# Quantifying Productivity Gains from Foreign Investment*

Christian Fons-Rosen, Sebnem Kalemli-Ozcan, Bent E. Sørensen,
Carolina Villegas-Sanchez, and Vadym Volosovych

PRELIMINARY: October 2012

**Abstract**

Using a new and unique global firm-level database, we quantify productivity gains from foreign investment. We find evidence of positive selection: multinationals invest in high productivity firms and/or firms with future growth potential. Correcting for this, we find that productivity of acquired firms increases in emerging markets but not in developed countries. Domestic firms in the same narrow sector of foreign investment suffer a decline in productivity which we interpret as a negative spillover due to increased competition. This holds for developed as well as emerging countries. In developed countries, we find evidence of positive effects of multinational investment on the productivity of domestic firms at the top quintile of the productivity distribution operating within the same broad but different narrow sector which we interpret as knowledge spillovers. In the absence of direct productivity effects and negligible spillover effects, our results imply small, if any, aggregate gains from foreign direct investment in developed economies. A similar result holds for emerging markets in spite of positive direct effects for affiliates, due to strong competition for factors of production and market shares between domestic firms and multinationals.

JEL: E32, F15, F36, O16.

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

*Affiliations: University of Pompeu Fabra; University of Maryland, CEPR, and NBER; University of Houston and CEPR; ESADE - Universitat Ramon Llul; Erasmus University Rotterdam.

# 1 Introduction

A key feature globalization is the increasing role of foreign direct investment (FDI) in total capital flows to both developed and emerging markets. Macro-level studies document a positive correlation between aggregate growth and aggregate FDI flows (see Kose, Prasad, Rogoff, and Wei (2009)) which is often considered a result of combination of direct productivity effects on acquired firms and knowledge spillovers to domestic firms in the host country, from multinationals with superior technology, know-how, and management practices.[1] However, no systematic multi-country studies so far provide direct *causal* evidence supporting this view.[2] This is task that this paper takes up.

Micro firm-level studies faces central identification problems because multinational firms endogenously *select* their targets. The new new trade theory stresses 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 and high future growth potential. There are very large differences in the level of productivity across firms: Syverson (2011) finds that total factor productivity for firms at the 90th percentile is twice as high as productivity at the 10th percentile. Given this range, there is amble scope for selection effects: for example, foreign firms may select themselves into high productivity sectors and drive weak domestic firms out of business. In such a case, domestic firms in the foreign activity sector are becoming more productive on average, but not because any single firm has itself become more productive. Establishing a causal effect of FDI on productivity (directly on foreign owned firms and indirectly via spillovers on domestic firms) is challenging: to identify such an effect, firm and sector specific selection effects must be accounted for, and we do so using data for many countries and sectors and using instrumental variables techniques.

Our data comes from the ORBIS database (compiled by Bureau van Dijk Electronic Publishing, BvD) and covers 60 countries worldwide, developed and emerging.[3] The data set has financial ac-

[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] Country-level studies cannot identify the causal effects due to several simultaneity problems inherent in the macro data. Existing firm-level studies focus on a single country/event study and hence lack external validity; i.e., they vary to a great extent depending on the country focus (developed or emerging) of the particular study. See survey by Barba-Navaretti and Venables (2004).

[3] AMADEUS is a European sub-set of ORBIS; the U.S. data is identical to data from Dun&Bradstreet (D&B). We

counting information from detailed harmonized balance-sheets of 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, where the dataset encompasses over 30 million shareholder/subsidiary links. 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 SIC classification) than the target German company and we also know the exact amount of investment; i.e., the percentage of voting shares held. We also know if the investor is a multinational company and or has a global ultimate owner together with whether this is a greenfield investment from the start-up or a full acquisition, merger, or a partial acquisition. We have this information for most private companies of all sizes and for the universe of listed companies for our countries.

Figure 1 illustrates, using data aggregated by sector, how TFP and foreign ownership are heterogenous even after sectoral aggregation. This correlation seen in this figure will be absorbed into fixed effects in our regression analysis as 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? Although this question has been asked many times before, researchers have only showed a positive correlation between the *level* of productivity and *level* of foreign ownership and not between the *changes* in productivity and *changes* in foreign ownership. Put it differently, upon inclusion of firm fixed effects, there seems to be no relation between FDI and productivity (See Aitken and Harrison (1999); Harrison, Martin, Natraj, 2011).[5] This is a

are in the process of adding data for the U.S. together with Japan, Korea, and Canada. Our main analysis will use 30 countries with good firm coverage 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. Often, we know the identity of the owners holding as low as 0.01% ownership stake in private companies.

[5]Partial exceptions are Arnold and Javorcik (2009) and Guadalupe, Kuzmina and Thomas (2010). These papers do not use fixed-effects so their identification is not from changes in foreign ownership and productivity; however,

puzzling result especially since it has been shown that acquired firms do better in terms of profits, revenues, value added, and labor productivity (See Chari, Chen, Dominquez, 2011).

One explanation for these conflicting findings is that there was not enough time series variation in the previous studies to identify from changes in productivity and foreign ownership over time. Our advantage over existing studies is that we have a large number of 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 potentially important given the results of the new new trade literature emphasizing firm heterogeneity (see Helpman (2006)). The productivity effects 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 a full description of heterogeneity in multinational investment which will correlate with heterogeneity in firm-level productivity as clearly shown in figure above.[6]

Our quest for causality for the direct total factor productivity effects implies that we need to control both for firm level and sector level selection; i.e., we have to condition on multinationals targeting growing industries and/or growing countries, as well as firm with high initial productivity through the use of sector-time, country-time, and firm fixed effects. In addition, we need exogenous firm-specific time-series variation. Our instrumentation strategy for the direct effect relies on interacting initial firm-level predicted foreign ownership shares with the growth of country and sector specific FDI. Because we account for firm, country, and sector specific constants, as well as specific time trends for sectors and countries, the exclusion and validity conditions of our instruments are likely to be justified. This type of instrument was first suggested by Acemoglu and Johnson (2007).

---

they use propensity-score matching, which is another method for dealing with unobserved firm-level heterogeneity. They both find productivity increases for acquired firms.

[6]Exceptions are Javorcik (2004), Aitken and Harrison (1999), and Arnold and Javorcik (2009), who use firm-level ownership shares.

Second, we ask whether domestic firms that operate in the same sector as foreign affiliates become more productive with increased foreign presence? Again, this question has been asked before and the finding was that horizontal spillovers are negative in emerging countries and positive in developed countries. The explanation has been that competition and business stealing effects are relatively more pronounced in emerging countries. But why are such competition effects are not present in developed countries? There can be many reasons, one being omitted sector-year effects. The spillover literature aggregates firm-level observations to proxy sectoral level FDI and then tests for potential productivity spillovers to domestic firms in the same sector or vertically-linked sectors. Unfortunately this literature cannot explicitly control for sector-time shocks (including sectoral trends) due to its focus on a single country. To identify spillover effects, controlling for sector-year influences may be a first order importance for alleviating endogeneity concerns because we try to trace out the productivity impact of *sectoral* foreign presence on the domestic firms within the same sector. Typically, sectoral foreign presence is correlated with other sector-year events and can only be controlled for in multi-country datasets.

After replicating the negative horizontal spillover result for developed and emerging countries, we decompose these spillovers into knowledge spillovers and competition effects. Here, we use the advantage of our relatively fine four digit classification and investigate spillovers within the two digit sector by decomposing them into competition (firms operating within the same four digit sector) and knowledge spillover effects (firms operating within same two digit but different four digit sector). This is not vertical spillovers as they are usually defined as spillovers between two digit sectors such as car manufacturers and electricity producers; however, our within two digit knowledge spillovers are between car manufacturers and car part producers. 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. 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 are investments by industrial firms while the latter are investments by banks and financial institutions. Industrial FDI, if it is horizontal, may be undertaken to avoid trade costs by locating production facilities overseas as argued by Markusen (1984). If foreign industrial ownership is vertical, it may reflect a desire to take advantage of cross-border factor price differences as argued by Helpman (1984) and Helpman and Krugman (1985). Most of the empirical literature finds that horizontal FDI dominates. A recent paper by Alfaro and Charlton (2009) casts doubt on this view by showing that vertical FDI has been underestimated due to data limitations of the earlier literature. Financial FDI may be undertaken in order to diversify income or financial firms may invest in low productivity firms at a discount price in order to reorganize and selling off the reorganized entities.

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 variable (IV) exercise, we cannot rule out that this effect in developed countries is driven solely by future growth potential; i.e., growing firms becoming foreign-owned. In emerging markets, the positive effect survives the IV analysis. For these countries if a domestic firm becomes fully owned by a multinational, this firm will experience a 50 percent productivity increase. This number is bigger than 13 percent increase found in Arnold and Javorcik (2009), but this effect is for plants. It is also bigger than 16 percent productivity increase found in Guadalupe, Kuzmina and Thomas (2010), who investigates a smaller sample of Spanish firms.

We find evidence of positive spillovers from foreign activity 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 domestic firms that are direct competitors there are strong negative competition effects. In emerging markets, we find evidence of negative productivity spillovers which are driven mainly by market share reallocation effects rather than entry and exit. Foreign-owned firms capture higher market shares in terms of employment even from non-direct competitors which dominates any potential knowledge spillovers. Knowledge spillovers are also negative even after we separate out competition effects. We conjecture that foreigners source from other foreigners in the non-competing sectors instead of domestic firms which can explain this result. We find a loss of 50 percent of market shares and 60 percent productive declines, which is much bigger than what has been found in the literature that does not control other sector-year trends.

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 (See Aitken and Harrison (1999), Haskel, Pereira, and Slaughter (2007), Keller and Yeaple (2009).)

These papers in general do not find direct effects when firm fixed effects are included but find negative horizontal spillovers and positive vertical spillovers. Given their single country focus, they cannot control for sector-year trends, which is problematic given the sector-time level variation of all the spillovers variables that the identification is based upon. The literature has not made much progress in decomposing productivity spillovers and competition effects, while accounting for selection effects, at least empirically—Alfaro and Chen (2012) construct a structural model aimed at such decomposition.

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

# 2 Methodology

## 2.1 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:

$$\ln\left(\textsc{tfp}_{i,s,c,t}\right) = \beta\,\textsc{fo}_{i,s,c,t} + \alpha_i + \delta_{c,t} + \phi_{s,t} + \epsilon_{i,s,c,t}\,, \tag{1}$$

where $\textsc{tfp}_{i,s,c,t}$ refers to total factor productivity of firm $i$, in sector $s$, in country $c$, at time $t$, and $\textsc{fo}_{i,s,c,t}$ is the percentage of firm $i$'s capital owned by foreign investors at time $t$. We also distinguish among industrial and financial foreign ownership, where $\textsc{fo}^{I}_{i,s,c,t}$ represents the share of capital owned by foreign industrial investors and $\textsc{fo}^{F}_{i,s,c,t}$ represents the share of capital owned by foreign financial investors. $\alpha_i$ represents firm-specific dummies, $\delta_{c,t}$ represents country-year (country×year) dummies, and $\phi_{s,t}$ represents sector-year (sector×year) dummies (fixed effects).

The parameter of interest is the "within" coefficient, $\beta$: a positive $\beta$ implies that changes in foreign ownership are associated with increasing productivity relative to firms that stay domestically owned. At this stage, we are not making any statements about whether domestic FDI targets become more productive or whether foreign-owned firms target more productive domestic companies (cherry-picking)—see Section 3.2 on 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 firm. We therefore estimate equation (1) by two-step feasible GLS.[7]

## 2.2 Productivity Spillovers

Traditionally, the literature on FDI spillovers has estimated an equation of the following type for the sample of domestic firms:[8]

$$\ln\left(\text{TFP}_{i,s,t}\right) = \beta \text{Spillover}_{s,t} + \alpha_i + \delta_t + \epsilon_{i,s,t} \; , \tag{2}$$

where $\text{TFP}_{i,s,t}$ refers to total factor productivity of firm $i$, in sector $s$, at time $t$ and $\text{Spillover}_{s,t}$ is a regressor, to be discussed, which captures the presence of foreign ownership in sector $s$. $\alpha_i$ represents firm-specific dummies and $\delta_t$ represents year dummies. The parameter of interest is $\beta$ and a positive coefficient indicates positive productivity spillovers from foreign-owned companies to domestic firms. The inclusion of firm-fixed effects is crucial because foreign investors may systematically invest in high productivity sectors. When firm-fixed effects are included, $\beta$ captures the correlation between the changes in the *Spillover* variable and changes in TFP. Similarly to equation (1), we estimate equation (2) by two-step feasible GLS.

However, there are potential sources of endogeneity. For example, certain sectors may be expected to have high productivity growth (e.g.; 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. Further, we control for the possibility that certain countries, such as the Baltics, are in a growth and investment phase by including country-year fixed effects. We estimate the following equation for the sample of domestic firms only:

$$\ln\left(\text{TFP}_{i,s,c,t}\right) = \beta \text{Spillover}_{s,c,t} + \alpha_i + \delta_{c,t} + \phi_{s,t} + \epsilon_{i,s,c,t} \; , \tag{3}$$

[7]The first step estimates the equation by OLS and the residuals obtained, squared, and for each firm the squared root of the mean squared residuals is calculated. In the second step, the regression is repeated weighting each firm by the inverse of its estimated standard error of the residual.

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

where $\text{TFP}_{i,s,c,t}$ 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 classification. 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 may mask important heterogeneity at finer sector classifications.

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

$$\text{Spillover}_{s2,t} = \frac{\sum_{i \in s2} \text{FO}_{i,t} \times \text{Y}_{i,t}}{\sum_{i \in s2} \text{Y}_{i,t}}, \tag{4}$$

where $s2$ refers to the two-digit sector classification and $\text{FO}_{i,t}$ indicates the share of foreign ownership of firm $i$. (Country subscripts are suppressed for better exposition.) Second, we define horizontal "competition spillovers" at the *four-digit* classification for each country:

$$\text{Spillover\_Comp}_{s4,t} = \frac{\sum_{i \in s4} \text{FO}_{i,t} \times \text{Y}_{i,t}}{\sum_{i \in s4} \text{Y}_{i,t}}, \tag{5}$$

where $s4$ refers to the *four-digit* sector classification. Finally, we construct the variable for "knowledge spillovers:"

$$\text{Spillover\_Know}_{s4,t} = \text{Spillover}_{s2,t} - \frac{\sum_{i \in s4} \text{FO}_{i,t} \times \text{Y}_{i,t}}{\sum_{i \in s2} \text{Y}_{i,t}}, \tag{6}$$

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, excluding output produced by foreign-owned companies in the same four-digit sector. We expect foreign-owned companies to provide technical assistance and knowledge transfer to domestic suppliers although we do not have data which allows us to verify this interpretation. The vertical spillover literature has usually relied on input-output matrices which provide linkages across two-digit sectors. We do not explore vertical spillovers nor make use of input-output tables but use the alternative new approach if examining if spillovers from supplier-customer relationship exist in closely related sectors. For example, if a foreign-owned company is a car manufacturer (four-digit sector classification 2910), it is possible that manufactures of electrical and electronic equipment for motor vehicles (classification (2931) would establish a business relationship with the company leading leading to knowledge transfers but not competition.

# 3 Vertical Spillovers

sectors in either developed or emerging countries. A full analysis of spillover effects would not be complete if we were not to study the role of "vertical" spillovers. The lack of positive horizontal spillover effects in emerging countries have lead researchers to investigate alternative explanations. Contacts with foreign-owned customers and suppliers could contribute to enhance their productivity, in particular, more advanced foreign owned firms may demand higher quality inputs from suppliers than required by domestic firms in the same sector. We follow Javorcik (2004) and define $Backward\ Spillover_{j,t}$ as a measure of foreign presence in industries that are being supplied by sector $j$. The aim of this variable is to capture contacts between domestic suppliers and foreign-owned customers:

$$\text{Backward Spillover}_{j,t} = \sum_{k \neq j} \alpha_{jk} \text{Spillover}_{k2,t} \tag{7}$$

and $\alpha_{sk}$: proportion of sector $j$ output supplied to sector $k$ where both $j$ and $s$ are two-digit sectors.

Similarly, we define Forward $\text{Spillover}_{j,t}$ as a measure of foreign presence in industries supplied by sector $j$. The aim of this variable is to capture contacts between foreign-owned suppliers and domestic customers:[9]

$$\text{Forward Spillover}_{j,t} = \sum_{m \neq j} \sigma_{jm} \text{Spillover}_{m2,t} \tag{8}$$

where $\sigma_{jm}$ is the share of inputs purchased by industry $j$ from industry $m$ in total inputs sourced

[9]Note that the coverage on export sales data is limited in the sample and therefore, we opt to not making use of this data in the interest of keeping a larger sample. In theory, we would have liked to exclude from the calculation the value of intermediate inputs that foreign-owned companies produce for the export market.

by sector $j$.[10]

We obtain the input-output coefficients from the World Input-Output Database (WIOD at $http://www.wiod.org/$) which provides standardize input-output matrices during the period 1995-2009, for the following countries in our sample: Austria, Belgium, Bulgaria, Czec Republic, Germany, Spain, Estonia, Finland, France, Hungary, Italy, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Sweden. We use input-output coefficient that vary year-by-year (most of the literature has had to use constant input-output coefficients.[11]

### 3.1 Firm Productivity and Market Shares

In order 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, market shares of foreign owned firms should increase. We estimate the following equation:

$$\ln(\text{MS}_{i,s,c,t}) = \alpha + \beta \text{FO}_{i,s,c,t} + \alpha_i + \delta_{c,t} + \phi_{s,t} + \epsilon_{i,s,t}\,, \tag{9}$$

where $\text{MS}_{i,s,c,t}$ refers to market share of firm $i$, in sector $s$, country $c$, at time $t$, and $\text{FO}_{i,s,c,t}$ 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.

[10] In calculating $\alpha_{sk}$ and $\sigma_{jm}$ output sold for final consumption was excluded. However, to have the most completed information we use output sold/bought from all sectors in the economy (35 sectors) rather than just manufacturing sectors (14 sectors)

[11] The input-output coefficients provided by WIOD correspond to the two-digit sector classification according to NACE Rev 1.1. We use sector correspondence tables to make the link to the two-digit NACE Rev. 2 classification available in our dataset.

## 3.2 Construction of Instruments

### 3.2.1 Direct Effect Regressions: TFP and foreign ownership

Consider the structural (causal) relation

$$(Y) \quad \text{Y}_{i,t} = \alpha_i + \delta_{c,t} + \phi_{s,t} + \alpha\, \text{FO}_{i,t} + u_{i,t} \ ,$$

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:

$$(F) \ \ \text{FO}_{i,t} = \gamma_0 + \gamma_1 \text{Y}_{it} + v_{i,t} \ .$$

The fixed effects in equation (Y) alleviate many endogeneity concerns but IV-estimation may still be needed for a consistent estimate of $\alpha$ that can be causally interpreted even if foreign investment is endogenous due to unobserved (by us) heterogeneity.

We use instruments with the structure

$$\text{Z}_{i,t} = \widehat{\text{FO}}_i \, \text{W}_{c,s,t} \ ,$$

where $\widehat{\text{FO}}_i$ is a non-time varying measure of predicted foreign ownership of firm $i$ and $\text{W}_{c,s,t}$ 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 $\text{FO}_{i,t}$ in equation (Y) ("relevance") and it needs to satisfy the exclusion restriction that it is uncorrelated with 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 regarding the exclusion restriction, we suppress the $c$ index and the country $\times$ year fixed effects for simpler notation. 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,

$$\mathrm{Y}_{i,t} = \mu_i + \nu_{s,t} + \delta \mathrm{Z}_{i,t} + w_{i,t} \ ,$$

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

$$\mathrm{Y}_{i,t} - \mathrm{Y}_{i.} - \mathrm{Y}_{s,t} + \mathrm{Y}_{s.} = \delta \left[\widehat{\mathrm{FO}}_i \mathrm{W}_{s,t} - \widehat{\mathrm{FO}}_i \mathrm{W}_{s.} - \widehat{\mathrm{FO}}_s \mathrm{W}_{s,t} + \widehat{\mathrm{FO}}_s \, \mathrm{W}_{s.}\right] + \left(w_{i,t} - w_{i.} - w_{s,t} + w_{s.}\right),$$

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

The structural relation (Y), demeaned, is

$$\mathrm{Y}_{i,t} - \mathrm{Y}_{i.} - \mathrm{Y}_{s,t} + \mathrm{Y}_{s.} = \alpha \left[\mathrm{FO}_{i,t} - \mathrm{FO}_i - \mathrm{FO}_{st} + \mathrm{FO}_{s.}\right] + \left(u_{i,t} - u_{i.} - u_{s,t} + u_{s.}\right)$$

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

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

This will be the case if

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

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

We choose $\widehat{\text{FO}}_i$ to be the initial level of foreign ownership $\text{FO}_{i0}$.[12] For a time-varying measure of growth in foreign ownership (now making the country dependence explicit again), we construct

$$I^I_{s,c,t} = \frac{\sum_{i \in c,s} \text{FO}^I_{i,t} \text{Y}_{i,0}}{\sum_{i \in c,s} \text{Y}_{i,0}} \; ; \tag{10}$$

where $\text{FO}^I_{i,t}$ is industrial ownership by foreign companies. I.e., $I^I_{s,c,t}$ is sector-level foreign industrial ownership in country $c$ at time $t$. We further construct

$$I^F_{s,c,t} = \frac{\sum_{i \in c,s} \text{FO}^F_{i,t} \text{Y}_{i,0}}{\sum_{i \in c,s} \text{Y}_{i,0}} \; ; \tag{11}$$

where $\text{FO}^F_{i,t}$ is ownership by foreign financial companies. I.e., $I^F_{s,c,t}$ is sector-level foreign financial ownership in country $c$ at time $t$.

We assume that country-sector level financial ownership is a function of future profit opportunities in the relevant sector-country cell as they accrue to a passive financial investor. We further assume that industrial foreign ownership is determined by the same factors as financial foreign ownership plus a factor

$$I^I_{sct} = b * I^F_{s,c,t} + \delta * A_{sct} + e_{sct} \; , \tag{12}$$

where $A_{sct}$ is the investment driven by extra future income that industrial owners can obtain from *active* management (or from market power, in case of mergers—whatever is specific to industrial ownership). If we know $b$, we can use $I^I_{sct} - b * I^F_{sct} = \delta * A_{sct} + e_{sct}$ as an exogenous instrument because the component of country-sector foreign ownership which is due to predicted future profits from passive investment, and which is the source of potential reverse causality, has been subtracted.

We obtain an estimate of $b$ by regressing $I^I$ on $I^F$ and take residuals; i.e.,

$$\text{W}_{c,s,t} = I^I_{sct} - \hat{b} * I^F_{s,c,t} \tag{13}$$

[12]We obtain very similar results using the predicted value from a probit regression in the first year possible for the firm ("$\widehat{\text{FO}}_{i,0}$"), where $\text{FO}_{i,t} = \beta_0 \text{FO}_{i,t-1} + \beta_1 \ln{(\text{K/L})}_{i,t-1} + \beta_2 \ln{(\text{VA/L})}_{i,t-1} + \beta_3 \ln{(\text{ASSETS})}_{i,t-1} + \beta_4 \ln{(\text{ASSETS})}^2_{i,t-1} + \beta_5 \text{AGE}_{i,t} + \beta_6 \text{AGE}^2_{i,t} + \delta_{ct} + \phi_{st} + \epsilon_{i,t}$ .

For the instrument to be valid, it is essential that firm and time dummies are included in the IV regressions because this implies that only changes relative to average values affect the results. For this reason, we 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

$$\mathrm{W}_{c,s,t} = \xi_0 + \xi_1 u_{c,s,t} + \xi_2 v_{c,s,t}$$

for constant coefficients $\xi_0, \xi_1$ and $\xi_2$. The validity of the instrument boils down to whether

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

i.e., whether $\widehat{\mathrm{FO}}_i \mathrm{W}_{c,s,t}$ is relatively high (low) when $(u_{i,t} - u_{i.} - u_{s,t} - u_{c,t} + u_{c,.} + u_{s,.})$ 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 $\mathrm{W}_{c,s,t}$) via a positive $\gamma_1$ 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 $u_{i,t} - u_{i.} - u_{s,t} - u_{c,t} + u_{c,.} + u_{s,.}$).

To summarize this in words, exogeneity will be violated if firms with relatively high initial foreign ownership (relative to their country and sector) are relatively more sensitive to the growth in the country-sector level of foreign ownership which is orthogonal to financial foreign ownership *because* foreign investors predict future TFP growth is higher for such firms in the absence of foreign industrial investment.

# 4 Data

## 4.1 Samples

We use the comprehensive firm-level worldwide database ORBIS, compiled by BvD, who specializes in gathering and providing company information. An advantage of ORBIS compared to the widelyused databases of listed companies COMPUSTAT North America and COMPUSTAT Global is the inclusion of private companies. ORBIS covers around 100 million listed and private companies from around the world—listed companies comprise 1 percent of the database.

The ORBIS data includes company financials in a standardized and internationally comparable format together with very detailed company ownership information, including information on whether foreign owners are financial or industrial firms. The data also allows us to construct continuous measures of foreign or domestic ownership. Using a continuous measure allows us to estimate the marginal effects of foreign ownership more precisely than it is possible with the binary "yes/no" variables used so far in the literature. The continuous foreign-ownership variable is crucial for exploiting firm-level heterogeneity in 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, we are left with information for 740,000 firms in 30 countries (15 developed countries and 15 emerging markets) during the period 1999–2008.[13] Panel A in Table 1 shows the number of observations and firms. Since we need information on the cost of materials for the TFP estimation, we go further down in the number of firms as shown in Panel B in Table 1. As seen, the firm coverage differs a lot from country-to country, and industrialized countries do not necessarily have better coverage. Figure 1 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, we have 80,000 to 134,000 firms, depending on the control variables.[14]

## 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. We convert

[13]See Appendix: Data for a full description of the data and the cleaning procedures. In the spillover regressions, the sample is reduced to 336 thousand firms because we focus on the sample of domestic firms.

[14]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" because there are not enough observations per country to estimate TFP.

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 at 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. Employment measured in persons and the distribution of employment is skewed with many firms having a minimum allowed number of employees (we restrict our analysis to firms with at least 15 employees).

*Firm productivity.*

Traditionally, the literature estimates firm productivity as a residual from a Cobb-Douglas 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. For example, 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) and Levinsohn and Petrin (2003) (LP) propose to use proxy variables to control 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) suggests using a generalized method of moments (GMM) estimation with the moment conditions outlined in LP (2003) and extensions to overcome some limitations of OP and LP. According to Petrin and Levinsohn (2012), the advantages of the Wooldridge, Levinsohn, and Petrin (WLP) estimator include: correction for simultaneous determination of inputs and productivity, no need to maintain constant returns to scale, and robustness to the Ackerberg, Caves, and Frazer (2008) critique.[15] In this paper, we use a measure of productivity estimated by the WLP method (see Appendix for more details). Specifically, we construct TFP as a residual from a Cobb-Douglas production function with capital and labor: $\ln(\text{TFP}_{i,t}) = \ln(\text{Y}_{i,t} - \text{M}_{i,t}) - \alpha_1 \ln(\text{L}_{i,t}) - \alpha_2 \ln(\text{K}_{i,t})$, where the parameters are estimated following the non-parametric control function approach of Wooldridge (2009).[16]

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

[16] 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 the 1 and 99 percentiles by country. However, similar results are obtained

*Explanatory variables.*

The 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, private equity, 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 companies, very small stock holders are typically unknown.[17] In addition, ORBIS contains information on-so called "ultimate" owners (UO) of the company by tracing the ownership pyramid beyond the direct owners. To find UOs of a company, BvD focuses on identifying the owners, if any, who exercise the greater degree of control over the company.

We prefer *direct ownership* because of the following considerations. First, the most of UO links are calculated by BvD but not reported by the original sources. BvD focuses on targets where at least one owner has more than 25 percent of direct ownership. For each such company, BvD looks for the owner with the highest direct ownership stake. If this shareholder is itself independent (being owned less than 25 percent by any of its owners), it is defined as the UO of the company. If the shareholder with the largest ownership share is not independent, the process is repeated until BvD finds the 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 from the ultimate ownership links, exactly because of the uncertainty associated with construction of this variable. In contrast, large owners are almost always precisely identified from our direct ownership variable. Finally,

if TFP is estimated by country, or by Levinsohn and Petrin (2003), and regardless of the level of winsorizing chosen (we also tried winsorizing the total sample at the 1 and 99 percentiles, winsorizing by country at the 5 and 95 percentiles, and by sector at the 1 and 99, and 5 and 95, percentiles).

[17] 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.

because the process of identifying the ultimate owner only uses the largest owners foreign owners with smaller than 25 percent stakes are ignored, which leads to incorrect classification of "foreign-owned" firms; we find that many foreign owners in our sample hold smaller than 25 percent but non-negligible stakes.

We compute the *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, or private equity firms. We separate foreign ownership by industrial investors and financial investors for the purpose of exploring the potential differential effects of the type of a FDI investor. Thus, we construct 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. We define firm to be "domestic" only if it never had *any* type of foreign owner during the sample period.

*Descriptive statistics.*

Panel A in Table 2 uses the subset of firms in Panel A of Table 1 which have available data for computing TFP. FDI is relatively high in the manufacturing and retail sectors and the share of output of firms with foreign financial owners is an order of magnitude smaller than the share of output of firms with foreign industrial owners. Overall, foreign-owned firms constitute a minority of firms with a share of about six to seven percent of output of all firms in our sample.

Panel B in Table 2 explores the relative importance of foreign-owned companies across developed and emerging countries and distinguishes between industrial and financial foreign ownership. From the first two columns of Panel B, 6.2 percent of our observations are classified as Industry-FDI and 0.4 percent as Financial-FDI. Focusing on firms with positive industrial or financial FDI in at least one year in the remainder of Panel B, we observe that the number of observations with positive industrial-FDI is slightly higher in emerging countries, while financial FDI investors "prefer" firms in developed countries. 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. 71 percent of emerging-country firms with foreign ownership have controlling industrial-FDI, while 63 percent of developed-country firms refer to controlling industrial-FDI. Figure 2 and Figure 3 show the distribution of industrial and financial FDI for developed and emerging countries, respectively. In developed countries the distribution of Industry-FDI is bi-modal whereas it is skewed towards full ownership in emerging markets. Financial-FDI is concentrated in the smaller stakes, with more than 2/3 of the firms having less than a 20 percent stakes held by foreign financial owners, in both groups of countries. There is a spike in the number of firms with an ownership share around 50 percent which likely reflects a desire by foreign owners to acquire a controlling stake.

Table 3 provides basic summary statistics of the variables used in the regression analysis in the subsample of manufacturing firms.[18] On average, firms in developed countries are more productive than firms in emerging countries regardless of measure, while industrial FO is somewhat larger for emerging-country firms. Financial FO is smaller than industrial FO in both samples and the variation of the former is also smaller. With respect to output shares at the 2- and 4-digit levels (the variables MS2dig_Output and MS4dig_Output) and employment market shares at the 2- and 4-digit level (MS2dig_Empl and MS4dig_Empl), we observe much higher concentration in emerging markets, especially at the 4-digit level, suggesting a less competitive market environment there. Panels B and D of Table 3 report features of the spillover variables in the sub-samples of purely domestic firms in developed and emerging countries. Here, as well as in all of the following empirical analysis, the domestic sample refers to firms that do not have foreign owners of any type during the period of analysis. Industrial spillover at the 2-digit level (the variable Industrial_Spillover) has a larger value in developed countries than in emerging markets and the same is true for industrial competition and knowledge spillovers (the variable Industrial_Spillover_Comp$_{s4}$ and Industrial_Spillover_Know$_{s2}$). The financial spillovers variables are basically nil on average; however, the maximum of the Financial_Spillover variable in emerging markets is much larger than in developed markets. Overall, there is significant

[18] The number of observations is somewhat smaller than that in Panel B of Table 1 because the sample here is only manufacturing firms. To limit the potential impact of outliers, we winsorize variables before performing our empirical analysis.

variation in the variables in both samples which we exploit in the following empirical analysis.

# 5 Results

## 5.1 Are Foreign Firms More Productive?

Table 4 shows, for manufacturing/all firms, correlations between labor productivity, value added, and foreign activity for all firms. Columns (1), (3), (5), and (7), which do not utilize firm fixed effects display clear positive correlations with foreign ownership—a pattern that has inspired many recent trade and FDI models.[19] After inclusion of firm fixed effects, in the case of labor productivity, the positive coefficient becomes minuscule (columns (2) and (4)) and, in the case of value added, the positive effect completely disappears (columns (6) and (8)) highlighting the potential importance of firm-level selection. This result holds for the sample of all firms and of manufacturing firms. In column (6), for the sample of all firms, foreign ownership has a negative correlation with firm level productivity. When firm-fixed effects are included, correlations are calculated from changes over time and our results do not indicate that the FDI causes an increase in productivity of acquired firms. While other factors could influence the simple correlations displayed, the prima facie evidence points to multinationals investing in *a priori* productive firms.

What about total factor productivity? Table 5 shows the relationship between FDI and firm productivity. Panel A focuses on the sample of firms operating in developed countries while Panel B focuses on the sample of firms operating in emerging countries. We opt to differentiate between developed and emerging countries given the results of the literature.[20]

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. This seem not to bias the results as they are robust to the inclusion of sector-year fixed effects. However, the positive effect of FDI on firm productivity is not of much economic

[19] See Helpman, Melitz, and Yeaple (2004) for a similar results for labor productivity using data on U.S. multinationals.

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

importance: 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. Columns (4) and (5) distinguish between industrial and financial FDI and it appears 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 is smaller (Girma (2005)). 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, possibly because financial investment helps overcome credit constraints in developing countries.

The results of 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 which turns insignificant once firm fixed effects are included. Therefore, these early studies find a positive correlation between foreign ownership and productivity levels but not between foreign ownership growth and productivity growth. Our set of control dummy variables guarantees that the 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 foreign investors targeting 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, using two-digit sectors as most have been used in most of the literature. Panel A and Panel B report results for the sample of developed and emerging countries, respectively. We distinguish between horizontal spillovers from foreign owned firms where the foreign owner holds a majority stake and firms where the foreign owner holds a minority stake and therefore is less likely to exercise control. 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 and column (3) in Panel A shows that these results are driven solely by majority owners, although these results are not so clear as the coefficient is insignificant for majority owners and negative for minority owners. Researchers who are skeptical about the role of FDI in transferring knowledge and technology argue that results, such as those of column (1), likely are the result of foreign-owned companies targeting more productive sectors. The previous empirical literature, focussing on the experience of individual countries, as well as lacking suitable instruments, was not able to properly address this issue.[21] Column (2) in Panel A includes sector-year fixed effects which control for effects that are common to firms in the same sector across countries, in particular technological innovations that all firms in a sector can benefit from. Compared to column (1), there is a reduction in the size of the coefficient to spillover of about 50 percent and it is no longer statistically significant. Columns (3) and (4) shows smaller reductions in the size of the coefficients related to majority and minority FDI. The lack of significance when sector-year dummies are included means that if spillovers are present they are partly (or mainly) global for typical firms 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).

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 of foreign-owned companies in the same two-digit sector—a finding in line with previous results of Aitken and

[21] One exception is Haskel, Pereira, and Slaughter (2007) who use an instrumental variable approach to tackle this concern in a sample of UK manufacturing firms.

Harrison (1999), who use firm-level panel data for Venezuela. Aitken and Harrison (1999) argue that positive knowledge spillovers may be counteracted by negative competition effects. Column (2) in panel B shows 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 majority and minority FDI: the negative spillover results found in columns (1) and (2) are mainly driven by industrial FDI of controlling investors.

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. It is not obvious why foreign competition does not lead to negative effects in developed countries although developed countries are thought to have the human capital and/or institutional and financial preconditions to better compete with foreign-owned companies. At the same time, the literature on FDI spillovers, acknowledging the potential negative competition effects, 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 use 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, columns (1)-(4) display results for an unbalanced panel of domestic firms.[22] 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 which 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 has overlooked due to a higher sectoral aggregation. In line with vertical

[22]Firms can enter and exit the sample, although we do not include that enter, exit, and then re-enter the raw data.

linkages theories, we find that there is scope for positive productivity spillovers from foreign-owned companies to domestic companies that are not direct competitors.

Column (2) addresses the possibility that foreign-owned companies target more productive sectors by including 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, the size of the knowledge spillover coefficient decreases by almost half in column (2) which, together with the unchanged negative competition effect, mechanically explains the insignificant results of 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 transfers are partly global and are universally available within the same intra-sector for those firms in contact with the 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—we do not examine global spillovers from developed to emerging countries. Spillovers are likely to obtain from controlling FDI, while they are unlikely to to found when a company invests for income or diversification and, indeed, columns (3) and (4) show that the spillover results are driven mainly by majority FDI. Finally, columns (5) and (6) of Table 7 consider a balanced panel of firms—firms observed over the full 2000-2007 period. By focusing on a permanent sample of firms, we examine if the results are reflecting new highly productive firms entering the sample leading to the Schumpeterian creative-destruction. The results in column (6) shows that the effects found in column are not solely, nor mainly, reflecting entry and exit.

In Table 8, we explore if foreign investment is indeed associated with increasing market shares of recipients of FDI. 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 an increase in market shares in the same two- and 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 domestically owned counterparts in the same sector, although the effect on employment is smaller with negative point estimates for financial owners.

Our findings for developed countries suggest a strong negative competition effect and positive knowledge spillover effects from industrial FDI. Focusing on the thinner 4-digit 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 (2) 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 negative knowledge spillovers in emerging markets. Again, as in the case of developed countries, the results are driven mainly by majority foreign investors (see columns (3) and (4)). Similarly, in columns (5) and (6) where a permanent sample of firms is considered, the negative competition finding is not the result of entry/exit—in fact, the effects are, if anything, larger for this sample of firms.

In Table 10, we explore the background for these results: columns (1) to (4) show that foreign-owned companies have growing output market shares compared to firms in their own 2- or 4-digit industry. Columns (5) to (8) show that foreign firms employ a significantly increasing share of workers in emerging economies and we believe this may be 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 workers 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.[23] In Tables 5, 8, and 10, we showed

[23] Alfaro and Chen (2012) has an alternative methodology based on a structural model.

that foreign-owned firms are associated with higher productivity and market shares in terms of output and employment in both developed and emerging countries. In order to account for the possibility of reverse causality due to FDI being allocated to growing firms, Table 11 provides results from instrumental variable estimation conducted according to the methodology outlined in Section 3.2. Columns (1) to (3) focus on developed countries, while columns (4) to (6) focus on emerging countries. We consider the role of total FDI. Panel A in Table 11 shows the second stage while Panel B considers the first stage regressions. It is clear from Panel B that the instrument and the endogenous variable (i.e., FDI) are highly correlated in both developed and emerging countries. From Panel A, for developed countries, foreign-owned firms have higher market shares in terms of output and they employ a larger share of workers. These results agrees with the non-instrumented results but the coefficients here are larger, suggesting downward bias in the non-instrumented regressions. There is little evidence of a causal impact of FDI on firm productivity—the point estimate is similar to that obtained in non-instrumented regressions, but the coefficient is no longer significant. Possibly foreign-owned firms target domestic firms in developed countries in order to diversify and such investments do no involve transfers of technology. In emerging markets foreign-owned firms become significantly more productive and the point estimate is much higher than found using non-instrumented regressions which indicates that foreign investors might endogenously target firms with less rapid TFP growth—possibly older established firms. Foreign owned firms also grow their market shares for output and employment rapidly in emerging countries.

### 5.4 Backwards and Forward Spillovers

Table 12 considers spillover to suppliers to or customers of foreign owned firms. In the first row, we see a positive and significant coefficient on the Backward variable in both developed and emerging countries. These indicates positive productivity spillovers between domestic firms and their foreign-owned clients in downstream sectors. While evidence on backward linkages through supplier-customer relationship had been previously found in the literature (see for example Javorcik (2004), Gertler and Blalock (2008), Liu (2008) and the references therein); findings of backward spillovers in developed countries are more scant. Barrios, Gorg and Strobl (2011) using firm-level data from Ireland find little support for backward spillovers when standard measures are employed. However, they find robust evidence for positive backward spillovers when constructing measures that consider the percentage of domestically produced inputs versus imported inputs. Jabbour and Mucchielli (2007) using Spanish manufacturing firm level data find conditional evidence of vertical spillovers. Spillovers depend on the technology gap between domestic firms and foreign affiliates and characteristics of the foreign-owned plant being fully owned companies more likely to generate positive productivity spillovers.

There is no indication of vertical linkages through contacts with foreign-owned suppliers, as the forward variable is insignificant in both developed and emerging markets. The negative competition effect from foreign-owned companies operating in the same two-digit sector of activity is still significant in the case of emerging countries and insignificant in the case of developed countries. As shown by our more disaggregated measures of spillovers, the insignificant result in the case of developed countries confounds negative competition effects and positive knowledge effects.

Overall, our results confirm those found in the literature. Even the magnitude of our estimated backward spillover coefficients are similar to the results of Javorcik (2004), so we do not further pursue this issue.

### 5.5 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 from the first wave of empirical micro studies is that firms are heterogeneous, which has inspired the development of new theories emphasizing this (see Melitz (2003), Bernard, Eaton, Jensen, and Kortum (2003) and Helpman, Melitz, and Yeaple (2004) among others). According to the early research, only a small fraction of firms engage in export activities and an even smaller fraction become multinational. The theoretical models developed to accommodate these empirical findings have implications for within and between sectoral allocation of resources: within-industry reallocation effects are supposed to contribute to overall higher productivity of the sector assuming that greater competition by exporting firms will drive less productive firms out of the market. An implication is 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 consider two dimensions of heterogeneity: the percentage of firm capital owned by foreign investors and differences in the productivity of domestic firms. First, regarding foreign ownership heterogeneity, Figure 4 shows the TFP distribution of foreign-owned and domestic companies in developed and emerging countries. In both sets 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). 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).

Second, Table 13 study whether differences in the ex-ante distribution of firm productivity have implications for the extent of competition and knowledge spillovers. In order to do so, we consider firms' total factor productivity in the first year we observe them in the sample (our measure of ex-ante productivity) and we split the sample into firms above or below median total factor productivity in each country-sector-year cell. In addition, split the sample firms according to whether firms 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 of Tables 7 and 9 for these different quantiles. The dependent variable is firm total factor productivity and we focus again on the sample of domestic firms. Column (1) of Table 13 shows results for developed countries while column (2) shows results for emerging countries. In the sample of developed countries, 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 in the top quartile. This is consistent with the idea that only the better firms have enough absorptive capacities to benefit from the activities of foreign-owned firms. When we focus on the sample of emerging countries, the competition results are similar, albeit larger, to those of the developed countries. Knowledge spillover effects are also negative for all quantiles in the sample of emerging countries, although the effect is not significant for the lowest and the highest categories. We conjecture that the least productive firms are engaged in craft-type local production that is not competing with firms that attract foreign ownership while the most productive firms are able to compete with foreign owned firms to the same extent as firms in developed countries outside the top quartile for which the impact also is not significant.

## 6 Conclusion

We asked several questions in this paper. In particular, we explored if there are positive effects of foreign investment on economic growth and productivity of the host economy. The questions and our findings are as follows.

1. Are foreign-owned firms more productive? Foreign-owned firms do not significantly contribute to productivity increases in developed countries but do so in emerging markets.

2. Are there positive spillovers to domestic firms from foreign ownership? There is little effect in developed countries. This paper develops the new results that this is due to offsetting negative competition effects in the same narrow sector and positive knowledge spillover effects in closely related sectors. In emerging countries, the effect is all negative. There is a negative competition effects and negative spillovers. We conjecture that negative spillovers are due to competition for limited resources of human capital.

3. Are there differences according to the extent of foreign ownership, whether multinationals have the majority control or not? In developed countries spillovers (positive or negative) obtain only from majority owned firms. In emerging markets, minority ownership leads to spillovers, although these are smaller than for majority owned firms.

## References

Acemoglu, D., and S. Johnson (2007): "Diseases on Deveolpment: The Effect of Life Expectancy on Growth," *Quarterly Journal of Economics*, 115(6), 925–985.

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. Eaton, J. B. Jensen, 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 1: 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 2: 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 1). *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 3: 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 2 and 4 for the details on construction of variables.

Table 4: 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.

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 2 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<br>Sample: Domestic Firms | | | | |
|---|---|---|---|---|
| | Panel A: Developed Countries | | | |
| | (1) | (2) | (3) | (4) |
| *Spillover* | 0.026**<br>(0.010) | 0.014<br>(0.009) | | |
| *Spillover* $FDI > 50$ | | | 0.014<br>(0.009) | 0.010<br>(0.007) |
| *Spillover* $FDI < 50$ | | | -0.016*<br>(0.009) | -0.014**<br>(0.006) |
| 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***<br>(0.015) | -0.067***<br>(0.015) | | |
| *Spillover* $FDI > 50$ | | | -0.057***<br>(0.016) | -0.063***<br>(0.016) |
| *Spillover* $FDI < 50$ | | | -0.025<br>(0.015) | -0.008<br>(0.016) |
| 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 *Spillover* $FDI > 50$ and *Spillover* $FDI < 50$. In particular, *Spillover* $FDI > 50 = \sum_{i \in s} FDI_{i,s,c,t} \times Y_{i,s,c,t} \times I(FDI > 50)_{i,s,c,t} / \sum_{i \in s} Y_{i,s,c,t}$ where $I(FDI > 50)$ is an indicator variable that takes the value of one if the percentage of firm foreign ownership is greater than 50 percent and zero otherwise. 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, *Spillover* $FDI < 50 = \sum_{i \in s} FDI_{i,s,c,t} \times Y_{i,s,c,t} \times I(FDI < 50)_{i,s,c,t} / \sum_{i \in s} Y_{i,s,c,t}$ where $I(FDI < 50)_{i,s,c,t}$ is an indicator variable that takes the value of one if the percentage of firm foreign ownership is greater than 0 and less or equal than 50 percent and, zero otherwise. *** , **, *, denote significance at 1%, 5%, 10% levels. See Sections 2 and 4 for details on variable construction.

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) |
| *Spillover Competition* | -0.024*** | -0.029*** | | | | |
| | (0.004) | (0.004) | | | | |
| *Spillover Knowledge* | 0.035*** | 0.022*** | | | | |
| | (0.007) | (0.006) | | | | |
| *Spillover Competition* $FDI > 50$ | | | -0.023*** | -0.035*** | -0.022*** | -0.037*** |
| | | | (0.005) | (0.004) | (0.006) | (0.006) |
| *Spillover Competition* $FDI < 50$ | | | -0.001 | -0.021*** | -0.006 | -0.024*** |
| | | | (0.005) | (0.004) | (0.006) | (0.006) |
| *Spillover Knowledge* $FDI > 50$ | | | 0.020** | 0.022*** | 0.019* | 0.023** |
| | | | (0.007) | (0.006) | (0.010) | (0.010) |
| *Spillover Knowledge* $FDI < 50$ | | | -0.015** | -0.003 | -0.010 | -0.003 |
| | | | (0.006) | (0.005) | (0.009) | (0.009) |
| Observations | 363,354 | 363,354 | 363,354 | 363,354 | 166,792 | 166,792 |
| Firms | 53,642 | 53,642 | 53,642 | 53,642 | 20,849 | 20,849 |
| Firm Fixed Effects | yes | yes | yes | yes | yes | yes |
| Country-Year Fixed Effects | yes | yes | yes | yes | yes | yes |
| Sector4dig-Year Fixed Effects | NO | YES | NO | YES | NO | 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. 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 (4) report the results from an unbalanced sample of firms while columns (5) and (6) 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 4-digit sector classification level. The spillover variables distinguish between Competition and Knowledge. 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 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. *Spillover Knowledge* 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. $Spillover\ Knowledge = Spillover\ Competition - \frac{\sum_{i \in s4} FDI_{i,s4,c,t} \times Y_{i,s4,c,t}}{\sum_{i \in s2} Y_{i,s2,c,t}}$ 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. In addition, the table differentiates between competition spillovers from $FDI > 50$ and $FDI < 50$ (idem for knowledge spillovers). $Spillover\ Competition\ FDI > 50 = \sum_{i \in s} FDI_{i,s,c,t} \times Y_{i,s,c,t} \times I(FDI > 50) / \sum_{i \in s} Y_{i,s,c,t}$ 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 and $I(FDI > 50)$ is an indicator variable that takes the value of one if the percentage of firm foreign ownership is greater than 50 percent and zero otherwise. $Spillover\ Competition\ FDI < 50 = \sum_{i \in s} FDI_{i,s,c,t} \times Y_{i,s,c,t} \times I(FDI < 50) / \sum_{i \in s} Y_{i,s,c,t}$ 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 and $I(FDI < 50)$ is an indicator variable that takes the value of one if the percentage of firm foreign ownership is greater than 0 and less or equal than 50 percent and, zero otherwise. *** , **, *, denote significance at 1%, 5%, 10% levels. See Sections 2 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 2 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) |
| *Spillover Competition* | -0.076*** (0.009) | -0.066*** (0.010) | | | | |
| *Spillover Knowledge* | -0.042** (0.013) | -0.069*** (0.015) | | | | |
| *Spillover Competition* $FDI > 50$ | | | -0.072*** (0.009) | -0.061*** (0.009) | -0.085*** (0.017) | -0.061*** (0.017) |
| *Spillover Competition* $FDI < 50$ | | | -0.028** (0.010) | -0.025** (0.012) | -0.067** (0.022) | -0.018 (0.024) |
| *Spillover Knowledge* $FDI > 50$ | | | -0.037** (0.013) | -0.068*** (0.014) | -0.036 (0.023) | -0.073** (0.026) |
| *Spillover Knowledge* $FDI < 50$ | | | -0.019 (0.012) | -0.023* (0.013) | -0.026 (0.027) | -0.001 (0.028) |
| Observations | 77,362 | 77,362 | 77,362 | 77,362 | 26,552 | 26,552 |
| Firms | 12,896 | 12,896 | 12,896 | 12,896 | 3,319 | 3,319 |
| Firm Fixed Effects | yes | yes | yes | yes | yes | yes |
| Country-Year Fixed Effects | yes | yes | yes | yes | yes | yes |
| Sector4dig-Year Fixed Effects | NO | YES | NO | YES | NO | 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. 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 (4) report the results from an unbalanced sample of firms while columns (5) and (6) 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 4-digit sector classification level. The spillover variables distinguish between Competition and Knowledge. In particular, $\textit{Spillover Competition} = \sum_{i\in s} FDI_{i,s,c,t} \times Y_{i,s,c,t} / \sum_{i\in s} Y_{i,s,c,t}$ where $FDI_{i,s,c,t}$ refers to the share of ownership by foreign 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. *Spillover Knowledge* 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. $\textit{Spillover Knowledge} = \textit{Spillover Competition} - \frac{\sum_{i\in s4} FDI_{i,s4,c,t} \times Y_{i,s4,c,t}}{\sum_{i\in s2} Y_{i,s2,c,t}}$ 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. In addition, the table differentiates between competition spillovers from $FDI > 50$ and $FDI < 50$ (idem for knowledge spillovers). $\textit{Spillover Competition } FDI > 50 = \sum_{i\in s} FDI_{i,s,c,t} \times Y_{i,s,c,t} \times I(FDI > 50) / \sum_{i\in s} Y_{i,s,c,t}$ 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 and $I(FDI > 50)$ is an indicator variable that takes the value of one if the percentage of firm foreign ownership is greater than 50 percent and zero otherwise. $\textit{Spillover Competition } FDI < 50 = \sum_{i\in s} FDI_{i,s,c,t} \times Y_{i,s,c,t} \times I(FDI < 50) / \sum_{i\in s} Y_{i,s,c,t}$ 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 and $I(FDI < 50)$ is an indicator variable that takes the value of one if the percentage of firm foreign ownership is greater than 0 and less or equal than 50 percent and, zero otherwise. *** , **, *, denote significance at 1%, 5%, 10% levels. See Sections 2 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 2 and 4 for the details on construction of variables.

## Table 11: Instrumental Variables Estimation

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 | 0.009 | 0.068** | 0.111*** | 0.161** | 0.226** | 0.144*** |
| | (0.028) | (0.026) | (0.024) | (0.071) | (0.072) | (0.044) |
| Observations | 377,023 | 377,023 | 377,023 | 79,757 | 79,757 | 79,757 |
| 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) | (2) | (3) | (4) | (5) | (6) |
| | FDI | FDI | FDI | FDI | FDI | FDI |
| $FO_0 \times \mathrm{W}_{s,c,t}$ | 25.90*** | 52.86*** | 44.89*** | 44.95*** | 43.07*** | 0.009 |
| | (5.90) | (5.33) | (3.79) | (3.98) | (4.57) | (0.007) |
| F-STATS | 19.28 | 98.25 | 139.74 | 127.57 | 88.77 | 1.79 |
| Observations | 377,023 | 377,023 | 377,023 | 79,757 | 79,757 | 79,757 |
| 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; the instrument $\widehat{FO}_0 \times$ Growth $\mathrm{FO}_{s,t}$ enters the first-stage regression in the same transformation. $\widehat{FO}_0$ is a non-time varying measure of predicted foreign ownership of firm $i$, equal to the initial level of foreign ownership of firm $i$. Growth $\mathrm{FO}_{s,t}$ represents a measure correlated with *growth* in foreign ownership that varies by country $c$, sector $s$ where firm $i$ operate, and time but not by firm. We obtain an estimate of Growth $\mathrm{FO}_{s,t}$ as the residuals from the regression of sector-level foreign industrial ownership in country $c$ at time $t$, $I^I_{s,c,t}$, on sector-level foreign financial ownership in country $c$ at time $t$, $I^F_{s,c,t}$, (i.e., Growth $\mathrm{FO}_{s,t} = I^I_{sct} - \hat{b} * I^F_{s,c,t}$). *** , **, *, denote significance at 1%, 5%, 10% levels. See Sections 2 and 4 for the details on construction of variables.

Table 12: Vertical Spillovers

| Dependent Variable: Firm Productivity<br>Sample: Domestic Firms | | |
|---|---|---|
| | Developed<br>(1) | Emerging<br>(2) |
| Backward Spillover | 0.068**<br>(0.023) | 0.072*<br>(0.043) |
| Forward Spillover | 0.023<br>(0.032) | -0.081<br>(0.050) |
| Spillover | 0.011<br>(0.009) | -0.067***<br>(0.016) |
| Observations | 357,995 | 55,565 |
| Firm Fixed Effects | yes | yes |
| Country-Year Fixed Effects | yes | yes |
| Sector2dig-Year Fixed Effects | yes | yes |
| Cluster | 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). Column (1) reports the results from the sample of developed countries while column (2) reports the results from the emerging countries sample. The spillover variables are constructed at the 2-digit sector classification level. $Spillover = \sum_{i \in s} FDI_{i,s,c,t} \times Y_{i,s,c,t} / \sum_{i \in s} Y_{i,s,c,t}$ where $FDI_{i,s,c,t}$ refers to the share of ownership by foreign-owned companies in firm i, 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 four-digit sector s, in country c at time t. $Backward\ Spillover_{j,t} = \sum_{k if k \neq j} \alpha_{jk} Spillover_{k,t}$. $Forward\ Spillover_{j,t} = \sum_{m if m \neq j} \sigma_{jm} Spillover_{m,t}$. *** , **, *, denote significance at 1%, 5%, 10% levels. See Sections 2 and 4 for the details on construction of variables.

Table 13: Firm Heterogeneity and Spillovers

| | | |
|---|---|---|
| DEPENDENT VARIABLE: FIRM PRODUCTIVITY<br>SAMPLE: DOMESTIC FIRMS | | |
| | DEVELOPED<br>(1) | EMERGING<br>(2) |
| *Spillover Competition* $1stQuartile\ of\ TFP\ distribution$ | -0.043**<br>(0.014) | -0.088***<br>(0.024) |
| *Spillover Competition* $2ndQuartile\ of\ TFPdistribution$ | -0.012*<br>(0.006) | -0.066***<br>(0.014) |
| *Spillover Competition* $3rdQuartile\ of\ TFPdistribution$ | -0.013*<br>(0.007) | -0.037**<br>(0.016) |
| *Spillover Competition* $4thQuartile\ of\ TFPdistribution$ | -0.057***<br>(0.017) | -0.077**<br>(0.032) |
| *Spillover Knowledge* $1stQuartile\ of\ TFPdistribution$ | 0.016<br>(0.026) | -0.019<br>(0.035) |
| *Spillover Knowledge* $2ndQuartile\ of\ TFPdistribution$ | 0.015<br>(0.012) | -0.113***<br>(0.023) |
| *Spillover Knowledge* $3rdQuartile\ of\ TFPdistribution$ | 0.004<br>(0.013) | -0.106***<br>(0.023) |
| *Spillover Knowledge* $4thQuartile\ of\ TFPdistribution$ | 0.072**<br>(0.032) | -0.021<br>(0.043) |
| Observations | 363,354 | 77,362 |
| 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). Column (1) reports the results from the sample of developed countries while column (2) reports 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. $Spillover\ Knowledge$ 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. The 1st Quartile includes all domestic firms below the 25 percentile of the initial TFP distribution of domestic firms (idem definition for the rest of quartiles). *** , **, *, denote significance at 1%, 5%, 10% levels. See Sections 2 and 4 for the details on construction of variables.

# Figures

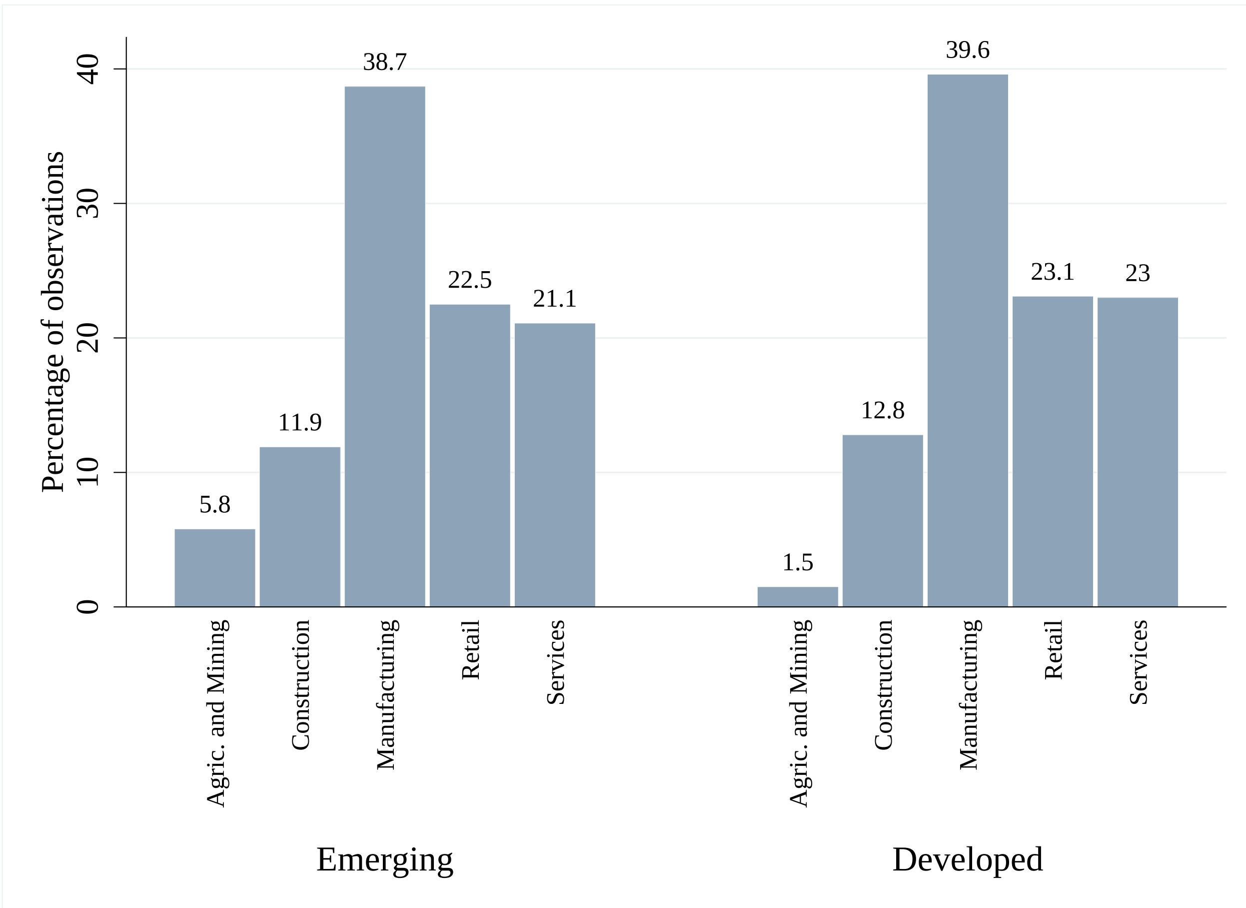
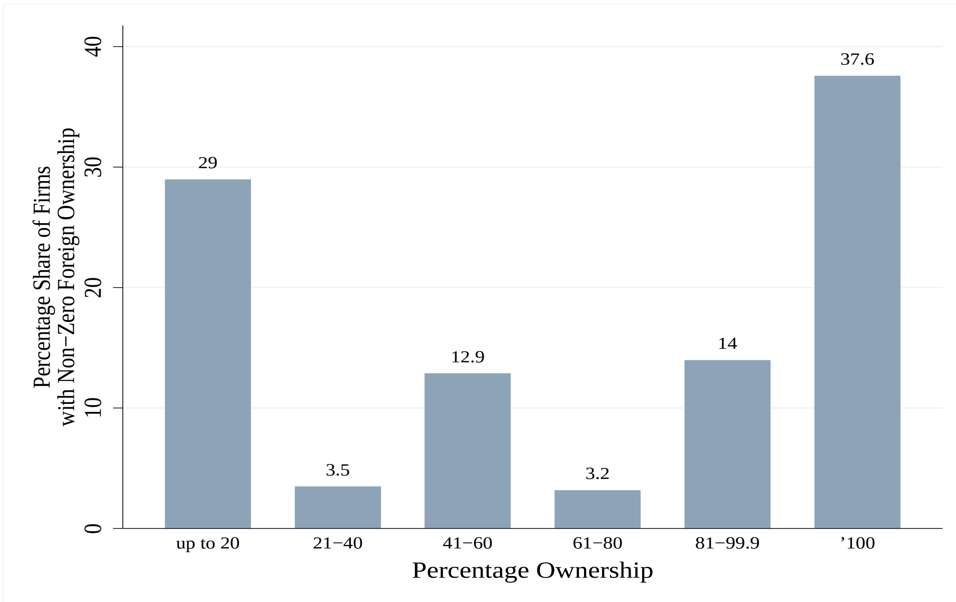



Figure 1: Sectoral Distribution of Firms

*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 2 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 1).

Panel A: Industry-FDI




Panel B: Financial-FDI

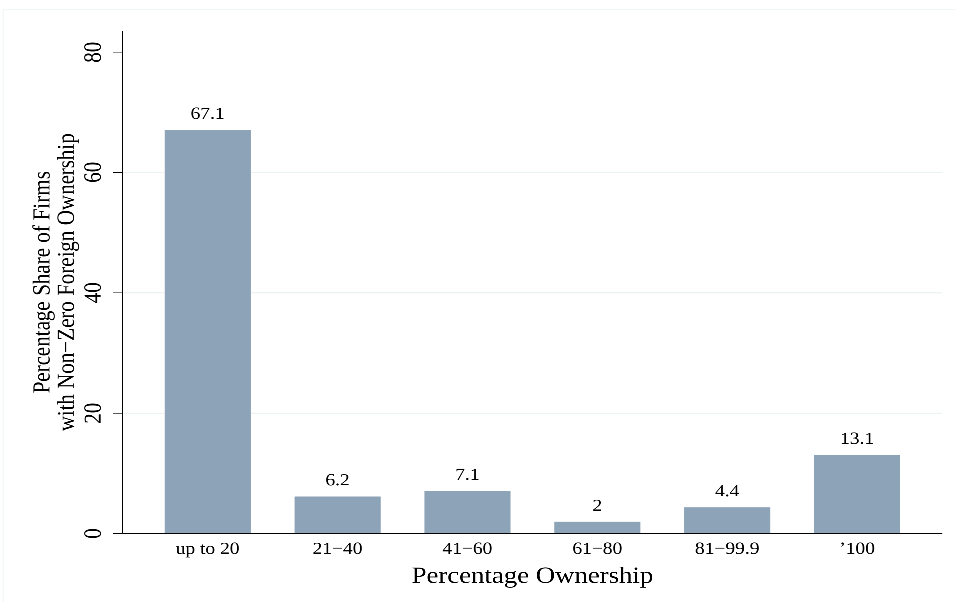
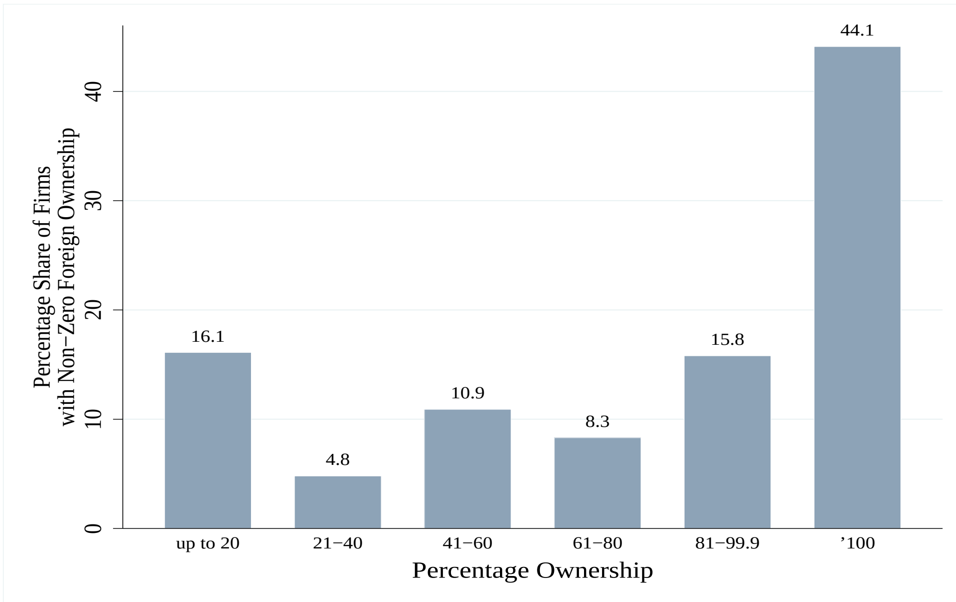



Figure 2: Distribution of Industry-FDI and Financial-FDI Among Foreign Owned Firms: Developed Countries

*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 1). 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 2 and 4 for the details on construction of variables.

Panel A: Industry-FDI




Panel B: Financial-FDI

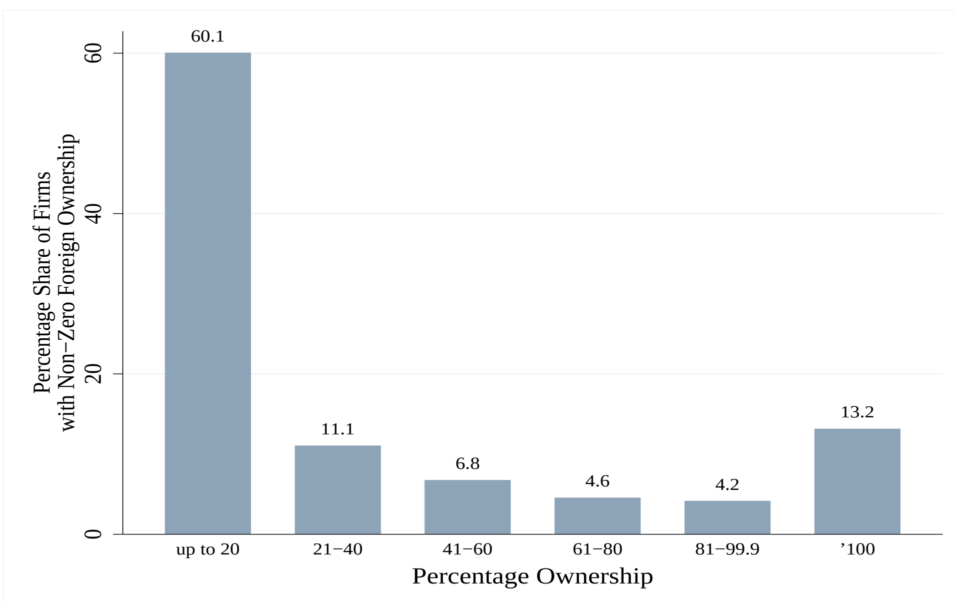
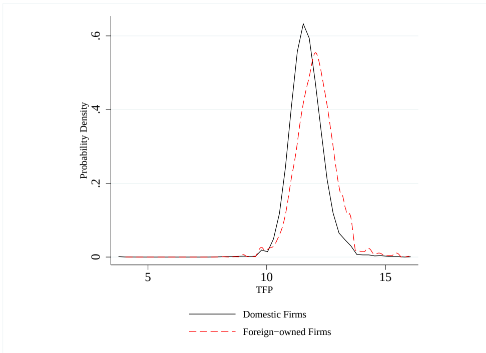
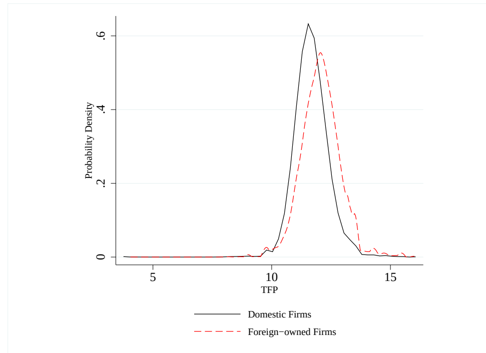



Figure 3: Distribution of Industry-FDI Among Foreign Owned Firms: Emerging Market Countries

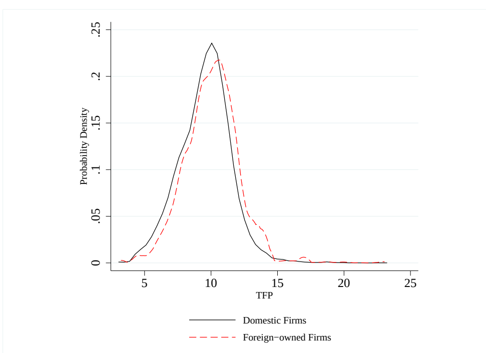
*Notes:* The figure shows the distribution of foreign ownership using all firms in all available years. Firms are drawn from the sample with available data for TFP construction (panel B of Table 1). The percentage of observations in a given ownership bin are computed relative to the total number of firms where foreign ownership of *given type* (industrial in panel A or financial in panel B) is larger than zero. See Sections 2 and 4 for the details on construction of variables.



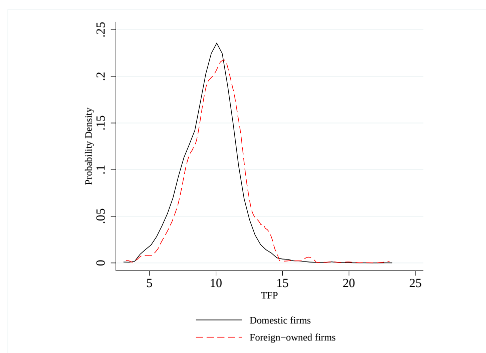

(a) Developed: Foreign-owned>0. Mean (Median) TFP of foreign-owned firms = 12.09 (12.08); Mean (Median) TFP of domestic firms = 11.66 (11.63




(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 4: 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 2 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 database ORBIS, which covers around 100 million listed and private companies 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. 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 European companies (roughly a half of the entire ORBIS universe).[24] The European subset of ORBIS includes 41 countries with varying coverage. It totals some 50 million companies: public and private, large, medium, and small, with about 10 thousand listed companies. A company with subsidiaries is required to prepare consolidated accounts; however, we use only *unconsolidated* accounts to avoid double counting.[25]

The literature typically cleans the raw data. 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 "general cleaning");

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

[24] For marketing purposes, the BvD packages this data in a separate database, AMADEUS, which has a very similar structure to ORBIS.

[25] 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. 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 while the remaining 55 companies are subsidiaries of these. Another example is LEGO, which has 38 subsidiaries of which 3 are directly owned—the remainder are subsidiaries of these. 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 because we do not have data for subsidiaries outside Europe).

## General cleaning

We focus on companies of a certain minimum size, discarding the companies defined by ORBIS as "small" (operating revenue less than EUR1 million; total assets less than EUR2 million, or number of employees less than 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 1996–2008. 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 "2005 PPP dollars" using yearly GDP deflators with 2005 base from the World Bank and 2005 end-of-year U.S. dollar exchange rates. We prefer using international dollars rather than Euros because we plan to expand our sample to non-European companies. The "$" sign will represent 205 PPP dollars in the following. Employment is measured in number of persons.

We drop all firms with assets less than $1,000 in any year, 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 a 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. 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), leaving 1.23 million firms.

Next, we drop firms with gaps in the data. For example, if a firm reports data for 2001–2004, not in 2005, and then in 2006, the 2006 data is eliminated from analysis. After dropping 203,409 gap,s we still have 1.23 million firms but fewer time series 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, total assets, or negative "costs of materials" and are left with 907 thousand firms.

Visual inspected reveals errors in the data, for example, some numbers seem to be coded in dollars rather than in millions of dollars, and to partially alleviate outliers due to typing mistakes, 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, and 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 firms which are in the financial according to ORBIS, many non-financial companies have significant investment income and our cleaning is intended to remove such firms. An extreme example is Warren Buffett's Berkshire Hathaway, which started as a textile firm and became an investment company over time. We also eliminate firms with sales larger than operating revenue. These filters get rid of phantom firms, tax-fronts, etc. The resulting sample covers the data for 788 thousand unique firms from 38 European countries 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 1999-2008 with approximately 740 thousand firms.

We concentrate on the sample of firms with more than 15 employees 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 1.

In order to compute the total factor productivity (TFP) at the firm leve,l 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 208,000 firms from 12 developed countries and 13 emerging markets. The data counts by country in this sample are presented in panel B of Table 1.

If we focus on the manufacturing sector only (to compare our findings to previous results in the literature),we obtain 134,000 firms.[26] 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 $t$:

$$y_{it} = \alpha + \beta_l l_{it} + \beta_k k_{it} + \omega_{it} + e_{it}\,, \tag{14}$$

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 $\omega_{it}$ and an additional term that reflects measurement error or unexpected productivity shocks $e_{it}$. We are interested in estimating $\omega_{it}$.

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

$$\omega_{it} = g(k_{it}, m_{it})\,, \tag{15}$$

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

$$E(e_{it}|l_{it}, k_{it}, m_{it}) = 0 \qquad t = 1, 2, ..., T\,, \tag{16}$$

[26]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.

substituting equation (15) into equation (14), we have the following regression function:

$$
\begin{aligned}
E(y_{it}|l_{it}, k_{it}, m_{it}) &= \alpha + \beta_l l_{it} + \beta_k k_{it} + g(k_{it}, m_{it}) \\
&\equiv \beta_l l_{it} + h(k_{it}, m_{it}) \,,
\end{aligned} \tag{17}
$$

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

In order to identify $\beta_l$ and $\beta_k$ we need some additional assumptions. First, rewrite equation (16) is in a more strong form, allowing more lags to condition on:

$$
E(e_{it}|l_{it}, k_{it}, m_{it}, l_{i,t-1}, k_{i,t-1}, m_{i,t-1}, ..., l_{i1}, k_{i1}, m_{i1}) = 0 \qquad t = 1, 2, ..., T\,. \tag{18}
$$

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

$$
E(\omega_{it}|\omega_{i,t-1}, ..., \omega_{i1}) = E(\omega_{it}|\omega_{i,t-1}) \qquad t = 2, 3, ..., T, \tag{19}
$$

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 $m$:

$$
\begin{aligned}
&E(\omega_{it}|k_{it}, l_{i,t-1}, k_{i,t-1}, m_{i,t-1}, ..., l_{i1}, k_{i1}, m_{i1}) \\
&\quad = E(\omega_{it}|\omega_{i,t-1}) \equiv f[g(k_{i,t-1}, m_{i,t-1})]\,.
\end{aligned} \tag{20}
$$

Recall from equation(15) 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 (14) gives:

$$
y_{it} = \alpha + \beta_l l_{it} + \beta_k k_{it} + f[g(k_{i,t-1}, m_{i,t-1})] + a_{it} + e_{it}\,. \tag{21}
$$

Now it is possible to specify *two* equations that identify $(\beta_l, \beta_k)$:

$$
y_{it} = \alpha + \beta_l l_{it} + \beta_k k_{it} + g(k_{i,t}, m_{i,t}) + e_{it} \tag{22}
$$

and

$$y_{it} = \alpha + \beta_l l_{it} + \beta_k k_{it} + f[g(k_{i,t-1}, m_{i,t-1})] + u_{it} \, , \tag{23}$$

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 (22) are those outlined in the equation(18), while the orthogonality conditions for equation (23) are

$$E(u_{it}|k_{it}, l_{i,t-1}, k_{i,t-1}, m_{i,t-1}, ..., l_{i1}, k_{i1}, m_{i1}) = 0 \qquad t = 2, ..., T \, . \tag{24}$$

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.[27] 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 Stichting.[28,29]

[27]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.

[28]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.

[29]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.

Having identified foreign ownership links of a given type, we compute *Foreign Ownership* (FO) variable as follows: For a firm $i$, $\text{FO}_{i,t}$ is the sum of all percentages of direct ownership by foreigners in year $t$; $\text{FO}^F_{i,t}$ ($\text{FO}^I_{i,t}$) 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 $\text{FO}^F_{i,t}$ is 15% and ($\text{FO}^I_{i,t}$) 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 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 |