,s,c,t}$ refers to output of firm i, in four-digit sector s, in country c at time t. $Knowlege Spillover$ refers to the output produced by foreign-owned companies in the same two-digit sector as the domestic firm but excluding the corresponding output produced by foreign companies operating in the same four-digit sector as the domestic firm. $Spillover Knowledge = Spillover Competition - \frac{\sum_{i \in s4} FDI_{i,s4,c,t} \times Y_{i,s4,c,t}}{\sum_{i \in s2} Y_{i,s2,c,t}}$ where in the second term, the numerator refers to output produced in the 4-digit sector by foreign-owned companies and the denominator is total two-digit sectoral output. Regarding sector classification, s2 refers to two-digit sector classification and s4 refers to 4-digit sector classification. *** , **, *, denote significance at 1%, 5%, 10% levels. See Sections 3 and 4 for the details on construction of variables.

Table 14: Instrumental Variable Competition and Spillovers Within and Between Four Digit Sectors: Developed Countries

Dependent Variable: Firm Productivity
Sample: Domestic Firms

	OLS (1)	IV (2)
Competition	-0.032***	-0.103**
	(0.005)	(0.044)
Knowledge	0.017**	0.246**
	(0.008)	(0.083)
Obs.	328448	328448
F first stage competition		17.44
F first stage knowledge		12.97
Firm Fixed Effects	yes	yes
Country-Year Fixed Effects	yes	yes
Sector4dig-Year Fixed Effects	yes	yes
Cluster	country-4dig-year	country-4dig-year

Estimation performed by Generalized Least Squares (GLS) where weights are the square root of the firm mean squared predicted residuals. Standard errors clustered at the corresponding level specified in the table are reported in parentheses. Results are obtained based on the sample of firms with no foreign ownership (i.e., firms that were never acquired (in any percentage) by a foreign-owned investor over the period of analysis). The dependent variable is the log of total factor productivity which is computed following Wooldridge-Levinsohn-Petrin methodology (WLP). The spillover variables are constructed at the 4-digit sector classification level. The spillover variables account for the share of foreign output in total sectoral output in particular, $Spillover_C ompetition = \sum_{i \in s} FDI_{i,s,c,t} \times Y_{i,s,c,t} / \sum_{i \in s} Y_{i,s,c,t}$ where $FDI_{i,s,c,t}$ refers to the share of ownership by foreign companies in firm i, four-digit sector s, in country c at time t. At the same time, $Y_{i,s,c,t}$ refers to output of firm i, in four-digit sector s, in country c at time t. $KnowlegeSpillover$ refers to the output produced by foreign companies in the same two-digit sector as the domestic firm but excluding the corresponding output produced by foreign companies operating in the same four-digit sector as the domestic firm. Regarding sector classification, s2 refers to two-digit sector classification and s4 refers to 4-digit sector classification. *** , **, *, denote significance at 1%, 5%, 10% levels.

Figures

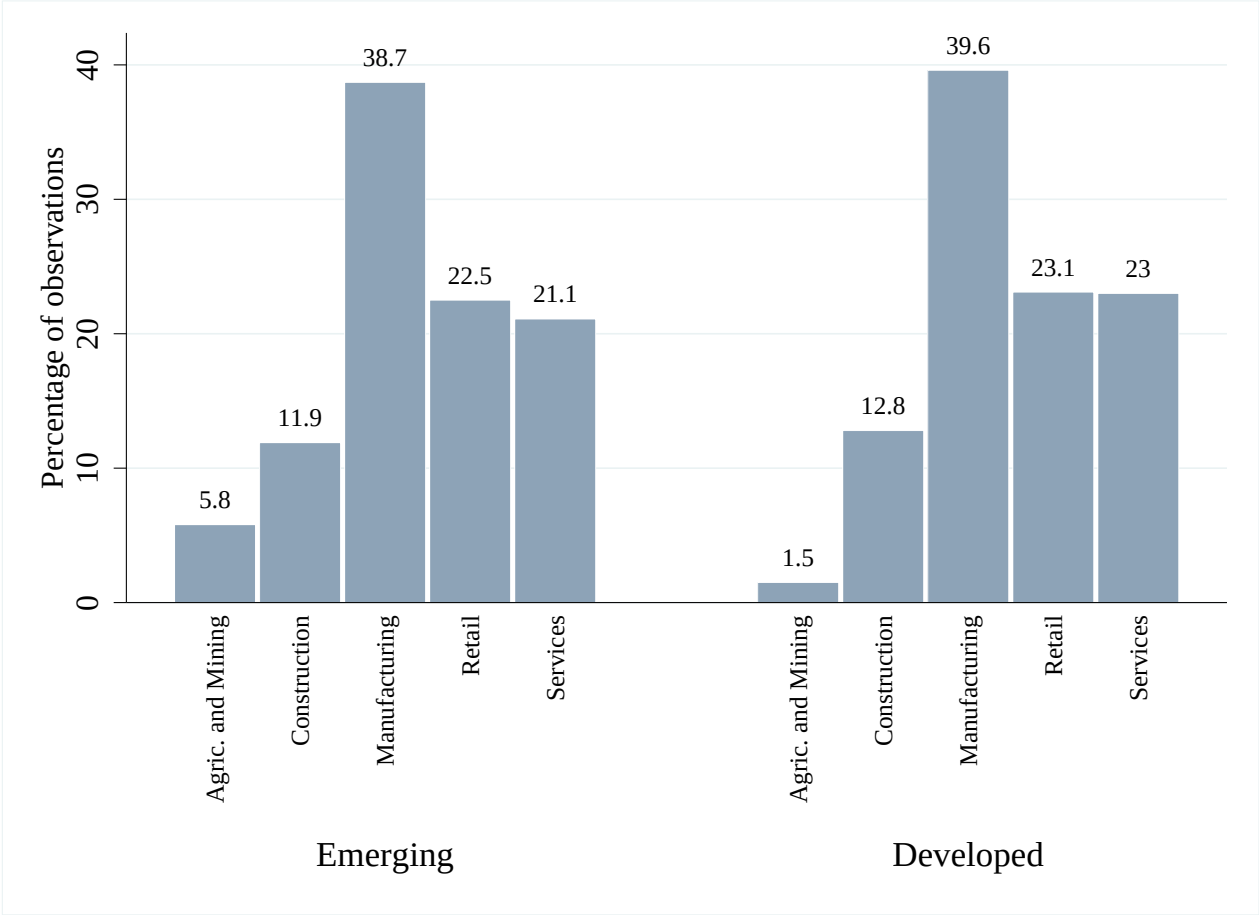
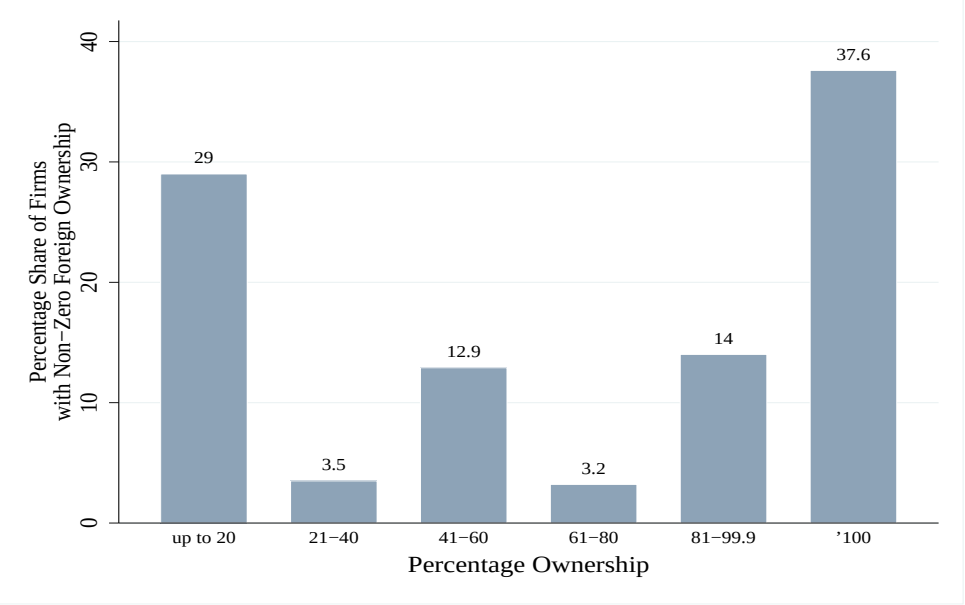


Figure 2: Sectoral Distribution of Firms

Notes: The figure shows the percentage of all firms in all available years in a given industry. Agric-Mining refers to Agriculture and Mining and corresponds to NACE 2 digit sector classification: 01, 02, 03, 05, 06, 07, 08, 09. Manufacturing: 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33. Construction: 41, 42, 43. Services: 49, 50, 51, 52, 53, 55, 56, 58, 59, 60, 61, 62, 63, 69, 70, 71, 72, 73, 74, 75, 77, 78, 79, 80, 81, 82, 85, 86, 87, 88, 90, 91, 92, 93, 94, 95, 96. Retail: 45, 46, 47. See Table A-2 for the industry classification and Sections 3 and 4 for the details on construction of variables. Firms are drawn from the sample with available data for TFP construction (panel B of Table 2).

Panel A: Industry-FDI



Panel B: Financial-FDI

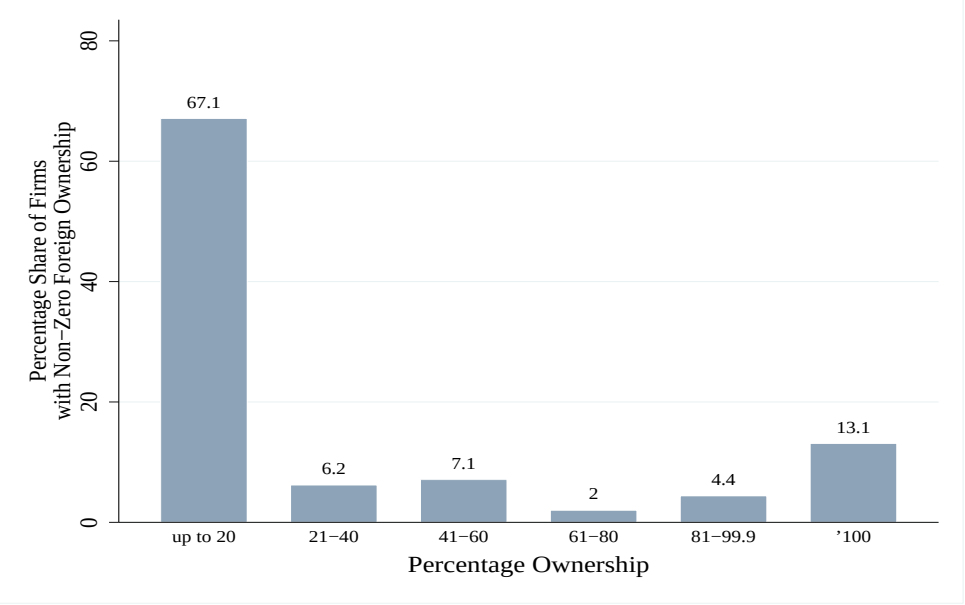
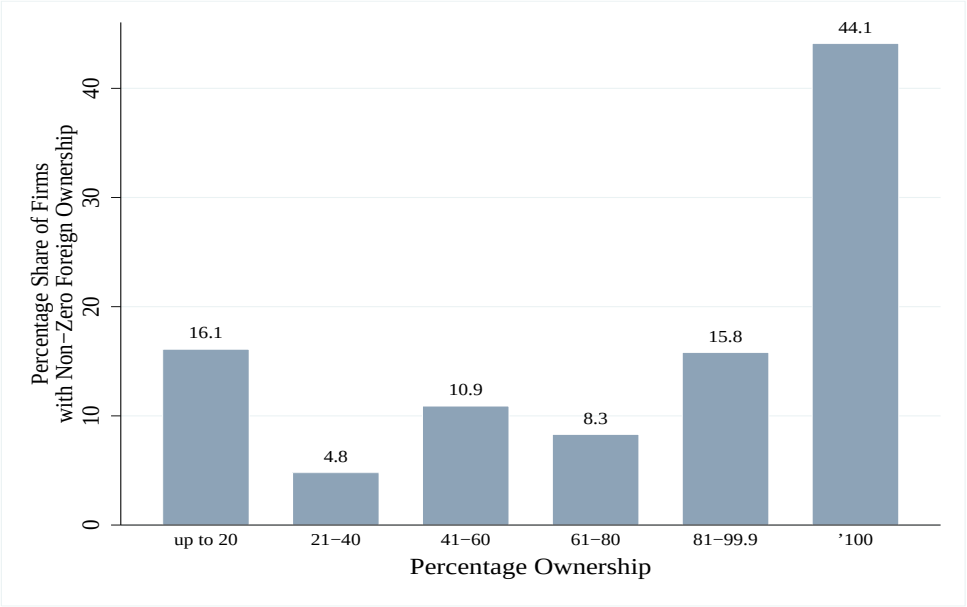


Figure 3: Distribution of Industry-FDI and Financial-FDI Among Foreign Owned Firms: Developed Countries

Notes: The figure shows the distribution of foreign ownership using all firms in all available years. Firms are drawn from the sample with available data for TFP construction (panel B of Table 2). The percentage of observations in a given ownership bin are computed relative to the total number of firms where foreign ownership of *given type* (industrial in panel A or financial in panel B) is larger than zero. See Sections 3 and 4 for the details on construction of variables.

Panel A: Industry-FDI



Panel B: Financial-FDI

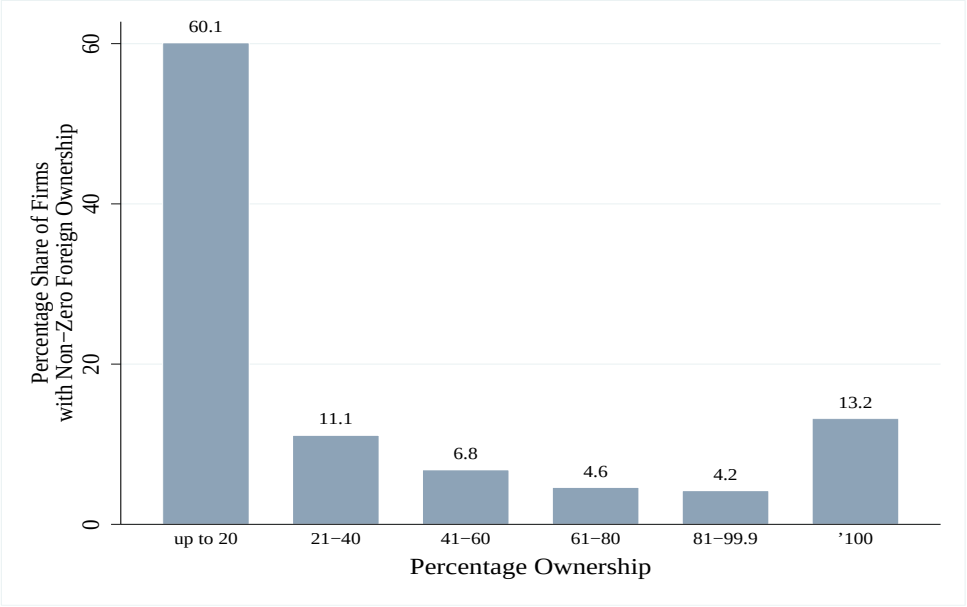
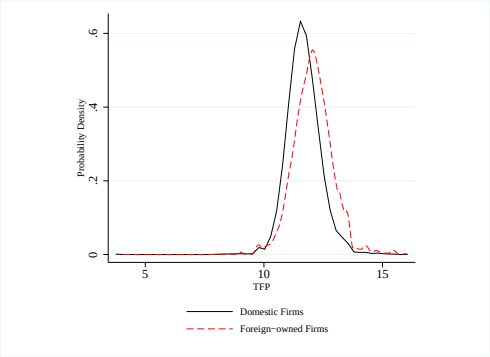
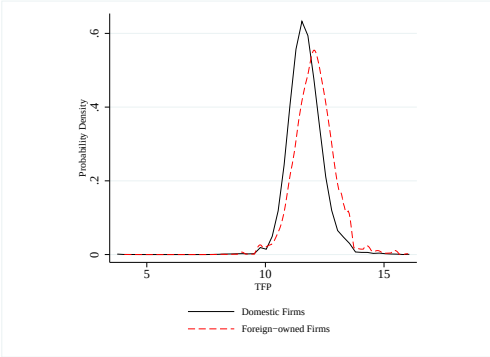


Figure 4: Distribution of Industry-FDI Among Foreign Owned Firms: Emerging Market Countries

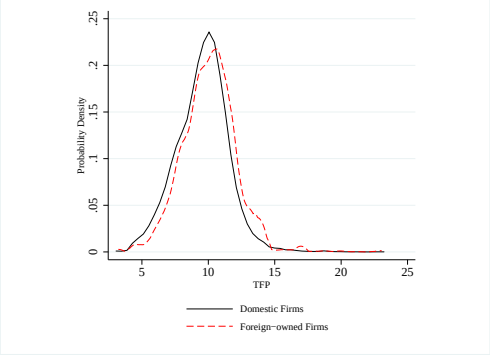
Notes: The figure shows the distribution of foreign ownership using all firms in all available years. Firms are drawn from the sample with available data for TFP construction (panel B of Table 2). The percentage of observations in a given ownership bin are computed relative to the total number of firms where foreign ownership of *given type* (industrial in panel A or financial in panel B) is larger than zero. See Sections 3 and 4 for the details on construction of variables.



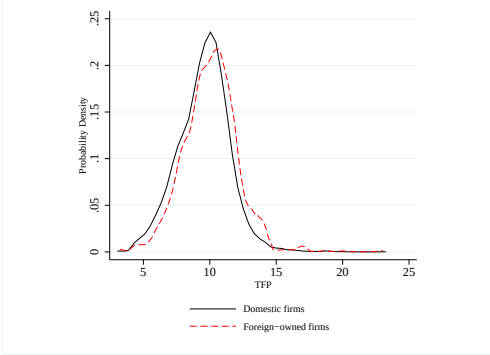
(a) Developed: Foreign-owned>0. Mean (Median) TFP of foreign-owned firms = 12.09 (12.08); Mean (Median) TFP of domestic firms = 11.66 (11.63



(b) Developed: Foreign-owned>50. Mean (Median) TFP of foreign-owned firms = 12.07 (12.07); Mean (Median) TFP of domestic firms = 11.66 (11.63)



(c) Emerging: Foreign-owned>0 Mean (Median) TFP of foreign-owned firms = 10.42 (10.43); Mean (Median) TFP of domestic firms = 9.55 (9.68).



(d) Emerging: Foreign-owned>50. Mean (Median) TFP of foreign-owned firms = 10.43 (10.45); Mean (Median) TFP of domestic firms = 9.55 (9.68)

Figure 5: TFP density distribution by foreign ownership

This figure plots the probability density of the logarithm of firm-level TFP (in PPP dollars 2005 base), computed by the method of Wooldridge, Levinsohn, and Petrin. The firm sample includes firms which never had foreign owners (domestic firms) and firms with positive industrial foreign ownership (foreign-owned firms) The probability density of a given value of the log(TFP) is obtained using the non-parametric univariate kernel density estimation. See Sections 3 and 4 for the details on construction of variables.

Appendix: Data

Sample Selection

We construct a unique data set of firm-level observations drawing the information from the comprehensive worldwide database of the company information **ORBIS**. ORBIS covers of around 100 million listed and private companies from around the world. At the moment of writing, ORBIS included 50 million companies in Europe, 24 million companies in North America, 7 million companies in South and Central America, and 9 million companies in Far East and Central Asia Among these there are over 65,000 listed companies in a more detailed format, plus nearly million M&A deals and rumors and around 90 million individuals.

In this study we focus on a subset of ORBIS covering European companies (roughly a half of the entire ORBIS universe).[22] European subset of ORBIS includes 41 countries with varying coverage. The database totals some 50 million public and private companies of large, medium, and small size with listed companies comprising only a small fraction of about 10 thousand companies. A company which has subsidiaries is required to prepare consolidated accounts; however, we use only *unconsolidated* accounts to avoid double counting.[23]

The literature typically subjects the raw data like this to a battery of cleaning. This appendix demonstrates the cleaning process in two major steps:

1. cleaning which is necessary for any project linking firm ownership with firm outcomes (we refer to this as the "general cleaning");

[22]For marketing purposes, the BvD packages this data in a separate database **AMADEUS**, which nevertheless has a very similar structure to the parent database.

[23]Even though the number of consolidated accounts is less than 1 percent of all accounts, it is important to use just the unconsolidated accounts. ORBIS categorizes all companies as subsidiaries regardless of the percentage of ownership: In standard accounting, a company A will be classified as a subsidiary of a company B if company B owns more than 50 percent of company A, while in ORBIS company A will be called a subsidiary even company B owns a 1 percent stake. There can be direct subsidiaries and also indirect subsidiaries owned by the direct subsidiaries. For example, BMW has 186 recorded subsidiaries, 54 of which are outside Europe (like BMW United States) and hence not in our data set. 77 out of the remaining 132 are direct subsidiaries owned more than 50 percent by the parent company. The remaining 55 companies are subsidiaries of these 77 companies. Another example is LEGO, that has 38 subsidiaries where only 3 of these are directly owned while the rest are subsidiaries of these 3. By using unconsolidated accounts outcomes do not include the outcome of parents and subsidiaries. By looking at the consolidated accounts of the 3 direct subsidiaries, we verified that the sum of sales and employment of the indirect subsidiaries is less than the numbers reported in the consolidated accounts of the 3 direct subsidiaries. (It will not be an exact match since we do not have data for subsidiaries outside Europe).

2. further cleaning pertaining to this project (we refer to this as the "project-specific cleaning").

General cleaning

From the beginning we focus on companies of a certain minimum size, discarding the companies defined by ORBIS as "small" (operating revenue equal to at least EUR1 million; total assets equal to at least EUR2 million, the number of employees equal to at least 10). The data coverage is limited at the beginning of the period and for some countries; due to the limited coverage before mid-1990s and delays with reporting the data coverage for meaningful analysis we focus on the period from 1996 to 2008. Initially we have information for 40 European countries and 1.8 million of unique firms for the period 1996–2008 of which many have missing outcomes and/or assets.

The main financial variables used in the analysis are total assets, operating revenue, tangible fixed assets and expenditure on materials, and employment. We convert all financial data into "PPP dollars 2005 base" using yearly GDP deflator with 2005 base from the World Bank and the 2005 end-of-year value of exchange rate versus the U.S. dollar. We prefer using international dollars rather than Euros because we plan to expand our sample to non-European companies. The "$" sign will represent PPP dollars 2005 base in the following. Employment is measured in persons.

We continue by dropping all firms that in any year have assets less than $1,000, employment negative or larger than 2 million (the employment of Walmart), negative sales, or negative operating revenue. As the result, we have 1.76 million firms. We drop firms that do not have ownership information and obtain the sample for 40 European countries and 1.42 million unique firms (See section Details of Foreign Ownership Calculations in this Appendix for details of ownership variables calculation).

Our firms represent a wide range of industries. The classification of 2 digit NACE Revision 2, Level 2 industries is presented in Table A-2. To continue with cleaning process, we drop the firms in certain industries, including Electricity, gas, steam and air conditioning supply (NACE codes 35xx); Water supply, sewerage, waste management and remediation activities (NACE codes 36xx–39xx); Financial and insurance services (NACE codes 41xx–43xx); Real estate (NACE codes 68xx); Public administration and defense (NACE codes 84xx); and activities of extraterritorial organizations (NACE codes 99xx). We obtain 1.23 million firms.

Next, we drop the data of the firms with gaps in the middle after the first spell of the data (the "holes" in the data). For example, if a firm reports the data in 2001–2004 and then in 2006 the 2006 is eliminated in analysis. After dropping 203,409 gaps we have still have 1.23 million firms but with less time observations.

For the construction of our regression variables we need non-missing data for certain financial variables. We drop firms with zero or missing employment, operating revenue and total assets, or negative 'costs of materials' and are left with 907 thousand firms.

After that we eliminate firms below the 0.1th percentile and above the 99.9th percentile in the distribution of sales to assets, operating revenue to assets, operating revenue to sales, employment to assets, employment to sales, employment to operating revenue, operating revenue less material costs ('value added' computed by us) to operating revenue, operating revenue less material costs to employment in any year. For the ratio of revenue to sales we drop firms above the 95th percentile in order to eliminate firms with high financial income. Although we drop all financial firms, many companies that are not financial but have significant investment income. An extreme example is Warren Buffett's Berkshire Hathaway, even that started as a textile firm and then became only an investment company over time. We also eliminate firms with sales larger than operating revenue. Overall, these filters allow us to get rid of phantom firms, tax-fronts, etc. The resulting sample covers the data for 788 thousand unique firms from 38 European countries during the period 1996–2008.

Project-specific cleaning

Data coverage, particular the sectoral information, is limited at the beginning of the period and for some countries. Therefore, we are limited to the sample of 15 developed countries and 15 emerging countries during the period 1999-2008 with approximately 740 thousand firms.

We concentrate on the sample of firms with more than 15 employees (see motivation in section Data in the main text) and known sector information (at 2- and 4-digit level of the NACE industry classification Revision 2 in Table A-2). This step eliminates roughly 1/2 of the previous sample bringing it down to a sample of 15 developed countries and 15 emerging countries during the period 1999-2008 with approximately 336 thousand firms. The data counts by country in this sample are

presented in panel A of Table 2.

In order to compute the total factor productivity (TFP) at the firm level we need data on output, employment, physical capital and cost of materials. Unfortunately, firms in some countries are not obliged to file their expenditure on materials. Furthermore, some firms do not report data on total fixed assets which limits our sample to 208 thousand firms from 12 developed countries and 13 emerging markets. The data counts by country in this sample are presented in panel B of Table 2.

If we focus on the manufacturing sector only (to compare our findings to previous results in the literature) we obtain 134 thousand firms.[24] The regression samples are drawn from this sample.

TFP Estimation

This appendix explains the details of the firm-level productivity estimates by the method of Wooldridge, Levinsohn and Petrin, as suggested by Olley and Pakes (1996) and Levinsohn and Petrin (2003) and further augmented by Wooldridge (2009). The following discussion is based on Wooldridge (2009), accommodated to the case of a production functions with two production inputs (see Wooldridge 2009 for a general discussion).

For firm i in time period t:

$$y_{it} = \alpha + \beta_l l_{it} + \beta_k k_{it} + \omega_{it} + e_{it}\,, \tag{10}$$

where y_{it}, l_{it}, and k_{it} denote the natural logarithm of firm value added, labor (a variable input), and capital, respectively. The firm specific error can be decomposed into a term capturing firm specific productivity ω_{it} and an additional term that reflects measurement error or unexpected productivity shocks e_{it}. We are interested in estimating ω_{it}.

A key implication of OP and LP estimation methods is that for some function $g(.,.)$:

$$\omega_{it} = g(k_{it}, m_{it})\,, \tag{11}$$

[24]See Appendix for NACE 2 sector classification. Manufacturing sectors are sectors 10, 11, 12, 13, 14, 15, 16, 17, 18, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33. We drop sector 19 "Manufacture of coke and refined petroleum products" since there are not enough observations per country to estimate TFP.

where m_{it} is a proxy variable (investment in OP, intermediate inputs in LP). Under the assumption

$$E(e_{it}|l_{it}, k_{it}, m_{it}) = 0 \qquad t = 1, 2, ..., T\,, \tag{12}$$

substituting equation (11) into equation (10), we have the following regression function:

$$\begin{aligned} E(y_{it}|l_{it}, k_{it}, m_{it}) &= \alpha + \beta_l l_{it} + \beta_k k_{it} + g(k_{it}, m_{it}) \\ &\equiv \beta_l l_{it} + h(k_{it}, m_{it})\,, \end{aligned} \tag{13}$$

where $h(k_{it}, m_{it}) \equiv \alpha + \beta_k k_{it} + g(k_{it}, m_{it})$.

In order to identify β_l and β_k we need some additional assumptions. First, rewrite equation (12) is in a more strong form, allowing more lags to condition on:

$$E(e_{it}|l_{it}, k_{it}, m_{it}, l_{i,t-1}, k_{i,t-1}, m_{i,t-1}, ..., l_{i1}, k_{i1}, m_{i1}) = 0 \qquad t = 1, 2, ..., T\,. \tag{14}$$

Second, productivity is assumed to follow a first-order Markov process:

$$E(\omega_{it}|\omega_{i,t-1}, ..., \omega_{i1}) = E(\omega_{it}|\omega_{i,t-1}) \qquad t = 2, 3, ..., T, \tag{15}$$

and it is also assumed that the productivity innovation $a_{it} \equiv \omega_{it} - E(\omega_{it}|\omega_{i,t-1})$ is uncorrelated with current values of the state variable k_{it} as well as past values of the variable input l, the state k and the proxy variables m:

$$\begin{aligned} &E(\omega_{it}|k_{it}, l_{i,t-1}, k_{i,t-1}, m_{i,t-1}, ..., l_{i1}, k_{i1}, m_{i1}) \\ &\quad = E(\omega_{it}|\omega_{i,t-1}) \equiv f[g(k_{i,t-1}, m_{i,t-1})]\,. \end{aligned} \tag{16}$$

Recall from equation(11) that $\omega_{i,t-1} = g(k_{i,t-1}, m_{i,t-1})$.

Plugging $\omega_{i,t} = f[g(k_{i,t-1}, m_{i,t-1})] + a_{it}$ into the equation (10) gives:

$$y_{it} = \alpha + \beta_l l_{it} + \beta_k k_{it} + f[g(k_{i,t-1}, m_{i,t-1})] + a_{it} + e_{it}\,. \tag{17}$$

Now it is possible to specify *two* equations that identify (β_l, β_k):

$$y_{it} = \alpha + \beta_l l_{it} + \beta_k k_{it} + g(k_{i,t}, m_{i,t}) + e_{it} \tag{18}$$

and

$$y_{it} = \alpha + \beta_l l_{it} + \beta_k k_{it} + f[g(k_{i,t-1}, m_{i,t-1})] + u_{it}\,, \tag{19}$$

where $u_{it} \equiv a_{it} + e_{it}$.

Important for the GMM estimation strategy, the available orthogonality conditions differ across these two equations. The orthogonality conditions for equation (18) are those outlined in the equation(14), while the orthogonality conditions for equation (19) are

$$E(u_{it}|k_{it}, l_{i,t-1}, k_{i,t-1}, m_{i,t-1}, ..., l_{i1}, k_{i1}, m_{i1}) = 0 \qquad t = 2, ..., T\,. \tag{20}$$

To proceed with the estimation, we could use an instrumental variable version of Robinson's (1988) estimator to allow f and g to be completely unspecified. Instead, we estimate these equations parametrically. In that, we follow Petrin, Reiter, and White (2011) and use a third-degree polynomial approximation using first order lags on the variable input as instruments.

Details of Foreign Ownership Calculations

To construct time and firm-specific foreign ownership variables we use two separate datasets by the BvD: the Ownership section of ORBIS dataset with "static" ownership breakdown for a given firm as of a given year-end, and the global **Zephyr** dataset containing the information about *changes* in ownership due to M&A. The ORBIS-Ownership database contains detailed information on owners of both listed and private firms including name, country of residence, and type (e.g., bank, industrial company, fund, individual, and so on). The global Zephyr database from the BvD which contains "deal records;" i.e., in each M&A, the target, the acquiring party or parties, the dates when the deal was announced and completed, and the type of the deal (e.g., Acquisition, Acquisition of 15%, Merger, Joint Venture, etc.).

Type-specific ownership.

The database refers to each record of ownership as an "ownership link" and BvD traces a link between two entities even when the ownership percentage is very small (sometimes less than 1 percent). For listed firms, very small stock holders are typically unknown.[25] An ownership link indicating that an entity A owns a certain percentage of Firm B is referred to in ORBIS as a "direct" ownership link.

We recode the the character variable with the direct ownership percentages into numeric format replacing some special character values according to the usual GAAP practice as follows: replace special code "WO" (wholly owned) with 100%; replace special code "MO" (majority owned) with 51%; replace code "CQP1" (50% plus 1 share) with 50%.

The database contains a variable with identifying owner country. If the owner's country is not the same as the country of the firm the link is identified as foreign. Often the owner country is missing. In such cases, the researchers who work with BvD data typically assume that the owner is located in the same country as the given company. To improve on this procedure we inspect the variable "owner name". When possible, we manually assign the foreign links when owner's name gives an indication that the owner is "foreign" even when the owner country is missing. The rest of the owners of unknown origin (typically small) are assigned to the home country.

Next we identify foreign links corresponding to a specific "owner type" using the available type of owner variable. The values of this variable is textual but sufficiently harmonized. Specifically, we identify *foreign ownership link of industrial type* if the foreign owner has the type Industrial company or Corporate. We identify *foreign ownership link of financial type* if the foreign owner has the type Bank, Financial company, Insurance, Insurance company, Mutual & Pension fund/Trust/Nominee, Other financial institution, Pension / mutual fund, Private Equity firms, or

[25] Countries have different rules for when the identity of a minority owner needs to be disclosed; for example, France, Germany, the Netherlands, and Sweden demand that listed firms disclose all owners with more than a five percent stake, while disclosure is required at three percent in the UK, and at two percent in Italy. See Schouten and Siems (2009). Information regarding US companies taken from the SEC Edgar Filings and the NASDAQ, however, stops at 1 percent (Bureau van Dijk, 2010) BvD collects its ownership data from the official registers (including SEC filings and stock exchanges), annual reports, private correspondence, telephone research, company websites, and news wires.

Stichting.[26,27]

Having identified foreign ownership links of a given type, we compute *Foreign Ownership* (FO) variable as follows: For a firm i, $FO_{i,t}$ is the sum of all percentages of direct ownership by foreigners in year t; $FO^F_{i,t}$ ($FO^I_{i,t}$) is the sum of all percentages of direct ownership by foreigners of financial (industrial) type. For example, if a Company A has three foreign owners with stakes 10 percent, 15 percent, and 35 percent, respectively, FO for this company is 60 percent. If the second owner is a bank, and the first and the third owner are industrial, the $FO^F_{i,t}$ is 15% and ($FO^I_{i,t}$) 45%. Owners of unknown origin (typically small) are assigned to the home country; the missing ownership percentage is set to zero, even though the link is preserved for other purposes (such as, for example, count of the number of owners).

Finally, we round the FO values to the 100th of a percent and clean the resulting year and firm-specific ownership data for erroneous values due to obvious mistakes. We encountered relatively few cases of those compared to the sample size. We drop a few firms where the computed total ownership (foreign and domestic) is larger than 102%. For the remaining cases, we replace $FO \subset [100, 102)$ by 100%.

Filling-in missing ownership information.

Kalemli-Ozcan, Sørensen and Volosovych (2010) provide detailed examples demonstrating that for the years we observe the ownership data from the ORBIS Ownership dataset, this database completely includes the information in the Zephyr database of Mergers and Acquisitions and adds to this becuase foreign ownership can change over time due to other reasons then M&As. The examples demonstrate that ownership information in Zephyr is clearly reflected in our FO variables, but there are companies that had changes in FO based on the ORBIS-Ownership database which do not appear in Zephyr.

Conversely, we have access to the ORBIS-Ownership dataset only at a biannual frequency for

[26] As of 2000, the only owner type values available are "Corporate" and "Individual". The more fine division starts from 2002 but no "Industrial company" value is available; both "Corporate" and "Industrial company" co-exist from 2004-on. We assign the "corporate" to be industrial type because it is otherwise impossible to determine the type of a given owner.

[27] The other types of the owners could be "government" type, public (for listed companies), or "other" for non-classified owners such as autocontrol, self-owned, employees/managers, individual, individual(s) or family(ies), personnel, employees, private individuals / private shareholders, foundation, foundation/research institute, unnamed private shareh., agg., miscellaneous undefined company, unknown, n.a., or simply missing.

the years 2000, 2002, 2004, 2006, 2008. We use the change in ownership information from Zephyr to fill-in the gaps in time series and to extend it to the earlier years. The Zephyr data can easily be matched with the ORBIS-Ownership because a BvD company identifier is included in both databases.

Specifically, we first need to clean the raw Zephyr dataset. We keep Zephyr deals in which both the BvD ID of the target and the acquiror are non-missing. Each deal comes with information about the stake acquired during this transaction and we need to turn all possible information into numeric values. For the cases in which the acquired stake is codified as unknown, we either have to infer this value by looking at non-missing information of the initial and final stakes, or alternatively we drop observations for which we lack this information.

In the next step, we need to clean the date variables. Zephyr includes a number of date variables showing when the deal took place (e.g., date announced, date completed, etc.). We drop observations for which no information on the date of the deal is provided, and if there are multiple non-missing dates, we use the date when the deal was completed.

In the following step, we generate the equivalent variables to the ones that had been created for ORBIS-Ownership. That is, we identify foreign links corresponding to a specific "owner type" using the available type of owner variable (e.g., foreign ownership link of industrial type, foreign ownership link of financial type). There are cases in which a target company has multiple ownership changes within the same year and the same acquiror. In this case, we keep the largest stake for a given acquiror and target in a given year. Therefore, after this step our Zephyr dataset is uniquely identified at the target-acquiror-year level. Finally, we collapse the data at the target-year level, thereby adding up all the foreign ownership stakes for each foreign nationality-type.

Once we have obtained the clean version of our Zephyr dataset at target firm-year, we are ready to merge it to the ORBIS-Ownership database, which has non-missing ownership information for the years 2000, 2002, 2004, 2006, 2008. In order to obtain the best match, in a sense of filling-in the missing gaps in ORBIS-Ownership but not "damaging" the data by overwriting with incorrect data from Zephyr, we adopt the following procedure. First, we generate a balanced panel for the ORBIS-Ownership database for the years 2000-2010. Next, we merge this balanced panel with our cleaned version of the Zephyr dataset using the unique BvD ID identifiers that are present in both

datasets. Given that our key reference for ownership information is the ORBIS-Ownership dataset, we tend to give priority to this database versus the Zephyr data set. Among other things, we do not replace non-missing ORBIS-Ownership information with Zephyr information. That is to say, we only add ownership from Zephyr when the corresponding ownership information is missing in ORBIS-Ownership. With respect to filling-in the missing gaps of data, these gaps of ownership information can be present in the initial years, the final years, or the years in between. For the gaps in the initial (final) years of ownership, we assume that the ownership is the same as in the first (last) observation with non-missing data. For the missing observations in the periods in between the first and last non-missing periods, we will replace the missing values with the non-missing observations of the earlier periods. The underlying assumption is that if a no transaction has been included in Zephyr, then there was no ownership change.

The resulting combined ownership dataset is merged with financial data.

Table A-1: Firm Coverage in Manufacturing: 2002–2007.

		(1)	(2)	(3)	(4)
	Sample	Firms	Firms with GUO	Firms with FO	Firms with Financial Data in Every Year
			Our sample		
1	UA	39952	451	628	18931
2	SK	3376	79	508	301
3	SI	3457	36	129	1510
4	SE	21159	1421	452	15236
5	RU	57259	1934	1330	69
6	RS	16642	64	505	6820
7	RO	49597	105	3885	14084
8	PT	33242	237	202	77
9	PL	11393	291	1542	2706
10	NO	6696	52	163	28
11	NL	1919	143	298	434
12	LV	2276	26	118	329
13	LT	2393	11	170	471
14	IT	116	15	3	84
15	HU	13029	29	245	587
16	HR	7650	90	178	4334
17	GR	4682	66	38	3484
18	GB	12828	487	2046	5670
19	FR	88854	1158	1975	56140
20	FI	10150	323	318	2999
21	ES	82059	1183	1169	43639
22	EE	4262	14	534	1882
23	DK	1600	69	174	64
24	DE	14384	382	1193	568
25	CZ	13234	305	1763	3160
26	CH	163	56	15	95
27	BG	7574	80	611	1422
28	BE	8804	420	678	3193
29	BA	2677	26	100	1019
30	AT	1610	46	213	81
	Sum	523037	9599	21183	188620
			Countries to Be Added		
1	US	6230	1554	190	1566
2	KR	37446	153	215	8845
3	JP	27577	1527	128	10727
4	CN	181906	776	1952	60504
			Additional Countries with Problematic Firm Coverage		
1	ZA	70	19	5	3
2	TW	1225	893	3	23
3	TR	78	3	5	.
4	TN	3	.	.	.
5	NZ	13	3	.	2
6	MY	919	144	139	54
7	MX	1278	44	277	.
8	MK	355	11	10	.
9	MA	6	.	.	.
10	KZ	12	2	3	2
11	IS	336	12	7	5
12	IN	213	15	13	3
13	IL	196	45	14	6
14	IE	586	89	174	15
15	ID	213	5	55	12
16	HK	55	12	13	7
17	EG	38	.	4	.
18	CO	409	13	10	17
19	CL	53	2	3	.
20	CA	10	3	3	.
21	BR	1926	65	366	.
22	BM	268	46	226	41
23	AU	593	239	165	19
24	AR	691	28	168	2
25	AE	11	4	.	.
	Sum	262716	5707	4148	82035

Notes: The table presents number of firms from ORBIS with some financial data from selected countries. **Countries**: Algeria (DZ), Argentina (AR), Australia (AU), Austria (AT), Belarus (BY), Belgium (BE), Bermuda (BM), Bosnia and Herzegovina (BA)[a], Brazil (BR), Bulgaria (BG), Canada (CA), Chile (CL), China (CN), Colombia (CO), Croatia (HR), Czech Republic (CZ), Denmark (DK), Egypt (EG), Estonia (EE), Finland (FI), France (FR), Germany (DE), Greece (GR), Hong Kong (HK), Hungary (HU), Iceland (IS), India (IN), Indonesia (ID), Ireland (IE), Israel (IL), Italy (IT), Japan (JP), Kazakhstan (KZ), Korea Republic of (KR), Latvia (LV), Lithuania (LT), Macedonia (MK), Malaysia (MY), Mexico (MX), Morocco (MA), Netherlands (NL), New Zealand (NZ), Norway (NO), Poland (PL), Portugal (PT), Romania (RO), Russian Federation (RU), Serbia (RS), Slovakia (SK), Slovenia (SI), South Africa (ZA), Spain (ES), Sweden (SE), Switzerland (CH), Taiwan (TW), Tunisia (TN), Turkey (TR), Ukraine (UA), United Arab Emirates (AE), United Kingdom (GB), United States of America (US). **Financial Data:** All companies with a known value of 1) Operating revenue; and 2) Total assets; and 3) Number of employees in *at least one* of the selected periods 2002–2007. **GUO is Global Ultimate Owner, FO is foreign owned in any amount larger than zero percent** .

Table A-2: (Appendix Table 2) NACE Revision 2, Level 2 Classification.

Code	Name of the Level 2 NACE sector
01	Crop and animal production, hunting and related service activities
02	Forestry and logging
03	Fishing and aquaculture
05	Mining of coal and lignite
06	Extraction of crude petroleum and natural gas
07	Mining of metal ores
08	Other mining and quarrying
09	Mining support service activities
10	Manufacture of food products
11	Manufacture of beverages
12	Manufacture of tobacco products
13	Manufacture of textiles
14	Manufacture of wearing apparel
15	Manufacture of leather and related products
16	Manufacture of wood and of products of wood and cork, except furniture, etc.
17	Manufacture of paper and paper products
18	Printing and reproduction of recorded media
19	Manufacture of coke and refined petroleum products
20	Manufacture of chemicals and chemical products
21	Manufacture of basic pharmaceutical products and pharmaceutical preparations
22	Manufacture of rubber and plastic products
23	Manufacture of other non-metallic mineral products
24	Manufacture of basic metals
25	Manufacture of fabricated metal products, except machinery and equipment
26	Manufacture of computer, electronic and optical products
27	Manufacture of electrical equipment
28	Manufacture of machinery and equipment n.e.c.
29	Manufacture of motor vehicles, trailers and semi-trailers
30	Manufacture of other transport equipment
31	Manufacture of furniture
32	Other manufacturing
33	Repair and installation of machinery and equipment
35	Electricity, gas, steam and air conditioning supply
36	Water collection, treatment and supply
37	Sewerage
38	Waste collection, treatment and disposal activities; materials recovery
39	Remediation activities and other waste management services
41	Construction of buildings
42	Civil engineering
43	Specialised construction activities
45	Wholesale and retail trade and repair of motor vehicles and motorcycles
46	Wholesale trade, except of motor vehicles and motorcycles
47	Retail trade, except of motor vehicles and motorcycles
49	Land transport and transport via pipelines
50	Water transport
51	Air transport
52	Warehousing and support activities for transportation
53	Postal and courier activities
55	Accommodation
56	Food and beverage service activities
58	Publishing activities
59	Motion picture, video and television programme production, sound recording and music publishing
60	Programming and broadcasting activities
61	Telecommunications
62	Computer programming, consultancy and related activities
63	Information service activities
64	Financial service activities, except insurance and pension funding
65	Insurance, reinsurance and pension funding, except compulsory social security
66	Activities auxiliary to financial services and insurance activities
68	Real estate activities
69	Legal and accounting activities
70	Activities of head offices; management consultancy activities
71	Architectural and engineering activities; technical testing and analysis
72	Scientific research and development
73	Advertising and market research
74	Other professional, scientific and technical activities
75	Veterinary activities
77	Rental and leasing activities
78	Employment activities
79	Travel agency, tour operator and other reservation service and related activities
80	Security and investigation activities
81	Services to buildings and landscape activities
82	Office administrative, office support and other business support activities
84	Public administration and defence; compulsory social security
85	Education
86	Human health activities
87	Residential care activities
88	Social work activities without accommodation
90	Creative, arts and entertainment activities
91	Libraries, archives, museums and other cultural activities
92	Gambling and betting activities
93	Sports activities and amusement and recreation activities
94	Activities of membership organizations
95	Repair of computers and personal and household goods
96	Other personal service activities
97	Activities of households as employers of domestic personnel
98	Undifferentiated goods- and services-producing activities of private households for own use
99	Activities of extraterritorial organizations and bodies