Where are the Productivity Gains from Foreign Investment?

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

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Abstract

We identify the effect of foreign direct investment (FDI) on host economies by separating positive productivity (TFP) effects of knowledge spillovers from negative effects of competition. We use a unique new firm/establishment-level data set covering the last decade for a large set of countries with information on economic activity, ownership stake, type, sector, and country of origin of foreign investors. Controlling for foreigners potentially selecting themselves into productive firms and sectors, we show that the positive effect of FDI on the host economy's aggregate productivity is a myth. Foreigners invest in high productivity firms and sectors, but do not increase productivity of the acquired firms nor enhance the productivity of the average domestic firm. In emerging markets, we find that the productivity of acquired firms increases but the effect is too small to significantly affect the aggregate economy. For domestic firms, a higher level of foreign investment in the same sector of operation leads to strong negative competition effects in both developed and emerging countries. In developed countries, we find evidence of positive spillovers through knowledge transfers only for domestic firms with high initial productivity levels operating within the same broad sector as the multinational investor but in a different sub-sector. Our results confirm the predictions of the new new trade and FDI literature, in that more productive firms select themselves into exporting and FDI activities. Similarly to this literature, we highlight the importance of firm-level heterogeneity in productivity as well as in foreign investment.

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1 Introduction

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

There is a central identification problem at the heart of this literature stemming from *selection* and *simultaneity*. The new 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. Foreign targets may not become more productive upon receiving foreign investment and there would be no reason why these foreign affiliates would pass productivity enhancing knowledge on to other domestic firms. Foreign-owned companies might drive weak domestic firms out of business, leading to the erroneous conclusion that domestic firms in the foreign activity sector are becoming more productive. Any finding of a positive relation between foreign ownership and domestic productivity can be an artifact of (a) foreigners investing in productive firms in productive sectors and (b) exit of low productivity domestic firms following foreign investment. 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

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

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

selection effects must be accounted for, as well as the possibility of dynamic effects through the exit of weak domestic firms.

The second difficulty in the quest for identification arises from the *simultaneity* problem. Foreign investment may be correlated over time with higher productivity of affiliates, or higher productivity of domestic firms with whom they interact; however, dynamic patterns might be driven simultaneously by time varying factors other than foreign ownership. To account for this problem, we need exogenous variation in firm-level foreign investment over time.

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

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

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

[4]For listed companies, disclosure rules vary from country to country but for most of our countries, we know the identity of the owner if the stakes owned exceed 3-5 percent. Often, we know the identity of the owners holding as low as 0.01% ownership stake in private or listed companies.

more productive over time with increased foreign ownership? Our quest for causality 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 or growing countries, as well as high productivity firms through the use of firm, sector-time, and country-time fixed effects. Second, we ask whether domestic firms that operate in the same or in a different sector than the foreign affiliates become more productive with increased foreign presence in such sectors? This requires us to decompose productivity effects into knowledge spillovers and competition. The latter can be studied both at the extensive and intensive margins. On the extensive margin, we account for survival bias. On the intensive margin, we explore the productivity effects of multinationals and their affiliates on continuing domestic firms. For both questions, in order to identify causal effects, we need exogenous firm-specific time-series variation. Our instrumentation strategy 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.

Our data and methodology has several advantages. The first advantage of our data set is its dynamic nature with direct micro FDI observations. Although a dummy for foreign ownership that changes over time can be used in a firm fixed effect estimation, it will only be informative about the extensive margin and will be silent on the intensive margin. This is important given the results of the new new trade literature emphasizing firm heterogeneity (see Helpman (2006)). The productivity effects (both direct and via spillovers) of foreign investment might vary if the presence of foreigners amount to owning companies in excess of 50 percent or less than this amount. Due to data availability, the literature most often uses a dummy variable to separate foreign and domestic companies (see, for example, Harrison, Love, and McMillan (2004), De Haas and Van Lelyveld (2006) and Bloom, Sadun, and Van Reenen (2009)), where the dummy indicates that the firm is owned by an "overseas" company in the amount of more than a certain percent. Other papers use 100 percent owned foreign subsidiaries of multinationals (See Desai, Foley, and Forbes (2007) and Alfaro and Chen (2012), for an example). Neither case will give a full description of direct and spillover effects of FDI.[5] To the best of our knowledge, we are the first to provide empirical

[5]Exceptions are Javorcik (2004), Aitken and Harrison (1999), and Arnold and Javorcik (2009), where the former two aggregate the firm-level ownership shares into sectoral foreign presence to investigate spillovers to domestic firms in Lithuania and Venezuela, respectively and; the latter investigates the direct effect of ownership shares on acquired

evidence on two dimensions of firm level heterogeneity: productivity and the extent of firm level foreign ownership.

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

firms using propensity-score techniques on manufacturing data from Indonesia.

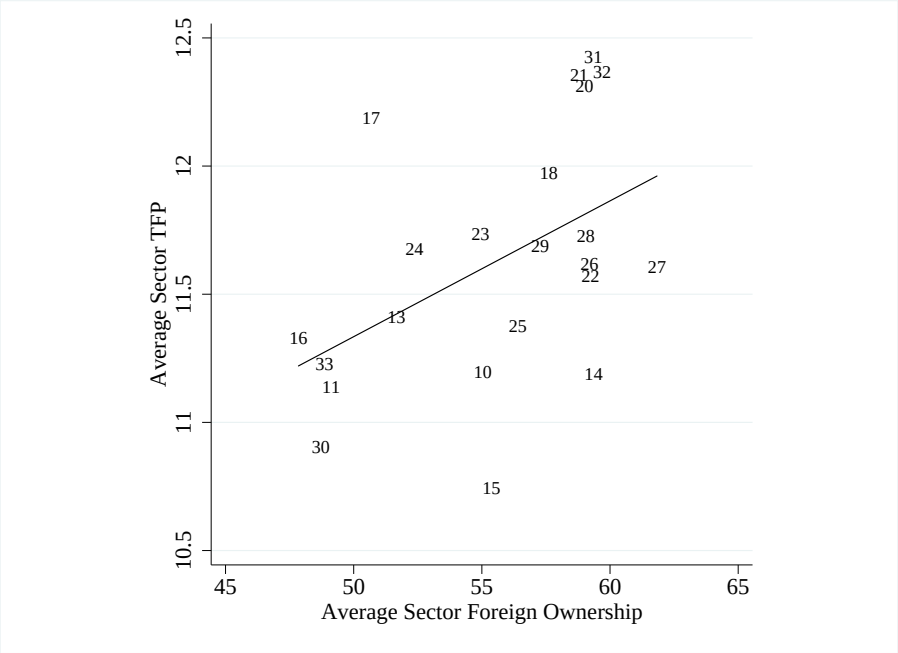

Figure 1: Foreign Investment and Productivity

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

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

[6] "Industry-FDI," refers to foreign ownership where the owner is a non-financial company, while "Financial-FDI" is undertaken by a hedge fund, mutual fund, or a bank. "Industry-FDI," if it is horizontal, may be undertaken to avoid trade costs by locating production facilities overseas as argued by Markusen (1984). If foreign 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," on the other hand, refers to the situation where financial companies invest in foreign firms. In a number of cases financial firms invest in low productivity firms at a discount price in order to reorganize (possible involving a break-up of the firm) and selling off the reorganized entity (or 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, this effect in developed countries is solely driven by future fundamentals (growth potential); i.e., growing firms becoming foreign-owned. In emerging markets, the positive effect survives the IV analysis, but it is quantitatively too small to have any meaningful effects in the aggregate. 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 the other domestic firms that are direct competitors there are strong negative competition effects. In the light of our previous finding of foreign owned firms being more productive due to high growth potential, rather than because of foreign ownership, we interpret this finding as a business creation effect of foreigners for the domestic firms that operate in the same two-digit sector but do not operate in the same four-digit sector.[7] 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.

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

2 Literature Review

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

[7] We labeling this "knowledge spillovers" following the literature because we lack a better name for now.

evidence for vertical spillovers with the productivity of domestic firms being correlated with the presence of multinationals in downstream and upstream sectors (potential suppliers and customers).

The papers discussed start by showing positive correlations between foreign ownership and productivity of acquired firms.[8] An implicit assumption is acquired firms become more productive and turn into potential sources of spillovers. However, the use of firm fixed effects are fundamental to the robustness of such a conclusion. Table 1 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.[9] 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 *a priori* productive firms.

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. In general, the literature investigates the effects of resource allocations; for example, Hsieh and Klenow (2009) show that allocation of factors across heterogenous firms has a large impact on cross-country income differences. Aitken, Harrison, and Lipsey (1996) and Feenstra and Hanson (1997) find that wages of skilled workers increase as a result of foreign activity in certain sectors. Finally, our paper is related to the literature that uses non-parametric techniques for estimating firm-level productivity. Our contribution is to investigate the causal effect of foreign investment on firm-level total factor productivity by

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

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

Table 1: Foreign Activity, Labor Productivity and Value Added

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

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

decomposing, and quantifying, the impact from knowledge spillovers, competition, and selection.

3 Methodology

3.1 Firm Productivity and Foreign Ownership

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

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

where $\text{TFP}_{i,s,c,t}$ refers to total factor productivity of firm i, in sector s, in 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. We also distinguish among industrial and financial foreign ownership, where $\text{FO}^I_{i,s,c,t}$ represents the share of capital owned by foreign industrial investors and $\text{FO}^F_{i,s,c,t}$ represents the share of capital owned by foreign financial investors. α_i represents firm-specific dummies, $\delta_{c,t}$ represents country-year (country×year) dummies, and $\phi_{s,t}$ represents sector-year (sector×year) dummies (fixed effects).

The parameter of interest is the "within" coefficient, β: a positive β 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 3.4 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.[10]

3.2 Productivity Spillovers

Traditionally, the literature on FDI spillovers has estimated an equation of the following type for the sample of domestic firms:[11]

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

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. α_i represents firm-specific dummies and δ_t represents year dummies. The parameter of interest is β and a positive coefficient indicates positive productivity spillovers from foreign-owned companies to domestic firms. The inclusion of firm-fixed effects is crucial because foreign investors may systematically invest in high productivity sectors. When firm-fixed effects are included, β 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 (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 (which is not an option in previous studies that estimate equation (2) using data for one single country). Further, we control for the possibility that certain countries,

[10]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.

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

such as the Baltics, to be in a growth and investment phase by including country-year fixed effects. We estimate the following equation for the sample of domestic firms only:

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

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

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

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:

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

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

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

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. 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.

3.3 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:

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

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.

3.4 Construction of Instruments

3.4.1 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:

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

The fixed effects in equation (Y) alleviate many endogeneity concerns but IV-estimation may still be needed for a consistent estimate of α 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 ignore the c index and the country $\times$ year fixed effects. These dummies play a role parallel to that of sector $\times$ time, but the treatment is similar and we leave those out as they would complicate notation significantly.

We want the reduced form regression,

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

to give unbiased estimates of δ. For the purpose of estimating δ, 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 $\widehat{\mathrm{FO}}_i$ is predicted (see details shortly) and the firm-average innovation $u_{i.}$—which most likely would correlate with firm specific ownership—is subtracted, as long as $u_{i,t} - u_{i.} - u_{s,t} + u_{s.}$ 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 $\widehat{\mathrm{FO}}_i$ to be the predicted value from a probit regression of the following type:

$$\begin{aligned} \mathrm{FO}_{i,t} \quad = \quad & \beta_0 \mathrm{FO}_{i,t-1} + \beta_1 \ln\left(\mathrm{K/L}\right)_{i,t-1} + \\ & \beta_2 \ln\left(\mathrm{VA/L}\right)_{i,t-1} + \beta_3 \ln\left(\mathrm{ASSETS}\right)_{i,t-1} + \beta_4 \ln\left(\mathrm{ASSETS}\right)^2_{i,t-1} + \\ & \beta_5 \mathrm{AGE}_{i,t} + \beta_6 \mathrm{AGE}^2_{i,t} + \delta_{ct} + \phi_{st} + \epsilon_{i,t} \end{aligned} \tag{8}$$

in the first year possible for the firm ("$\widehat{\mathrm{FO}}_{i,0}$"). For a time-varying measure of growth in foreign

ownership (now making the country dependence explicit again), we choose

$$\mathrm{W}_{s,c,t} = \frac{\sum_{i \in c,s} \mathrm{FO}_{i,t} \mathrm{Y}_{i,0}}{\sum_{i \in c,s} \mathrm{Y}_{i,0}} \ ; \tag{9}$$

i.e., sector-level foreign ownership in country c at time 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 ξ_0, ξ_1 and ξ_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 γ_1 in equation (F)) *and* above average predicted foreign ownership (in the initial period), also are the firms with TFP-growth above the sector and country average (high $u_{i,t} - u_{i.} - u_{s,t} - u_{c,t} + u_{c,.} + u_{s,.}$). We assume that such a pattern is not present which seems reasonable because it will not break down even if $(u_{i,t} - u_{i.} - u_{s,t} - u_{c,t} + u_{c,.} + u_{s,.})$ is positively correlated with $u_{c,s,t}$ unless these variables are further correlated with predicted initial foreign ownership.

3.4.2 Spillover Regressions: TFP and sectoral spillovers

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

rule out the possibility that foreign investors target more productive sectors in particular countries.

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

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

$$IVSpillover_{c,s,t} = \widehat{\mathrm{FO}}_{c,s,0} \times \mathrm{W}_{c,t} \times \mathrm{W}_{s,t} \ . \tag{10}$$

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

4 Data

4.1 Samples

We use the comprehensive firm-level worldwide database ORBIS, compiled by BvD, who specializes in gathering and providing company information. An advantage of ORBIS compared to the widely-used databases of listed companies COMPUSTAT for the U.S. 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.[12] Panel A in Table 2 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 2. As seen, the firm coverage differs a lot from country-to country, and industrialized countries do not necessarily have better coverage. Figure 2 shows the average percentage of observations by sectoral categories. Manufacturing is the largest sector in both developed and emerging countries, with roughly 40 percent of observations belonging to this sector. This sector is followed by the retail and services sectors (20 percent of observations each in both groups of countries) and construction (12 percent). If we want to focus only on manufacturing, we have 80,000 to 134,000 firms, depending on the control variables.[13]

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 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.

[12] 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.

[13] 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.

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.[14] 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).[15]

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, fund, individual, and so on). The database refers to each record of ownership as an "ownership link." An ownership link indicating that an entity A owns a certain percentage of firm B is referred as a "direct" ownership link. BvD traces a direct link between two entities even when the ownership

[14] 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.

[15] 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 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).

percentage is very small (sometimes less than 1 percent). For listed firms, very small stock holders are typically unknown.[16] In addition, ORBIS contains information on-so called "ultimate" owners (UO) of the company by tracing the ownership pyramid beyond the direct owners. 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, UO links are calculated by BvD but not reported by the original sources. BvD focuses on targets where all owners have less than 25 percent of direct ownership. Firms with one owner which owns more than 25 percent is designed the ultimately owner. BvD looks for the owner with the highest direct ownership stake. If this shareholder is itself independent (being owned less than 25 percent by a single owner), it is defined as the UO of the company and 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 this variable. In contrast, large owners are almost always precisely identified from our direct ownership variable.

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-*

[16] 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.

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 3 uses the subset of firms in Panel A of Table 2 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 3 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 3 and Figure 4 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 4 provides basic summary statistics of the variables used in the regression analysis in the

subsample of manufacturing firms.[17] 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 4 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 variation in the variables in both samples which we exploit in the following empirical analysis.

5 Results

5.1 Are Foreign Firms More Productive?

Before we analyze spillover effects from foreign-owned companies to domestic firms, we explore whether foreign-owned firms are indeed more productive. 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.[18]

For developed countries, column (1) of Panel A shows that foreign-owned companies are more

[17] The number of observations is somewhat smaller than that in Panel B of Table 2 because the sample here is only manufacturing firms. To limit the potential impact of outliers, we winsorize variables before performing our empirical analysis.

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

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 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.

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, where Panel A and Panel B report results for the sample of developed and emerging countries, respectively. We distinguish between horizontal spillovers from foreign-owned industrial and financial companies. Column (1) in Panel A shows that foreign-owned companies have a significant impact on the productivity of the typical domestic firm in the same two-digit sector and column (3) in Panel A shows that these results are driven by both industrial and financial FDI. Previous studies have found evidence of significant positive horizontal spillovers in developed countries; however, these studies could not differentiate between industrial and financial FDI. Financial companies can be expected to invest in order to diversify income streams and are *a priori* less likely to engender knowledge spillovers. Researchers who are 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.[19] Column (2) in Panel A includes sector-year fixed effects which control for effects that are common across countries implying that the results are driven by local effects in the domestic country. 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) show identical reductions in the size of the coefficients related to industrial and financial FDI. The lack of significance when sector-year dummies are included means that if spillovers 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-

[19] 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.

owned companies in the same two-digit sector—a finding in line with previous results of Aitken and Harrison (1999), who use firm-level panel data for Venezuela. 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 industrial and financial FDI: the negative spillover results found in columns (1) and (2) are mainly driven by industrial FDI.

Table 6 focuses on the role of foreign presence in the same two-digit sector and provides some new evidence on horizontal spillovers in developed countries. 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, 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 linkages theories, we find that there is scope for positive productivity spillovers from foreign-owned companies to domestic companies that are not

direct competitors.

Columns (2) and (3) again address the possibility that foreign-owned companies target more productive sectors by including two-digit and four-digit sector-year fixed effects, respectively. The results show a robust negative competition spillover effect from FDI within the targeted four-digit sector and a positive and significant effect of the knowledge spillovers to other four-digit sectors within the same two-digit sector. However, 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 industrial FDI, while they are unlikely to to found when a financial company invests for income or diversification and, indeed, columns (4) and (5) show that the spillover results are driven by industrial FDI and not by financial FDI. Finally, columns (6) and (7) 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 (7) shows that the negative competition effect from industrial FDI is not solely the result of 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.

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 (3) in Table 9 show that there are negative productivity spillovers from industrial foreign-owned companies operating in the same four-digit sector. Unexpectedly, we also find negative knowledge spillovers in emerging markets. Again, as in the case of developed countries, the results are driven by industrial FDI (see columns (4) and (5)). Similarly, in columns (6) and (7) where a permanent sample of firms is considered, the negative competition finding is not solely the result of entry/exit.

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.[20] In Tables 5, 8, and 10, we showed that foreign-owned firms are associated with higher productivity and market shares in terms of output and employment 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

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

results from instrumental variable estimation conducted according to the methodology outlined in Section 3. Columns (1) to (3) focus on developed countries, while columns (4) to (6) focus on emerging countries. Given the lack of findings for Financial-FDI, we constrain the analysis to the role of total FDI (i.e., the sum of industrial and financial FDI). Panel A in Table 11 shows the second stage while Panel B considers the first stage. It is clear from Panel B that the instrument and the endogenous variable (i.e., FDI) are highly correlated in both developed and emerging countries. However, In emerging markets foreign-owned firms are more productive and have higher market shares at the four-digit level in terms of output and employment even after controlling for country-four digit sector-year fixed effects. In developed countries, foreign-owned firms have higher market shares in terms of output; however, there is no evidence of a causal impact of FDI on firm productivity. The fact that foreign-owned firms target the most productive domestic firms in developed countries might reflect that foreign-owned companies invest in order to diversify risk—and such investments do no involve transfers of technology—which may explain the results in Table 11.

5.4 Firm Heterogeneity, Foreign Ownership and Spillovers

In a recent paper, Bernard, Jensen, Redding, and Schott (2011) review the empirical evidence on firm heterogeneity in international trade. One of the main insights 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 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 5 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). The graphical evidence is confirmed by the results shown in columns (1) and (3) of Table 12. Foreign-owned companies in developed countries are always more productive than domestic companies regardless of the ownership stake. In contrast, only majority owned foreign-owned companies in emerging countries are more productive than their domestic counterparts. These results have obvious implications in terms of spillovers to domestic companies as shown in columns (2) and (4). In developed countries, all types of foreign ownership have a negative competition effect on the productivity of domestic firms. Only majority owned foreign companies have positive knowledge spillovers (see column (2)) which confirms firm organization theories that postulate that only majority owned affiliates will transfer technology to their affiliates because of verification costs and weak investor protection (see Antras, Desai and Foley (2009)). In emerging countries, consistent with foreign-owned companies with less than 50 percent ownership not being productive than domestic companies themselves, column (4) shows no significant effect from these companies on the productivity of domestic companies.

Second, we study whether differences in the ex-ante distribution of firm productivity 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 in column (3) 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.

Columns (1) and (2) of Table 13 show the results for developed countries while columns (3) and (4) show results for emerging countries. In the sample of developed countries, column (1) shows that the negative competition effect is present for *all* firms; on the other hand, the positive knowledge spillover effect is concentrated among the firms with total factor productivity above the median. This is consistent with the idea that only the better firms have enough absorptive capacities to benefit from the activities of foreign-owned firms. If we split the sample into four quartiles, the negative competition spillover effects are present at all levels of total factor productivity; however, only domestic firms at the top of the total factor productivity distribution can capture the knowledge spillover benefits from FDI. Finally, when we focus on the sample of emerging countries, the competition results are similar to those of the developed countries sample (see column (3)). The negative spillover competition effect is present for *all* domestic firms regardless of their ex-ante total factor productivity. Furthermore, when domestic firms are split into below and above median total factor productivity, there is evidence of a negative knowledge effect for *all* firms. On the other hand, when we decompose domestic firms based on their productivity according to the quartiles, we find non-significant results for the top and bottom quartiles. The domestic firms that are hurt the most from the presence of foreign-owned companies in related sectors are firms at the second and third quartile. These firms suffer both from a negative direct competition effect in the output market as well as an indirect competition effect from foreign-owned firms in related sectors that compete in inputs (i.e., employment and capital). The results in column (4) of Table 13 seem to indicate that only the very top domestic firms have enough absorptive capacity to offset the negative effects from competing on the inputs market. Domestic firms at the lower end of the distribution are not negatively affected either, probably because they are not direct competitors for inputs with the higher-end foreign-owned companies.

5.5 IV Spillovers

Table 14 reports on IV-estimation of spillovers. As previously discussed, foreign ownership may be endogenous to firm characteristics, such as growth prospects, that are unobservable by econometricians. Possibly, such unobserved features correlate with productivity in firms which are not themselves targeted by foreigners. We perform IV-estimation in order to hedge against such patterns. From the first row of results, we observe a stronger competition effect of spillovers using

IV-estimation. It is comforting that the sign and significance of the results is robust but the change in magnitude needs discussion. There are several reason why the IV results may be stronger: the obvious explanation is that OLS is biased due to endogeneity of sectoral investment and the coefficients differ because IV is not subject to such bias. Another reason that comes to mind is the classical result that measurement error in a regressor leads to bias towards zero in OLS. It is also possible that actual foreign ownership within the fairly small 4-digit sectors is a more noisy indicator of competition than the less volatile instrument. Another potential explanation could be that the instrument correlates more with some country-sector-year cells and these cells at the same time are the ones where competition spillovers matter more.[21] We believe that the first two explanations are more likely. For knowledge spillovers, the sign and significance are also robust to OLS versus IV estimation, but here the IV-coefficient is more than ten times the size of the OLS-coefficient. This large discrepancy is more puzzling. Endogeneity bias of OLS is likely not severe for knowledge spillovers as the regressor involves foreign investment in other 4-digit sectors, therefore, the large difference between OLS and IV is probably not mainly due to endogeneity bias. LATE effects are not easily surmised in the present setting which leaves measurement error, in the general sense just used, as the likely explanation. Simply put, the instrument may be a much better measure of available knowledge than the OLS regressor. The instrument is based partly on world-wide investment in the relevant sectors and possibly our interpretation of local knowledge spillovers is too narrow.

6 Conclusion

We asked three main questions in this paper. If the answers were all positive, it would provide strong support for positive effects of foreign investment on aggregate economic growth and productivity of the host economy. However, the answers turned out to be quite different than expected. The questions are as follows.

1. Are foreign-owned firms more productive? Foreign-owned firms target more productive domestic companies but do not contribute to further productivity increases. Only in emerging

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

markets, there is evidence of productivity enhancing effects of foreign owned companies on targets. However, these effects are too small to contribute to aggregate country productivity even if the whole domestic sector were bought out by foreigners—an unrealistic scenario.

2. Are there differences according to the extent of foreign ownership, whether multinationals have the majority control or not? In developed countries, regardless of ownership stakes, foreign-owned companies target more productive domestic firms. In emerging markets, foreign investors target more productive domestic firms and acquire a controlling stake.

3. Are there productivity spillovers from foreign ownership? In both developed countries and emerging markets, there are strong negative competition effects in the same sector of operation. Only in developed countries is there evidence of positive productivity spillovers—but only for firms that are not direct competitors of the foreign investor and which have high ex ante productivity. This positive effect is driven by the activity of foreign affiliates with majority control.

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7 Tables

Table 2: Number of Observations per Country

Panel A: Total Number of Firms

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

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

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

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

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

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

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

Panel B: Percentage of Observations by Ownership Category

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

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

Table 4: Summary Statistics

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

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

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

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

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

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

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

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

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

Dependent Variable: Firm Productivity
Sample: Domestic Firms

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

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

Table 8: Channels in Developed Countries

Total Sample of Firms in Developed Countries

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

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

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

Dependent Variable: Firm Productivity
Sample: Domestic Firms

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

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

Table 10: Channels in Emerging Countries

Total Sample of Firms in Emerging Countries

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

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

Table 11: Instrumental Variable Approach

	Panel A: Second Stage					
	Developed			Emerging		
	(1)	(2)	(3)	(4)	(5)	(6)
	TFP	$\ln(MS4dig_Y)$	$\ln(MS4dig_L)$	TFP	$\ln(MS4dig_Y)$	$\ln(MS4dig_L)$
FDI	0.005	0.074**	0.052	0.475***	0.741***	0.470***
	(0.036)	(0.029)	(0.036)	(0.097)	(0.129)	(0.110)
Observations	377,281	377,281	377,280	79,838	79,838	79,838
Firms	52,808	52,808	52,808	12,907	12,907	12,907
Firm Fixed Effects	yes	yes	yes	yes	yes	yes
Country-Year Fixed Effects	yes	yes	yes	yes	yes	yes
Sector4dig-Year Fixed Effects	yes	yes	yes	yes	yes	yes
Country-Sector4dig-Year Fixed Effects	yes	yes	yes	yes	yes	yes
Cluster	country-4dig-year	country-4dig-year	country-4dig-year	country-4dig-year	country-4dig-year	country-4dig-year
	Panel B: First Stage					
	Developed			Emerging		
	(1) FDI	(2) FDI	(3) FDI	(4) FDI	(5) FDI	(6) FDI
$\hat{FO_0} \times IndustryFDI_{sector,t}$	0.257***	0.525***	0.3122***	0.446***	0.384***	0.062*
	(0.055)	(0.052)	(0.048)	(0.038)	(0.039)	(0.035)
F	21.9	101.68	41.93	137.03	95.64	3.13
Observation	377,281	377281	377,280	79,838	79,838	79,838
Firms	52,808	52,808	52,808	12,907	12,907	12,907
Firm Fixed Effects	yes	yes	yes	yes	yes	yes
Country-Year Fixed Effects	yes	yes	yes	yes	yes	yes
Sector4dig-Year Fixed Effects	yes	yes	yes	yes	yes	yes
Country-Sector4dig-Year Fixed Effects	yes	yes	yes	yes	yes	yes
Cluster	country-4dig-year	country-4dig-year	country-4dig-year	country-4dig-year	country-4dig-year	country-4dig-year

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

Table 12: Foreign Ownership Heterogeneity, Firm Productivity and Spillovers

Dependent Variable: Firm Productivity
Sample: Domestic Firms

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

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

Table 13: Firm Heterogeneity and Spillovers

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

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

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

Dependent Variable: Firm Productivity
Sample: Domestic Firms

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

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

Figures

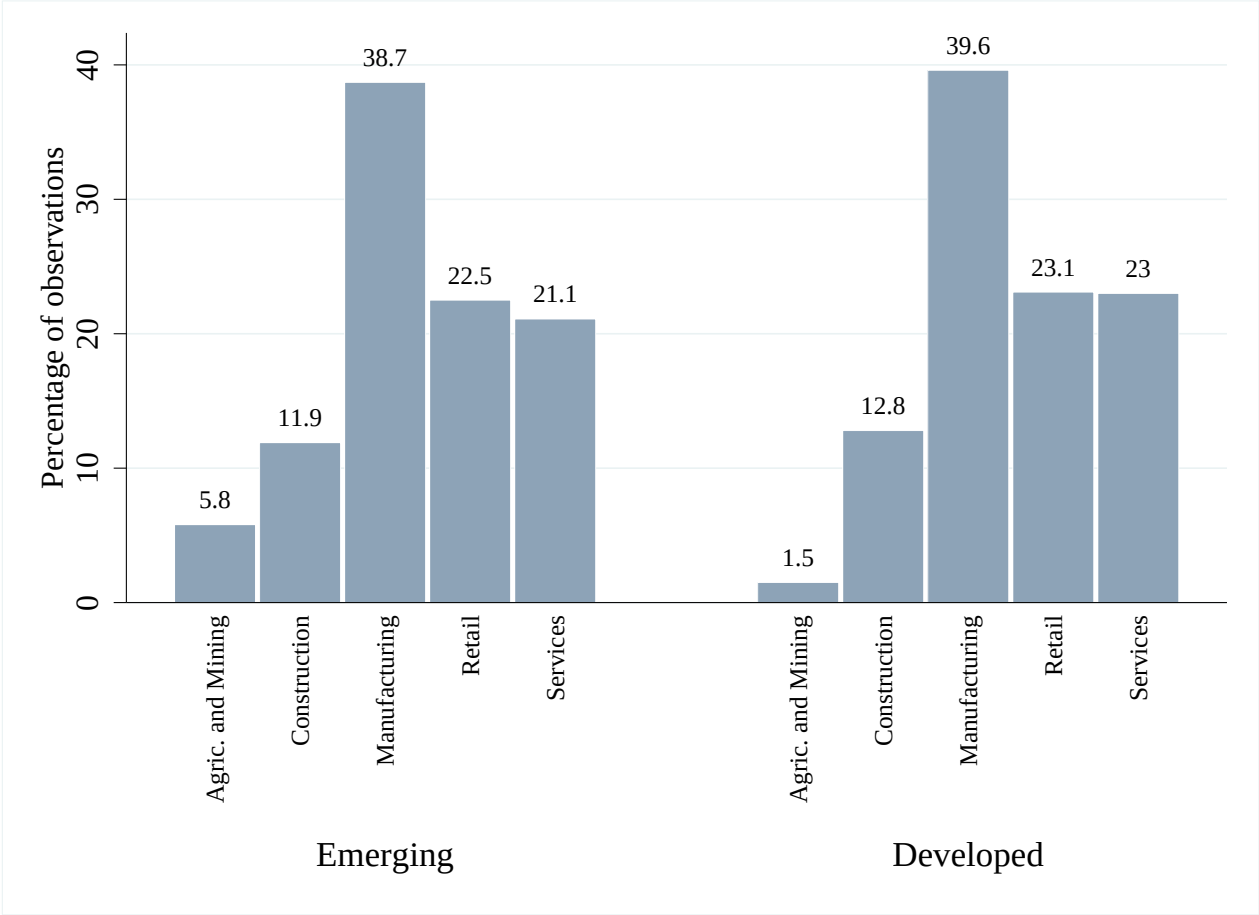
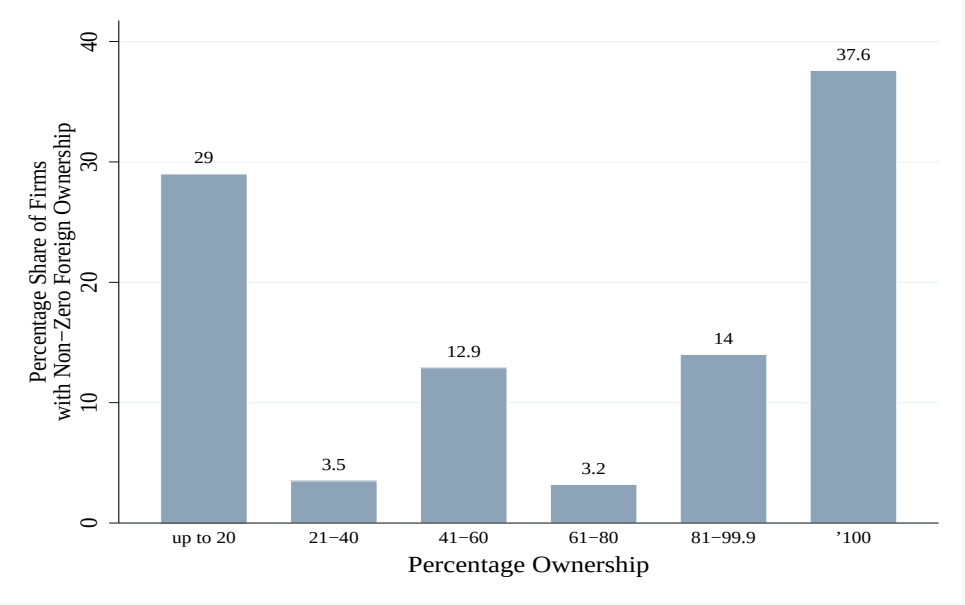


Figure 2: Sectoral Distribution of Firms

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

Panel A: Industry-FDI



Panel B: Financial-FDI

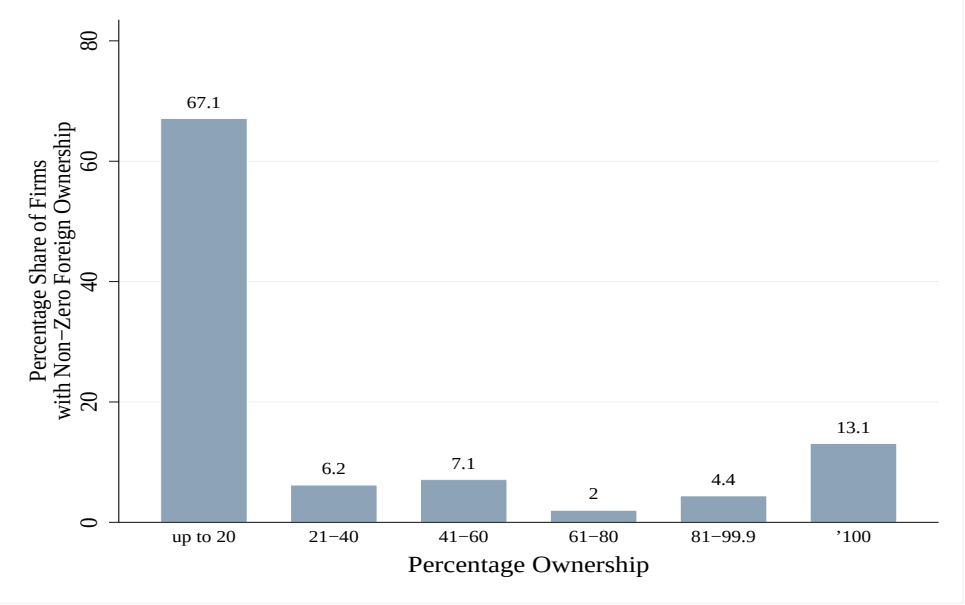
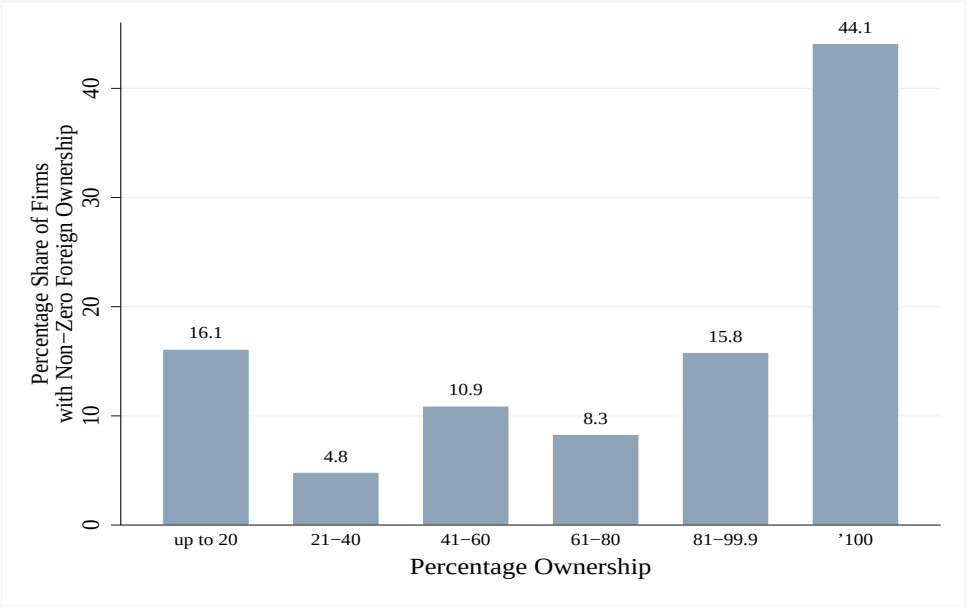


Figure 3: Distribution of Industry-FDI and Financial-FDI Among Foreign Owned Firms: Developed Countries

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

Panel A: Industry-FDI



Panel B: Financial-FDI

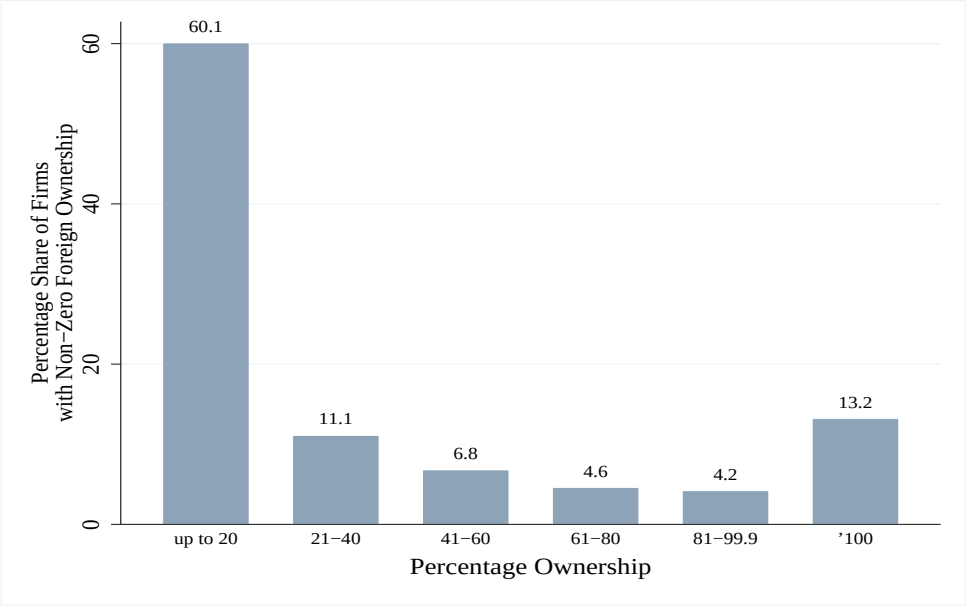
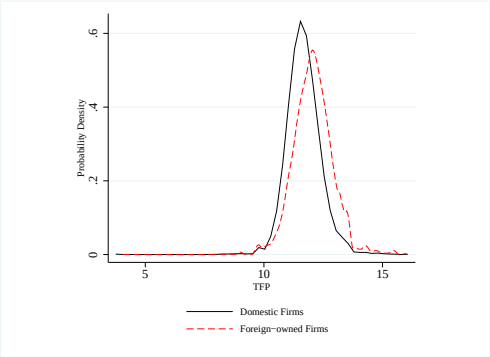
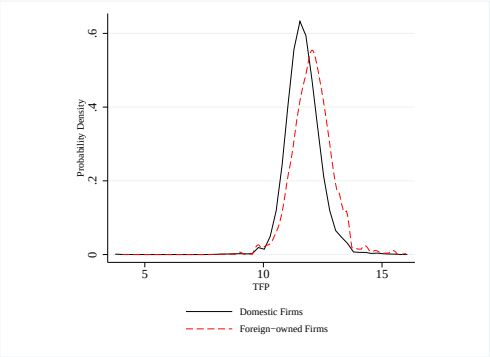


Figure 4: Distribution of Industry-FDI Among Foreign Owned Firms: Emerging Market Countries

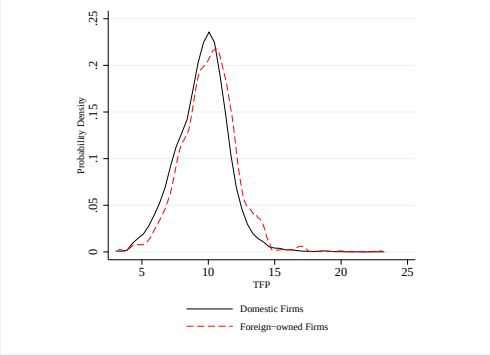
Notes: The figure shows the distribution of foreign ownership using all firms in all available years. Firms are drawn from the sample with available data for TFP construction (panel B of Table 2). The percentage of observations in a given ownership bin are computed relative to the total number of firms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



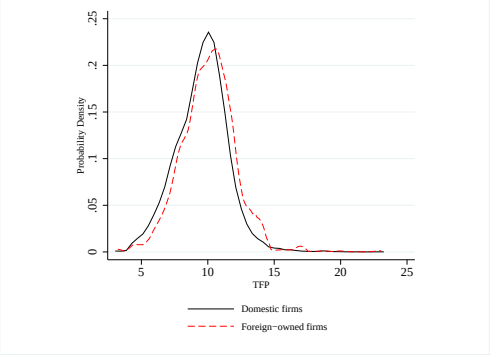
(a) Developed: Foreign-owned>0. Mean (Median) TFP of foreign-owned firms = 12.09 (12.08); Mean (Median) TFP of domestic firms = 11.66 (11.63



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



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



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

Figure 5: TFP density distribution by foreign ownership

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

Appendix: Data

Sample Selection

We construct a unique data set of firm-level observations drawing the information from the comprehensive 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).[22] 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.[23]

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").

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

[23]Even though the number of consolidated accounts is less than 1 percent of all accounts, it is important to use just the unconsolidated accounts. ORBIS categorizes all companies as subsidiaries regardless of the percentage of ownership: In standard accounting, a company A will be classified as a subsidiary of a company B if company B owns more than 50 percent of company A, while in ORBIS company A will be called a subsidiary even company B owns a 1 percent stake. There can be direct subsidiaries and also indirect subsidiaries. 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 2.

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 thousand firms from 12 developed countries and 13 emerging markets. The data counts by country in this sample are presented in panel B of Table 2.

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

TFP Estimation

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

For firm i in time period t:

$$y_{it} = \alpha + \beta_l l_{it} + \beta_k k_{it} + \omega_{it} + e_{it}\,, \tag{11}$$

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

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

$$\omega_{it} = g(k_{it}, m_{it})\,, \tag{12}$$

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

$$E(e_{it}|l_{it}, k_{it}, m_{it}) = 0 \qquad t = 1, 2, ..., T\,, \tag{13}$$

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

substituting equation (12) into equation (11), we have the following regression function:

$$\begin{aligned} E(y_{it}|l_{it}, k_{it}, m_{it}) &= \alpha + \beta_l l_{it} + \beta_k k_{it} + g(k_{it}, m_{it}) \\ &\equiv \beta_l l_{it} + h(k_{it}, m_{it}) \,, \end{aligned} \tag{14}$$

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

In order to identify β_l and β_k we need some additional assumptions. First, rewrite equation (13) is in a more strong form, allowing more lags to condition on:

$$E(e_{it}|l_{it}, k_{it}, m_{it}, l_{i,t-1}, k_{i,t-1}, m_{i,t-1}, ..., l_{i1}, k_{i1}, m_{i1}) = 0 \qquad t = 1, 2, ..., T \,. \tag{15}$$

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

$$E(\omega_{it}|\omega_{i,t-1}, ..., \omega_{i1}) = E(\omega_{it}|\omega_{i,t-1}) \qquad t = 2, 3, ..., T, \tag{16}$$

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:

$$\begin{aligned} &E(\omega_{it}|k_{it}, l_{i,t-1}, k_{i,t-1}, m_{i,t-1}, ..., l_{i1}, k_{i1}, m_{i1}) \\ &\quad = E(\omega_{it}|\omega_{i,t-1}) \equiv f[g(k_{i,t-1}, m_{i,t-1})] \,. \end{aligned} \tag{17}$$

Recall from equation(12) 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 (11) gives:

$$y_{it} = \alpha + \beta_l l_{it} + \beta_k k_{it} + f[g(k_{i,t-1}, m_{i,t-1})] + a_{it} + e_{it} \,. \tag{18}$$

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

$$y_{it} = \alpha + \beta_l l_{it} + \beta_k k_{it} + g(k_{i,t}, m_{i,t}) + e_{it} \tag{19}$$

and

$$y_{it} = \alpha + \beta_l l_{it} + \beta_k k_{it} + f[g(k_{i,t-1}, m_{i,t-1})] + u_{it}\,, \tag{20}$$

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 (19) are those outlined in the equation(15), while the orthogonality conditions for equation (20) are

$$E(u_{it}|k_{it}, l_{i,t-1}, k_{i,t-1}, m_{i,t-1}, ..., l_{i1}, k_{i1}, m_{i1}) = 0 \qquad t = 2, ..., T\,. \tag{21}$$

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

Details of Foreign Ownership Calculations

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

Type-specific ownership.

The database refers to each record of ownership as an "ownership link" and BvD traces a link between two entities even when the ownership percentage is very small (sometimes less than 1

percent). For listed firms, very small stock holders are typically unknown.[25] An ownership link indicating that an entity A owns a certain percentage of Firm B is referred to in ORBIS as a "direct" ownership link.

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

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

Next we identify foreign links corresponding to a specific "owner type" using the available type of owner variable. The values of this variable is textual but sufficiently harmonized. Specifically, we identify *foreign ownership link of industrial type* if the foreign owner has the type Industrial company or Corporate. We identify *foreign ownership link of financial type* if the foreign owner has the type Bank, Financial company, Insurance, Insurance company, Mutual & Pension fund/Trust/Nominee, Other financial institution, Pension / mutual fund, Private Equity firms, or Stichting.[26,27]

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

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

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

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 $\text{FO} \subset [100, 102)$ 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