

# Foreign Ownership, Selection, and Productivity<sup>\*</sup>

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March 2014

## Abstract

Using a unique firm level panel data set from several advanced countries, we show that both financial (private equity, banks, hedge funds) and industrial foreign investors select high productivity manufacturing firms in line with the predictions of FDI/trade models. We investigate the effect of foreign direct investment (FDI) on the productivity of target firms and we utilize the similarity of financial and industrial firms in the selection of target firms to control for endogenous selection on unobservables. We find that firms which receive FDI display small increases in productivity, although these become visible only with a lag of several years.

JEL: E32, F15, F36, O16.

Keywords: Multinationals, Selection, Productivity.

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# 1 Introduction

The biggest shareholder in several key companies such as Apple, Nestle and McDonald's is the private equity firm BlackRock. It owns a stake in almost every listed company not just in America but globally. Over 4 trillion USD worth of directly controlled assets, it is the single biggest investor in the world.<sup>1</sup> Recent UNCTAD data shows that this is not an isolated event and that during the period 2005-2007 nearly 40% of private equity M&A deals took place in the manufacturing sector.

We examine how productivity of domestic firms relates to acquisitions by financial investors, such as BlackRock, and acquisitions by industrial investors. We show that foreign financial (private equity, banks, hedge funds) investment and industrial foreign investment are both associated with high productivity of manufacturing firms; however, the industrial foreign investment correlates more with productivity. Under the assumption that this observed difference reflects the impact of more intense management by industrial firms, we control for endogenous selection on time-varying unobservable characteristics and quantify the productivity improvements resulting from foreign investment.

Our data comes from the ORBIS database (compiled by Bureau van Dijk Electronic Publishing, BvD) and covers 60 countries worldwide, including both developed and emerging ones. We only use data from advanced countries. The data set has financial accounting information from detailed harmonized balance-sheets of target companies, their investors, and non-acquired companies. It also provides the amount of foreign investment together with the type and country of origin of the investor. The dataset is crucially different from the other data sets that are commonly-used in the literature such as COMPUSTAT for the United States, Compustat Global, and Worldscope databases in that 99 percent of the companies in ORBIS are private, whereas the former popular data sets mainly contain information on large listed companies. A fundamental advantage is the detailed ownership

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<sup>1</sup>Economist, December 2013.

information provided encompassing over 30 million shareholder/subsidiary “links.”

We contribute to the literature along several dimensions. There are two issues emphasized in the existing literature. First, multinational subsidiaries generally outperform domestic firms.<sup>2</sup> Second, the most prevalent form of multinational entry is through acquisition, rather than greenfield investment, and the superior performance of companies receiving FDI could be due to multinational selecting domestic firms which *a priori* were better performing.<sup>3</sup> It is not straightforward then to separate whether the clear empirical correlation between ownership and productivity is due to selection or to active improvements productivity caused by, say, transfers of superior technologies and organizational practices to foreign subsidiaries from multinational investors. In an influential paper, Guadalupe, Kuzmina, and Thomas (2012) investigated FDI and productivity, using unique data from a set of Spanish firms that contains information about how newly acquired subsidiaries increase productivity by investing and introducing new technologies. In order to control for selection, they implement a propensity score reweighting estimator, which controls for selection on observable factors, and obtain estimates of the average treatment effect of foreign acquisition on innovation. They find an important effect of FDI in terms of innovation. Using a similar matching estimator, Arnold and Javorcik (2009) estimate the productivity effects of FDI for Indonesian firms, finding a 13.5 percent increase in productivity after three years. In this paper, we attempt to make further progress by allowign for selection on firm-level time varying unobservable characteristics using a novel source of exogenous variation.

Most papers in the empirical FDI literature finds a positive correlation between target’s productivity and foreign ownership: Conyon (2002) and Harris and Robinson (2003) for the UK, Fukao, Ito, Kwon, and Takizawa (2008) for Japan, Arnold and Javorcik (2009) for Indonesia, Criscuolo and Martin (2009) for the United States

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<sup>2</sup>See Caves (1974), Helpman, Melitz, and Yeaple (2004), Baldwin and Gu (2003), Ramondo (2009), Criscuolo and Martin (2009), and Arnold and Javorcik (2009).

<sup>3</sup>See Barba-Navaretti and Venables (2004).

and Guadalupe, Kuzmina, and Thomas (2012) for Spain. This positive selection effect has been labeled “cherry picking.” The theoretical and empirical finance literature on the other hand argues the opposite, foreign financial investors target low productivity firms with growth potential and buy these firms at fire-sale prices. This literature asserts that low-performing firms are the most likely to be acquired (Lichtenberg and Siegel (1987)). Blonigen, Fontagne, Sly, and Toubal (2012), using French data, show that foreign firms invest in companies that had high productivity levels several years prior to acquisition but suffered a negative productivity shock before acquisition (what they label “cherries for sale”). Using a sample of New EU member countries, Damijan, Kostevcz, and Rojec (2012) find that the selection criteria of target firms differ significantly across countries. In some countries, better firms are chosen as targets for acquisition (i.e., cherry picking) while in others “lemons” with growth potential were selected. None of the papers in this literature have separate data for financial and industrial FDI at the firm level. Our data contains such a distinction, with ownership shares that vary over time.

Finally, we relate to the existing trade literature that focuses on which parent firms will choose to engage in FDI (Helpman, Melitz, and Yeaple (2004); Burstein and Monge-Naranjo (2009)), and the extent of FDI activity (Blonigen (2005)). Nocke and Yeaple (2007) model FDI as the combination of complementary assets and inputs from firms located across different countries, and they evaluate empirical predictions about the parent firms mode of foreign entry: greenfield or acquisition, as a function of parent firm characteristics. These models predict that high productivity firms will export to foreign markets and among those only the most productive will engage in FDI activities. There is an additional ranking within FDI activities showing that green field investors are more efficient than cross-border investors (Nocke and Yeaple (2008)). The emphasis in this literature is on the endogenous decision of the firm to serve foreign markets based on its own productivity level, where form of foreign entry might differ.

The paper proceeds as follows. In section 2, we describe the data. Section 3 investigates selection both by financial and industrial investors. Section 4 estimates the productivity effects of FDI without accounting for endogeneity based on unobservable characteristics. Section 5 outlines our instrumental variable strategy. Section 6 re-estimates the productivity effects condition on selection on unobservable characteristics. Section 7 studies the balance sheets of acquired firms and Section 8 concludes.

## 2 Data

We focus on a European subset of ORBIS where coverage is relatively good because company reporting is regulatory. We have 40 European countries and 1+ million unique firms, for which detailed information is available, 1996–2008. This makes around 4+ million firm-year observations in an unbalanced panel. For our key regressions we want to be comparable to the previous literature so we use firms in the manufacturing sector with more than 15 employees. This limits the analysis to 134 thousand firms from 25 countries, 1999–2008, since we also need to use data where variables to calculate TFP exist. Finally, we will focus on a sample of advanced European countries first for which foreign financial investor data is more comprehensive: Belgium, Germany, Spain, Finland, France, Italy, Norway, Portugal and Sweden. This will bring down the sample to 300,000+ firm-year observations.

### 2.1 Foreign Ownership: Industrial and Financial Investors

The ownership section of ORBIS contains detailed information on owners of both listed and private firms, including name, country of residence, and type (e.g., bank, industrial company, private equity, individual, and so on). The database refers to each record of ownership as an “ownership link.” An ownership link indicating that an entity A owns a certain percentage of firm B is referred to as a “direct” ownership link. BvD traces a direct link between two entities even when the ownership

percentage is very small (sometimes less than 1 percent). For listed companies, very small stock holders are typically unknown.<sup>4</sup> In addition, ORBIS contains information on-so called “ultimate” owners (UO) of the company by tracing the ownership pyramid beyond the direct owners. To find UOs of a company, BvD focuses on identifying the owners, if any, who exercise the greater degree of control over the company. We compute the *Foreign Ownership* (FO) as the sum of all percentages of *direct* ownership by foreigners.<sup>5</sup> Owners of unknown origin (typically small) are assigned to the home country. We define a firm to be “domestic” only if it never had *any* type of foreign owner during the sample period.

We define a *financial owner* as either a bank, financial company, insurance company, mutual or pension fund, other financial institution, or private equity firm while an *industrial owner* operates in the industrial sector.  $FO_{i,s,c,t}^I$  (*Industrial FO*) and  $FO_{i,s,c,t}^F$  (*Financial FO*) are the shares owned by foreign industrial and financial investors, respectively.

Table (1) displays the fraction of firms with foreign ownership. From Panel A, FO is relatively high in the manufacturing and retail sectors and the share of output of firms with foreign financial owners is considerably smaller than that of firms with foreign industrial owners. Overall, foreign-owned firms contribute with about 7 percent of output of all firms. Panel B in Table (1) explores the relative importance of foreign-owned companies by owner type. Focusing on firms with positive industrial or financial FO in at least one year, we observe that industrial FO clearly dominates financial FO but on average financial FO represents around 10 percent of foreign investment the manufacturing sector.

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<sup>4</sup>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. Information regarding US companies taken from the SEC Edgar Filings and the NASDAQ, however, stops at one percent. 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.

<sup>5</sup>For example, if a company has three foreign owners with stakes of 10, 15, and 35 percent, FO for this company is 60 percent.

The detailed sector classification available in the dataset allows us to explore differences across industrial and financial investors within the manufacturing sector. Figure (2) shows the share of industrial and financial foreign investment by two-digit sector in our sample of manufacturing firms. On average, close to 10 percent of foreign investment in the manufacturing sector is conducted by financial foreign owners. There are some sectors with higher presence of financial investors like Textile, Pharmaceutical, Rubber or to a lesser extent Computer and Electronics.

The distributions of FO in Panel C of Table (1), are drawn from the regression samples of firms in the manufacturing sector. The ownership patterns in this smaller sample closely follow the patterns observed in the “All Industries” sample of Panel B, which makes us confident in the representativeness of our regression sample.

Do industrial and financial owners differ in the shares they hold in local firms? Figure (3) shows that the distribution of Industrial FO is bi-modal. There is a spike in the number of firms with an ownership share around 50 percent, likely reflecting a desire to control the firm. The distribution of shares among foreign financial investors is completely different, almost 65 percent of financial owners prefer to hold less than 20 percent of the firm equity.

## 2.2 Variables and descriptive statistics

The main *financial variables* used are total assets, operating revenue, tangible fixed assets, and expenditure on materials. We convert financial variables to “PPP US dollars with 2005 base,” using country GDP deflators (2005 base) and converting to dollars using the end-of-year 2005 exchange rate. The distribution of these (logged) variables does not change much over time and is very close to normal. Employment is in persons, and the distribution of employment is skewed with many firms having 15 employees (our chosen minimum).

*Firm productivity.* We construct TFP as the residual from a Cobb-Douglas production function with capital and labor:  $\log(\text{TFP}_{i,t}) = \log(Y_{i,t} - M_{i,t}) - \alpha_1 \log(L_{i,t}) -$

$\alpha_2 \log(K_{i,t})$ , where the coefficients are estimated by the method of Wooldridge, Levinsohn and Petrin (WLP), as explained in Appendix. 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).

Table 2 shows correlations between labor productivity and foreign activity for firms in all industries or in manufacturing using a raw uncleaned sample. There is a clear positive correlation between foreign ownership and labor productivity, if firm fixed effects are not accounted for, a pattern that has inspired many recent trade and FDI models.<sup>6</sup> However, after the inclusion of firm fixed effects, the positive coefficient halves or completely disappears, depending on the productivity measure.<sup>7</sup> This highlights the importance of firm-level selection. When firm-fixed effects are included, correlations are calculated from *within*-firm changes over time, suggesting that foreign ownership does not lead to an increase in the productivity of acquired firms. While other factors could influence the simple correlations displayed, this *prima facie* evidence points to multinationals investing in *a priori* productive firms.

### 3 Do Foreign Firms Target More Productive Domestic Firms?

Is it the case that foreign companies acquire most productive domestic firms? Figure (4) plots the density distribution of initial total factor productivity (TFP) for

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<sup>6</sup>See Helpman, Melitz, and Yeaple (2004) for similar results on labor productivity using data on US multinationals.

<sup>7</sup>This sample has 4 million observations overall and over 1 million observations in manufacturing. Our regression samples are much smaller because we need data on, e.g., materials. We use the full sample in Table 2 in order to document that this pattern is not an artifact of data cleaning.



domestic and foreign-owned companies. We focus on the sample of firms that were originally domestic (i.e., the percentage of foreign ownership is zero the first time we observe the firm in the sample) and plot the distribution according to whether the firm was foreign owned or not by the fourth year. Panel (a) in figure (4) shows that foreign owned firms by the fourth year had initially higher productivity compared to firms that remained domestic. We are not aware of any other study that distinguishes between industrial and financial foreign investors in the manufacturing sector and it is a priori not clear whether financial foreign owners target more productive local firms. On the one hand, financial investors seeking to diversify risk will select high performing firms. On the other hand, there is evidence that activist hedge funds target financially distressed firms and contribute to an efficient restructuring of the economically viable firms (Lim (2013)). Panel (b) in figure (4) shows that in the manufacturing sector both industrial and financial owners select initially more productive firms.

The graphical analysis in figure (4) suggest that both foreign-industrial and financial owners target more productive domestic firms. We complement these unconditional results estimating a selection equation that conditions on alternative firm characteristics that could potentially influence the foreign investment decision. We estimate a selection equation of the following type:

$$FO_{it}^T = \beta_0 + \beta_1 Productivity_{t-1} + \beta_2 X_{t-1} + \delta_c + \delta_s + \delta_t + u_{it} \quad (1)$$

where  $T = I, F$  refers to type (industrial (I) or financial (F)).  $FO_{it}^I$  is a dummy variable that equals one if industrial foreign investment is greater than zero and zero otherwise. Similarly,  $FO_{it}^F$  is a dummy variable that equals one if financial foreign investment is greater than zero and zero otherwise.  $Productivity_{t-1}$  is a measure of firm level productivity lagged one period, either labor productivity or total factor productivity.  $X_{t-1}$  are firm level characteristics (capital to labor ratio, total assets and age).  $\delta_c$  are country dummies,  $\delta_s$  are two-digit sector dummies and

$\delta_t$  are year dummies.

Table (3) shows the main results. We use two measures of firm productivity, columns (1) to (4) show the results using labor productivity while columns (5) to (8) focus on total factor productivity. Columns (1) and (2) show that foreign industrial and financial investors target firms with higher labor productivity. Columns (5) and (6) confirm that firms with higher total factor productivity are more likely to be acquired by both industrial and financial foreign investors. Columns (3) and (4) as well as (7) and (8) explore more in detailed the foreign investment decision according to the productivity distribution of targets. We classify firms according to whether their lagged productivity is within the lowest, medium or highest percentile of the distribution. Column (7) shows that the probability of being an industrial foreign owner increases by 0.023 for firms in the highest percentile of the TFP distribution (0.005 for firms in the mid percentile of the distribution). Column (8) shows similar effects for financial foreign owners.

## 4 Are Foreign-Owned Firms more Productive?

We now ask whether foreign-owned firms become more productive with increased foreign ownership; that is, we estimate dynamic relations with foreign ownership growth and productivity growth (for brevity, “difference regressions”). The literature has only found a positive correlation between the *level* of productivity and *level* of foreign ownership and not between *changes* in productivity and *changes* in foreign ownership.<sup>8</sup>

We follow the parameter parsimonious approach of Javorcik (2004) and estimate the growth in TFP on the change in FO, experimenting with the length of the growth interval. Therefore, we explore the relationship between foreign ownership and firm

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<sup>8</sup>Exceptions are Guadalupe, Kuzmina, and Thomas (2012) and Arnold and Javorcik (2009) since they employed a matching estimator in a difference-in-difference context.

productivity by estimating the following equation:

$$\Delta \log(\text{TFP}_{i,s,c,t}) = \beta \Delta \text{FO}_{i,s,c,t} + \delta_{c,t} + \delta_{s,t} + \epsilon_{i,s,c,t}, \quad (2)$$

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  $t$ .  $\delta_{c,t}$  represents country-year (country $\times$ year) dummies (fixed effects) and  $\delta_{s,t}$  represents sector-year (sector $\times$ year) dummies (fixed effects).

The parameter of interest is the ‘‘within’’ coefficient,  $\beta$ : a positive  $\beta$  implies that changes in foreign ownership are associated with increasing productivity relative to firms that stay domestically owned.

Table 4 shows the relationship between foreign ownership and firm total factor productivity in the manufacturing sector. As we have been emphasizing, accounting for firm selection is crucial and after differentiation, all specifications in Table 4 are free of firm-specific time invariant effects. An additional factor that we have not stressed but is equally important is the role of country and sector selection. Foreigners may invest in growing countries or sectors resulting in reverse causality; consequently, all columns account for country-year and sector-year fixed effects.

Columns (1) to (4) of Table 4 show the results at different time horizons. Only after four years there is a positive and statistically significant relationship between foreign ownership and firm productivity. However, this effect is not of much economic importance: a ten percent increase in foreign ownership is associated with a 0.1 percent increase in firm productivity (see column (4)). Only considerable increases in firm ownership (of the order of 100 percent change) would lead to a moderate increase in firms’ productivity (around 1.5 percent increase).

Foreign investment is not usually in the form of 100 percent ownership. We know the percentage of foreign ownership and therefore we can explore heterogeneity in foreign investment. Given the possibility that such heterogeneity may interact

with heterogeneity in total factor productivity,<sup>9</sup> it is important to know the exact amount of investment. Due to data availability, the literature most often uses a dummy variable which indicates whether the firm is owned by an “overseas” entity in the amount of more than a certain percent; see, for example, Bloom, Sadun, and Van Reenen (2009), Keller and Yeaple (2009) and Haskel, Pereira, and Slaughter (2007). Other papers use 100 percent foreign-owned subsidiaries of multinationals; see, for example, Desai, Foley, and Forbes (2007) and Alfaro and Chen (2012). Neither case will give a full description of heterogeneity in multinational investment.<sup>10</sup>

Figure (5) shows the distribution of the change in foreign ownership at different time horizons. We are interested in uncovering whether large positive changes in foreign ownership have a significant positive impact of firm productivity growth. Therefore we estimate the following equation:

$$\Delta \log(\text{TFP}_{i,s,c,t}) = \beta^b \Delta \delta_{i,s,c,t}^b + \delta_{c,t} + \delta_{s,t} + \epsilon_{i,s,c,t}, \quad (3)$$

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  $\delta_{i,s,c,t}^b$  are indicator variables depending on whether the change in foreign ownership falls into each of the following categories:  $[-100\%, -50\%]$ ,  $(-50\%, 0\%)$ ,  $(0\%, 50\%)$ ,  $[50\%, 100\%]$  and add a different category for those observations that did not experience any change in foreign ownership.  $\delta_{c,t}$  represents country-year (country  $\times$  year) dummies (fixed effects) and  $\delta_{s,t}$  represents sector-year (sector  $\times$  year) dummies (fixed effects).

Table (5) shows the results from estimating equation (3). For short horizons, there is no effect of foreign ownership on productivity. Likely, the changes introduced by foreign owned companies take time to be implemented and have an effect. Indeed, we observe a positive and significant effect of foreign ownership after three years. Column (4) shows that after four years positive changes in foreign ownership are

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<sup>9</sup>Syverson (2011) finds a very wide range of productivity levels across firms.

<sup>10</sup>Exceptions are Javorcik (2004), Aitken and Harrison (1999), and Arnold and Javorcik (2009), who use firm-level ownership shares. Their samples are limited to firms from single countries.

associated with higher productivity but most interestingly big negative changes in foreign ownership have a similar impact on firm productivity. We conjecture that large dis-investment by foreign owned companies are accompanied by large domestic investment which could have a similar effect to that of foreign investment. In other words, the target firm benefits from large changes in ownership regardless of whether the majority owner is foreign or domestic.

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 4 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 the next section starting by the description of the instrumental variable methodology in what follows.

## 5 Methodology: Instrumental Variable

Consider the structural (causal) relation

$$(TFP) \quad TFP_{i,t} = \alpha_i + \sum_{k=0}^K \beta_k FO_{i,t-k} + f(X_{it}, \psi) + u_{i,t} ,$$

where FO is foreign ownership, TFP is total factor productivity,  $i$  denotes firm fixed effects, including initial productivity.  $f(X, \psi)$  is a non-linear function of observed firm variables such as size and age of the firm. We allow for time lag in the causal effect of foreign ownership on productivity, reflecting the time it takes to implement new processes etc.

Foreign ownership is a function of current and expected future productivity and a non-linear function of firm-level variables. We split current and expected future productivity into a “passive” component,  $p$ , which reflects productivity which would materialize whether the firm receives FDI or not and an “active” component,  $a$ , which reflects productivity that materialize from active foreign ownership. We assume that the function forms are identical for industrial and financial owners, with the exception that industrial firms which invest  $FO^I$  expect larger future productivity gains from active ownership than do financial firms which invest  $FO^F$ . Some financial investors change management practice in take-over targets (Brav, Jiang, and Kim (2009); Kaplan and Stromberg (2009)) but industrial owners can be expected to further bring blue-prints and operating experience (Guadalupe, Kuzmina, and Thomas (2012)). We assume

$$FO_{i,t}^I = \alpha_i + \sum_{l=0}^L \gamma_l E_t \{p_{i,t+l}\} + \sum_{l=0}^L \delta_l^I E_t \{a_{it+l}\} + g(X_{it}, \phi) + e_{i,t} ,$$

$e_{i,t}$  is a noise term.

$$FO_{i,t}^F = \alpha_i + \sum_{l=0}^L \gamma_l E_t \{p_{i,t+l}\} + \sum_{l=0}^L \delta_l^F E_t \{a_{it+l}\} + g(X_{it}, \phi) + e_{i,t} ,$$

In order to control for the foreign investment which is endogenous to productivity, we would like to subtract financial foreign ownership from industrial foreign ownership at the firm level. By subtracting financial from industrial foreign ownership, we expect to remove the endogenous component from the foreign investment decision ( $p_{i,t+l}$ ). In other words, both industrial and financial foreign owners are expected to target high productive firms, the effect of this passive investment strategy is captured by  $\gamma_l$  which is common to both types of investors. Subtracting  $FO_{i,t}^F$  from  $FO_{i,t}^I$  would leave us with the expected productivity change after acquisition due to ownership changes. However, at the firm level, both types of FDI are usually not

available.<sup>11</sup> Our strategy is therefore to aggregate FDI to the sector level and take the contrast there, using sectoral FDI as an instrument for firm-level FDI. We do this by country and weigh FO by the size of the firm measured by operating revenue in the initial year we observe the firm  $Y_{i,0}$ , where we use the initial year in order to use weights that are not a function of foreign investment since year 0. We construct sectoral industrial investment,

$$FO_{s,c,t}^I = \sum_{i \in c,t,s} FO_{i,t}^I Y_{i,0} / \sum_{i \in c,s} Y_{i,0} ; \quad (4)$$

and sectoral financial investment,

$$FO_{s,c,t}^F = \sum_{i \in c,t,s} FO_{i,t}^F Y_{i,0} / \sum_{i \in c,s} Y_{i,0} . \quad (5)$$

Now,  $W_{s,c,t} = FO_{s,c,t}^I - FO_{s,c,t}^F$ , satisfies

$$W_{s,t} = \alpha_s + \sum_{l=0}^L \kappa_l E_t \{ a_{st+l} \} + e_{s,t} ,$$

where country indices have been suppressed for readability and  $\kappa_l = \delta_l^I - \delta_l^F$ , which will be positive if industrial owners invest more for the purpose of increasing productivity through active management than do financial investors. This is not a maintained assumption, but the instrument we construct in the following will be weak if this is not satisfied.

Table (7) shows the correlation between firm level productivity and country-sector level industrial and financial investment. The effect of foreign industrial investment on productivity is four times that of foreign financial investment, which is consistent with our assumptions regarding the differential response of productivity to industrial and financial foreign ownership.

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<sup>11</sup>Only 8 percent of the observations in our sample show positive foreign ownership. Of these, 96 percent have some industrial foreign ownership and only 2 percent (740 observations) show positive industrial and foreign ownership.

We next construct instruments for foreign investment. We take initial values to be predetermined while time variation in our instruments is derived from the country and sector-level variable  $w$ . Standard continuous-variable IV methods turned out to perform poorly and considering the patterns of FDI in figure (3), it is clear that foreign investment clusters around 0 percent and 100 percent and any instrument that does not reflect this is unlikely to work well.

Figure (5) shows the distribution of the change in foreign ownership for different length periods. Because of the near discrete nature of FDI, we construct four intervals for changes in FDI according to:  $[-100\%, -50\%], (-50\%, 0\%), (0\%, 50\%), [50\%, 100\%]$  and add a different category for those observations that did not experience any change in foreign ownership. We have a total of five different categories ( $j = 1, 2, \dots, 5$ ) and we use a multinomial model to estimate the probability  $P(x_{it} \in j)$  as

$$P(x_{it} \in j) = \gamma_1^j \Delta w_{c,s,t} + \gamma_2^j \Delta w_{c,s,t} \times \delta_c + \gamma_3^j \Delta w_{c,s,t} \times \delta_s + \quad (6)$$

$$\gamma_4^j \Delta w_{c,s,t} \times \ln(Assets_{i0}) + \quad (7)$$

$$g(X_{i0})' \phi^j + \delta_c + \delta_s + \delta_t + u_{i,c,s,t} \quad (8)$$

where  $w_{c,s,t}$  is the contract between industrial and financial investment at the sector level and the remaining right-hand side variables are predetermined:  $g(X_{i0})$  is vector non-linear function of firm predetermined characteristics,  $\delta_s$ ,  $\delta_c$  and  $\delta_t$  refer to the sector, country and year fixed effects. The error term is likely correlated with future TFP-growth but by construction uncorrelated with the regressors. Referring to all exogenous and predetermined variables as  $Z_{it}$  so we have

$$P(x_{it} \in j) = Z'_{it} \psi + u_{it} ,$$

for a vector of parameters  $\psi$ .

From the multinomial logit estimation, we obtain the predicted probability that



an observation falls into each of the five different categories  $j$  previously defined. Ultimately we are interested in the “theoretical” percentage of foreign ownership that a firm should enjoy based on the sectoral differences between industrial and financial foreign ownership as well as firm initial characteristics. Therefore, to assign a predicted percentage of foreign ownership to an observation we compare the predicted probabilities across categories for the same observation. If the predicted probability of being in the category that involves no change in foreign ownership ( $j|_{\Delta FO=0}$ ) is greater than 0.8 we assign this firm to the category with no change in foreign ownership. The rest of the firms where the predicted probability of no change in ownership below 0.8 are assigned to that category of the remaining four which has the highest predicted probability according to the rule:

$$\hat{j} = \arg \max(P(\widehat{x_{it} \in j}), j \neq j|_{\Delta FO=0})$$

Once observations are assigned to each category the predicted percentage of foreign ownership for each firm will be the median foreign ownership in the corresponding category  $j$ :

$$\widehat{FO}_{it} = \text{median}(FO_j)$$

Table 6 show the estimated coefficient of selected regressors from the multivariate regression. (The full will be available from the authors.) The table demonstrates the important role of the contrast in financial and industrial FDI in predicting firm level FDI.

## 6 Reduced Form Results

Table (8) shows the results using the indicator variables associated to each of the predicted categories in the first stage strategy.<sup>12</sup> We focus on the four-year horizon

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<sup>12</sup>Table (??) in the appendix using using a continuous measure of predicted foreign ownership.

results that have turned out to be the relevant time period after which we observe significant changes in firm productivity. Column (1) shows the results without sector-year fixed effects and it shows how large changes in foreign ownership result in significant increases in firm productivity. The effect of large foreign ownership changes (i.e., changes of over 50 percent ownership) on productivity compare to small changes (i.e., changes of less than 50 percent) are twice as large. Column (2) shows that most of the effect of small ownership changes is driven by foreign investors targeting more productive sectors. We would like to control for the possibility of foreign owners targeting growing sectors in particular countries. To do so, we include country-sector-year fixed effects in the estimation and column (4) shows the results.<sup>13</sup> After the inclusion of country-sector-year fixed effect large and small changes have similar magnitude effects.

Compared to the OLS results shown in table (5) large negative changes in foreign ownership are no longer associated with productivity increases. The reason is as follows. Changes in ownership (whether foreign or not) may be associated with an increase in TFP and a new owner can improve productivity. The time variation in our instrument is coming from country-sector data and not from firm-level ownership and therefore isolates the change in the foreign ownership component. This explains why OLS is significant also for large negative changes in ownership while IV is not.

## **7 How Do Acquired Firms Adjust Their Balance Sheets (TO COME)**

Having received FDI, acquired firms display increased productivity. Is this due to more physical investment, upgrading machinery, larger use of external finance, more

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<sup>13</sup>Notice before column (4) we show the results without country-sector-year fixed effects and the number of observations in column (3) is lower than that of column (2). The reason is we exclude country-sector-year cells with less than 60 observations. Similar to results in column (3) the effect of large changes are twice as large as the effect of small changes even after controlling for country-sector-year fixed effects.

debt, putting pressure on managers, or hiring of higher skilled workers? We have access to balance sheet data for all our firms and we plan to examine questions such as these by studying how the balance sheets of acquired firms change relative to domestic firms using the instrument developed in the previous sections.

## **8 Conclusion**

TO BE ADDED.

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## Tables

Table 1: Relative Importance of Foreign Ownership across Sectors and Samples

Panel A: Percentage of Observations by Ownership Category and Industry, Firms in All Industries								
FO Measure	FO	Industrial FO	Financial FO					
Industry								
Agric. and Mining	4.4	4.3	0.3					
Construction	1.4	1.4	0.1					
Manufacturing	8.4	8.1	0.5					
Retail	9.0	8.8	0.4					
Services	5.1	4.8	0.5					
Total	6.9	6.6	0.4					

Panel B: Percentage of Observations by Ownership Category, Firms in All Industries								
All Firms			Foreign-owned Firms					
FO	Industrial FO	Financial FO	Industrial FO	Financial FO	FO > 50%	Industrial FO > 50%	Financial FO > 50%	
6.8	6.6	0.4	96.2	6.0	62.9	61.5	1.4	

Panel C: Percentage of Observations by Ownership Category, Firms in Manufacturing								
All Firms			Foreign-owned Firms					
FO	Industrial FO	Financial FO	Industrial FO	Financial FO	FO > 50%	Industrial FO > 50%	Financial FO > 50%	
8.1	7.8	0.5	96.5	5.7	61.1	59.6	1.4	

*Notes:* The distributions in Panels A and B are drawn from the sample with available data for TFP construction (Panel B of Table ??), while the distributions in Panel C are drawn from the regression samples of firms in the manufacturing sector with available data for the main regressions (see Data Appendix). 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 ?? for the industry classification. The “total” sample shows the distribution for the entire sample of firms with available data for TFP construction. FO refers to industrial plus financial FO (marked FO), or either of these two types (marked Industrial FO and Financial FO; resp.). FO is the percentage share of firm’s voting equity owned by foreign owners. Panels B and C report the percentage of observations by ownership category. “All firms” report on firms with available data for TFP construction (Panel B) or the regression samples of firms in the manufacturing sector (Panel C). The “foreign-owned” sample includes a subset of firms with industrial FO, or financial FO, or industrial plus financial FO positive in at least one year. “FO > 50%” refers to firms with controlling foreign ownership (FO higher than 50% of voting shares).



Table 2: Foreign Activity and Labor Productivity, Preliminary Explorations

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Firms	All	All	Manuf.	Manuf.	All	All	Manuf.	Manuf.
DEPENDENT VARIABLE	log(Y/L)	log(Y/L)	log(Y/L)	log(Y/L)	log(VA/L)	log(VA/L)	log(VA/L)	log(VA/L)
FO	0.518*** (0.008)	0.027*** (0.005)	0.622*** (0.012)	0.037*** (0.008)	0.552*** (0.007)	-0.018*** (0.005)	0.494*** (0.011)	0.002 (0.008)
Firm Fixed Effects	no	yes	no	yes	no	yes	no	yes
Sector Fixed Effects	yes	yes	yes	yes	yes	yes	yes	yes
Country-Year Fixed Effects	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:* All refers to the full sample while Manuf. refers to the manufacturing sample.  $Y$  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.  $FO$  is the log of one plus the percent share of foreign ownership in firm  $i$  capital structure.

Table 3: Selection: Firm Characteristics

Productivity Measure: Foreign Ownership:	Labor Productivity				TFP			
	FO <sup>I</sup> (1)	FO <sup>F</sup> (2)	FO <sup>I</sup> (3)	FO <sup>F</sup> (4)	FO <sup>I</sup> (5)	FO <sup>F</sup> (6)	FO <sup>I</sup> (7)	FO <sup>F</sup> (8)
<i>Productivity</i> <sub><i>t</i>-1</sub>	0.219*** (0.019)	0.096** (0.041)			0.103*** (0.014)	0.060* (0.032)		
<i>2nd tertiale Productivity</i> <sub><i>t</i>-1</sub>			0.179*** (0.019)	0.141** (0.050)			0.046** (0.020)	-0.059 (0.048)
<i>3rd tertiale Productivity</i> <sub><i>t</i>-1</sub>			0.280*** (0.023)	0.189*** (0.056)			0.202*** (0.023)	0.100** (0.051)
$\ln(K/L)_{t-1}$	-0.023** (0.008)	-0.032* (0.019)	-0.022** (0.008)	-0.035* (0.019)	-0.002 (0.008)	-0.023 (0.019)	-0.003 (0.008)	-0.023 (0.019)
$\ln(Assets)_{t-1}$	0.378*** (0.008)	0.251*** (0.014)	0.381*** (0.007)	0.249*** (0.014)	0.376*** (0.008)	0.247*** (0.016)	0.375*** (0.008)	0.246*** (0.015)
<i>Age</i>	-0.001** (0.000)	-0.001 (0.001)	-0.001** (0.000)	-0.001 (0.001)	-0.001** (0.000)	-0.001 (0.001)	-0.001** (0.000)	-0.001 (0.001)
Observations	315713	315713	315713	315713	315713	315713	315713	315713
R <sup>2</sup>	.23	.16	.23	.16	.23	.16	.23	.16
Country Fixed Effects	yes	yes	yes	yes	yes	yes	yes	yes
Sector two-digit Fixed Effects	yes	yes	yes	yes	yes	yes	yes	yes
Year Fixed Effects	yes	yes	yes	yes	yes	yes	yes	yes

*Notes:* The dependent variables are FO<sup>I</sup> and FO<sup>F</sup>. FO<sup>I</sup> equals one if the percentage of foreign ownership by industrial investors is greater than zero. FO<sup>F</sup> equals one if the percentage of foreign ownership by industrial investors is greater than zero. Columns (1) to (4) use labor productivity (value added over employment) as measure of productivity while columns (5) to (8) use total factor productivity. All variables are lagged one period.  $\ln(K/L)_{t-1}$  is the log of the ratio of tangible fixed assets to employment.  $\ln(Assets)_{t-1}$  is the log of total assets. Age is the firm age.

Table 4: Foreign Ownership and Firm Productivity

	$\Delta \log(\text{TFP})$ (1)	$\Delta_2 \log(\text{TFP})$ (2)	$\Delta_3 \log(\text{TFP})$ (3)	$\Delta_4 \log(\text{TFP})$ (4)
$\Delta \log(\text{FO})$	-0.008 (0.006)			
$\Delta_2 \log(\text{FO})$		-0.004 (0.006)		
$\Delta_3 \log(\text{FO})$			0.005 (0.007)	
$\Delta_4 \log(\text{FO})$				0.015* (0.008)
Observations	319495	265363	221509	182263
Year Fixed Effects	yes	yes	yes	yes
Sector 2 dig - Year Fixed Effects	yes	yes	yes	yes

*Notes:* FO is transformed as  $(\text{FO}/100) + 1$ . All specifications control for the following firm characteristics:  $\log(K/L)_0$  is the log of the ratio of tangible fixed assets to employment in the first year we observe the firm and  $\log(\text{Assets})_0$  is the log of total assets the first year we observe the firm.

Table 5: Categories of Foreign Ownership Change and Firm Productivity

	$\Delta \log(\text{TFP})$ (1)	$\Delta_2 \log(\text{TFP})$ (2)	$\Delta_3 \log(\text{TFP})$ (3)	$\Delta_4 \log(\text{TFP})$ (4)
$I(\Delta \text{FO} \in [50\%, 100\%])$	-0.002 (0.006)	0.004 (0.006)	0.015** (0.006)	0.030*** (0.007)
$I(\Delta \text{FO} \in (0\%, 50\%))$	0.006 (0.004)	0.005 (0.004)	0.012** (0.005)	0.026*** (0.006)
$I(\Delta \text{FO} \in (0\%, (-50\%)))$	0.004 (0.005)	0.002 (0.005)	-0.002 (0.006)	0.008 (0.008)
$I(\Delta \text{FO} \in (-50\%, (-100\%)))$	0.008 (0.006)	0.010* (0.006)	0.016** (0.007)	0.034*** (0.008)
Observations	319495	265363	221509	182263
Year Fixed Effects	yes	yes	yes	yes
Sector 2 dig - Year Fixed Effects	yes	yes	yes	yes

*Notes:* All specifications control for the following firm characteristics:  $\log(K/L)_0$  is the log of the ratio of tangible fixed assets to employment in the first year we observe the firm and  $\log(\text{Assets})_0$  is the log of total assets the first year we observe the firm.

Table 6: Multinomial (Selected Regressors)

	$\Delta(\text{FO})$ (1)	$\Delta_2(\text{FO})$ (2)	$\Delta_3(\text{FO})$ (3)	$\Delta_4(\text{FO})$ (4)
<i>Category<sub>j</sub> = 2</i>				
$\Delta w$	0.197	0.180** (0.070)	0.200*** (0.046)	0.182*** (0.045)
$\Delta w \times \log(\text{ASSETS})_0$	-0.016 (0.000)	-0.016*** (0.003)	-0.014*** (0.002)	-0.012*** (0.002)
<i>Category<sub>j</sub> = 3</i>				
$\Delta w$	0.150	0.168*** (0.045)	0.130** (0.043)	0.126** (0.043)
$\Delta w \times \log(\text{ASSETS})_0$	-0.008 (0.000)	-0.009*** (0.002)	-0.007** (0.002)	-0.007** (0.002)
<i>Category<sub>j</sub> = 4</i>				
$\Delta w$	0.100	0.067* (0.036)	0.036 (0.032)	0.033 (0.032)
$\Delta w \times \log(\text{ASSETS})_0$	-0.006 (0.000)	-0.004** (0.002)	-0.002 (0.002)	-0.002 (0.002)
<i>Category<sub>j</sub> = 5</i>				
$\Delta w$	-0.156 (0.000)	-0.136*** (0.038)	-0.089** (0.035)	-0.063* (0.034)
$\Delta w \times \log(\text{ASSETS})_0$	0.012	0.011*** (0.002)	0.008*** (0.002)	0.006** (0.002)
Observations	315713	262262	218937	180137
R <sup>2</sup>	.29	.21	.2	.2
Year Fixed Effects	yes	yes	yes	yes
Country Fixed Effects	yes	yes	yes	yes
Sector Fixed Effects	yes	yes	yes	yes
$w \times \text{sector}$	yes	yes	yes	yes
$w \times \text{country}$	yes	yes	yes	yes
$\log(\text{VA}/L)_0 \times \text{sector}$	yes	yes	yes	yes
$\log(\text{VA}/L)_0 \times \text{country}$	yes	yes	yes	yes
$\log(\text{K}/L)_0 \times \text{sector}$	yes	yes	yes	yes
$\log(\text{K}/L)_0 \times \text{country}$	yes	yes	yes	yes
$\log(\text{ASSETS})_0 \times \text{sector}$	yes	yes	yes	yes
$\log(\text{ASSETS})_0 \times \text{country}$	yes	yes	yes	yes

Notes: All specifications control for the following firm characteristics:  $\log(\text{VA}/L)_0$  is the log of value added to total employment the first year we observe the firm.  $\log(\text{K}/L)_0$  is the log of the ratio of tangible fixed assets to employment in the first year we observe the firm and  $\log(\text{ASSETS})_0$  is the log of total assets the first year we observe the firm.

Table 7: Productivity and Sector Level Foreign Ownership by Type

	$\Delta \log(\text{TFP})$ (1)	$\Delta_2 \log(\text{TFP})$ (2)	$\Delta_3 \log(\text{TFP})$ (3)	$\Delta_4 \log(\text{TFP})$ (4)
$\Delta \log(\text{FO}_{cst}^L)$	0.005** (0.002)	0.015*** (0.003)	0.019*** (0.004)	0.021*** (0.004)
$\Delta \log(\text{FO}_{cst}^F)$	0.001 (0.001)	0.003 (0.002)	0.005** (0.002)	0.004* (0.002)
Observations	319495	265363	221509	182263
R <sup>2</sup>	.016	.028	.038	.051

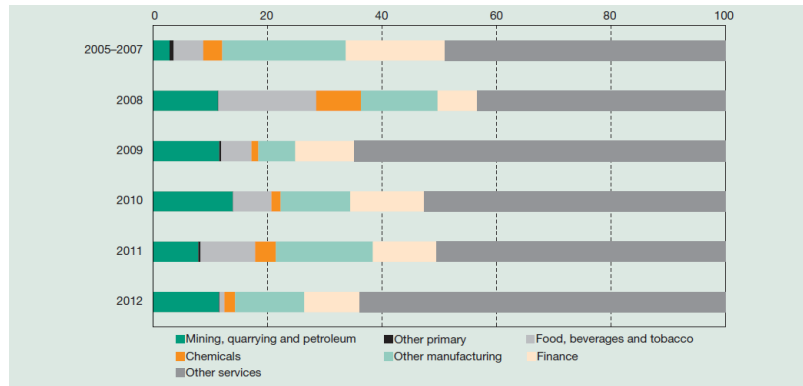
*Notes:* The dependent variable is the change in firm productivity. Results are obtained by GLS.

Table 8: Predicted Categories of Foreign Ownership Change and Firm Productivity

	$\Delta_4 \log(\text{TFP})$ (1)	$\Delta_4 \log(\text{TFP})$ (2)	$\Delta_4 \log(\text{TFP})$ (3)	$\Delta_4 \log(\text{TFP})$ (4)
$\hat{I}(\Delta_{\text{FO}} \in [50\%, 100\%])$	0.043*** (0.006)	0.014** (0.007)	0.028** (0.010)	0.019* (0.010)
$\hat{I}(\Delta_{\text{FO}} \in (0\%, 50\%))$	0.019*** (0.004)	0.006 (0.005)	0.013** (0.006)	0.016** (0.006)
$\hat{I}(\Delta_{\text{FO}} \in (0\%, -50\%))$	0.010* (0.006)	-0.006 (0.007)	0.007 (0.009)	0.009 (0.009)
$\hat{I}(\Delta_{\text{FO}} \in [-50\%, -100\%])$	-0.012 (0.017)	-0.001 (0.017)	0.004 (0.023)	-0.002 (0.024)
Observations	180137	180137	122672	122672
Year FE	yes	yes	yes	yes
Sector 2 dig - Year FE	no	yes	yes	yes
Country-Sector 2dig- Year FE	no	no	no	yes

*Notes:* All specifications control for the following firm characteristics:  $\log(K/L)_0$  is the log of the ratio of tangible fixed assets to employment in the first year we observe the firm and  $\log(\text{Assets})_0$  is the log of total assets the first year we observe the firm.

Figure 1: Cross-border M&As by private equity firms, by sector and main industry, 2005-2012.

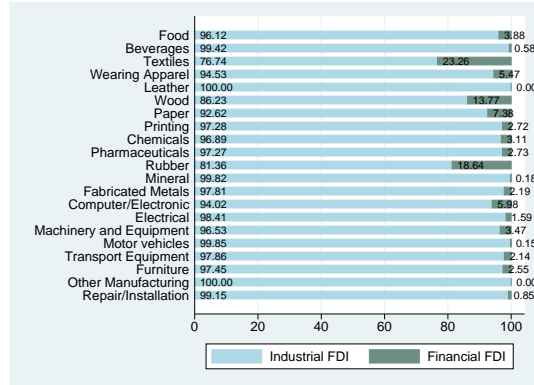


Source: UNCTAD FDI-TNC-GVC Information System, cross-border M&A database ([www.unctad.org/fdistatistics](http://www.unctad.org/fdistatistics)).  
 Note: Not adjusted to exclude FDI by SWFs.

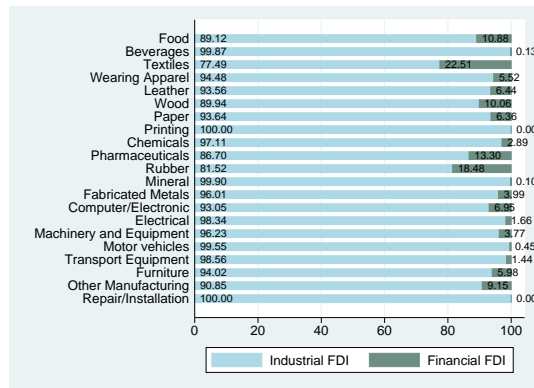


Figure 2: Share of Industrial and Financial Foreign Investment by Sector

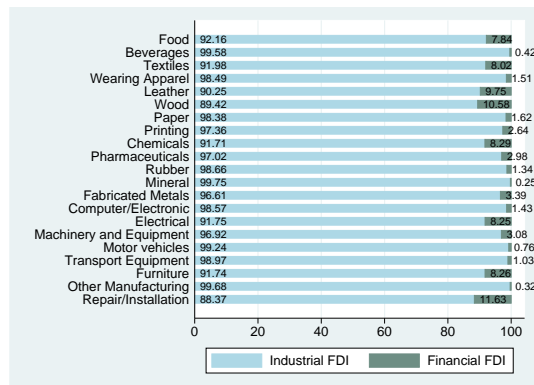
(a) 2002



(b) 2004

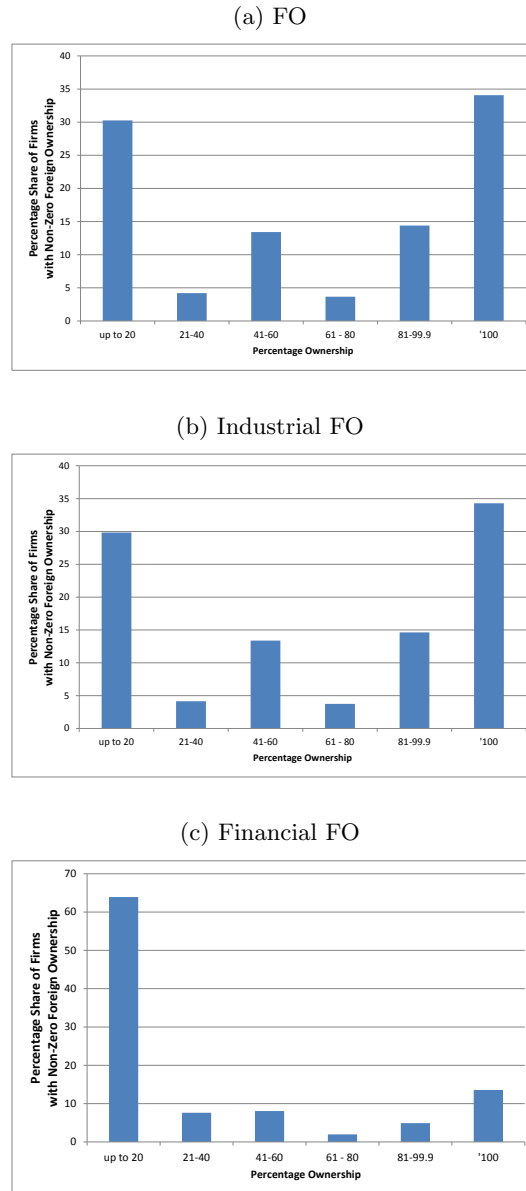


(c) 2006



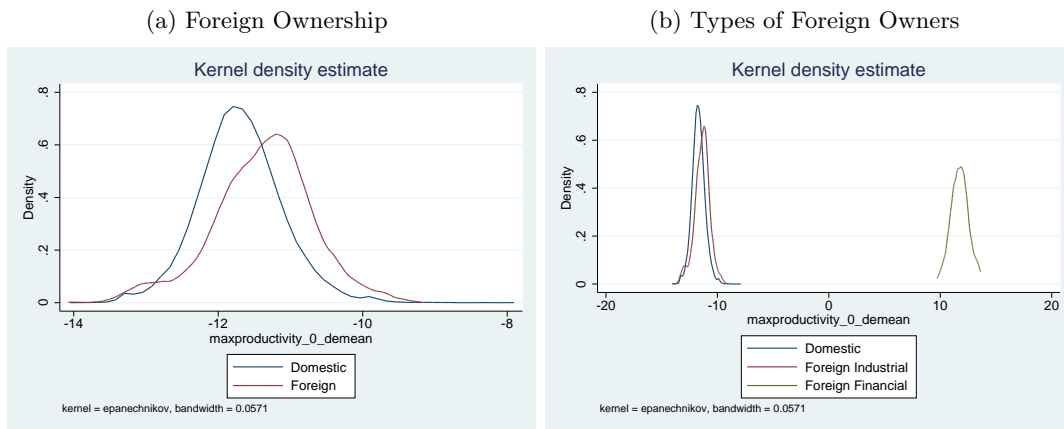
Notes: ).

Figure 3: Distribution of Industry-FO and Financial-FO Among Foreign Owned Firms



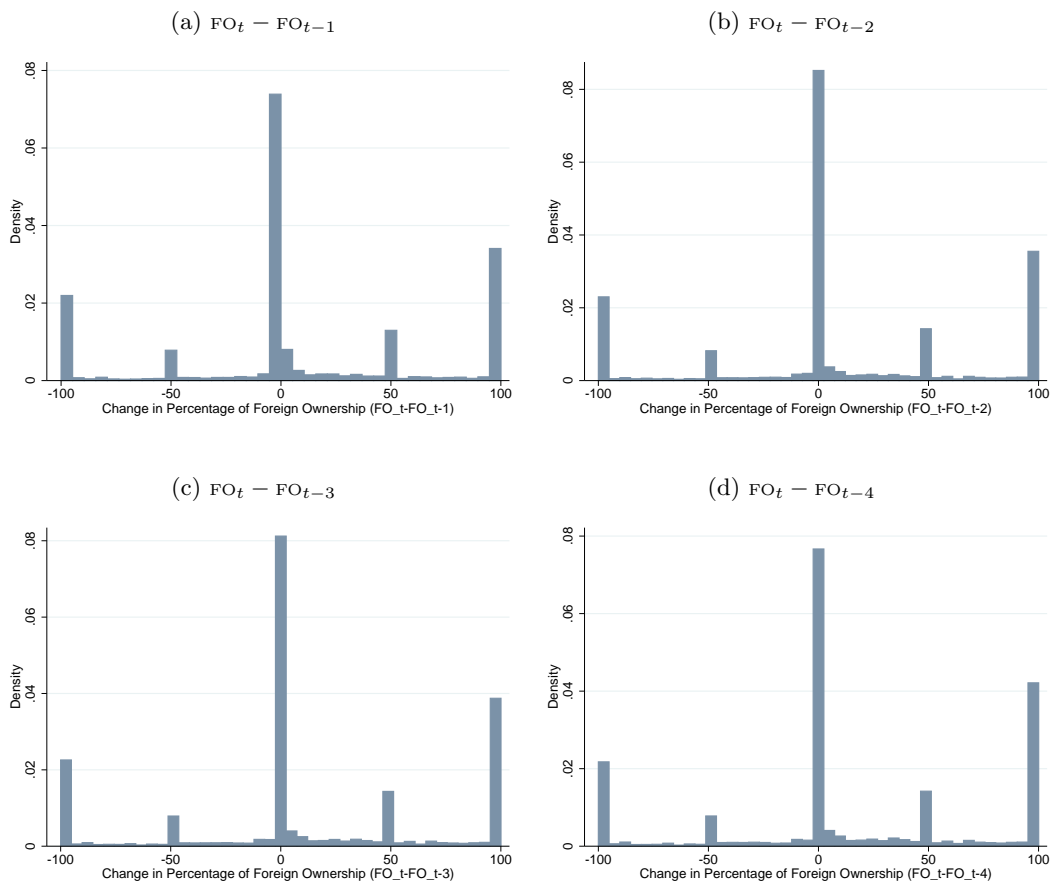
*Notes:* The figure shows the distribution of foreign ownership using all manufacturing firms in all available years. Firms are drawn from the regression samples of firms in the manufacturing sector with available data for the main regressions (see Data Appendix). Each graph defines foreign-owned firms as firms with foreign ownership of a given type (industrial, financial, or both) positive in at least one year. The percentage of observations in each ownership bin are computed relative to the total number of foreign-owned firms.

Figure 4: Distribution of Initial Productivity (TFP) for Acquired and Non-acquired Firms.



*Notes:* Initial productivity at the firm level is measured by total factor productivity ( $\ln(\text{TFP})$ ) in the first year the firm appears in the sample, demeaned by sector and country over the sample period. The solid line represents ( $\ln(\text{TFP})$ ) of domestic firms (firms that originally do not have any foreign ownership and remain non-acquired after four years ( $t+4$ )). In panel (a), the dashed line refers to foreign owned firms (those that are originally domestic but were acquired at some point during the next four years ( $t+4$ )). In panel (b), the dashed line refers to foreign industrial firms (those that are originally domestic but were acquired by a foreign industrial investor at some point during the next four years ( $t+4$ )); the dotted-dashed line refers to foreign financial firms (those that are originally domestic but were acquired by a foreign financial investor at some point during the next four years ( $t+4$ )).

Figure 5: Distribution of the Change in Foreign Ownership



Notes: Notes:

## TFP Estimation

This appendix explains the details of the firm-level productivity estimation performed using 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). 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 a generalized method of moments estimation of TFP to overcome some limitations of OP and LP, including correction for simultaneous determination of inputs and productivity, no need to maintain constant returns to scale, and robustness to the Akerberg, Caves, and Frazer (2008) critique.<sup>14</sup> 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  $t$  define:

$$y_{it} = \alpha + \beta_l l_{it} + \beta_k k_{it} + \omega_{it} + e_{it}, \quad (9)$$

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

A key assumption of the OP and LP estimation methods is that for some function  $g(\cdot, \cdot)$ :

$$\omega_{it} = g(k_{it}, m_{it}), \quad (10)$$

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<sup>14</sup>Akerberg, 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.

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

$$E(e_{it}|l_{it}, k_{it}, m_{it}) = 0 \quad t = 1, 2, \dots, T, \quad (11)$$

substituting equation (10) into equation (9), we have the following regression function:

$$\begin{aligned} E(y_{it}|l_{it}, k_{it}, m_{it}) &= \alpha + \beta_l l_{it} + \beta_k k_{it} + g(k_{it}, m_{it}) \\ &\equiv \beta_l l_{it} + h(k_{it}, m_{it}), \end{aligned} \quad (12)$$

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

In order to identify  $\beta_l$  and  $\beta_k$ , we need some additional assumptions. First, rewrite equation (11) in a form allowing for more lags :

$$E(e_{it}|l_{it}, k_{it}, m_{it}, l_{i,t-1}, k_{i,t-1}, m_{i,t-1}, \dots, l_{i1}, k_{i1}, m_{i1}) = 0 \quad t = 1, 2, \dots, T. \quad (13)$$

Second, assume productivity follows a first-order Markov process:

$$E(\omega_{it}|\omega_{i,t-1}, \dots, \omega_{i1}) = E(\omega_{it}|\omega_{i,t-1}) \quad t = 2, 3, \dots, T, \quad (14)$$

and assume 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  $m$ :

$$\begin{aligned} E(\omega_{it}|k_{it}, l_{i,t-1}, k_{i,t-1}, m_{i,t-1}, \dots, l_{i1}, k_{i1}, m_{i1}) \\ = E(\omega_{it}|\omega_{i,t-1}) \equiv f[g(k_{i,t-1}, m_{i,t-1})]. \end{aligned} \quad (15)$$

Recall from equation(10) 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 equation (9) gives:

$$y_{it} = \alpha + \beta_l l_{it} + \beta_k k_{it} + f[g(k_{i,t-1}, m_{i,t-1})] + a_{it} + e_{it}. \quad (16)$$

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

$$y_{it} = \alpha + \beta_l l_{it} + \beta_k k_{it} + g(k_{i,t}, m_{i,t}) + e_{it} \quad (17)$$

and

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

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 (17) are those outlined in the equation(13), while the orthogonality conditions for equation (18) are

$$E(u_{it} | k_{it}, l_{i,t-1}, k_{i,t-1}, m_{i,t-1}, \dots, l_{i1}, k_{i1}, m_{i1}) = 0 \quad t = 2, \dots, T. \quad (19)$$

To proceed with the estimation, 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 of variable input as instruments.<sup>15</sup>

## Details of Foreign Ownership Calculations

To construct time and firm-specific foreign ownership variables we use two separate datasets available from the BvD: the Ownership section of ORBIS dataset with “static” ownership breakdown for a given firm at year-end, and the global Zephyr dataset containing information about *changes* in ownership due to M&A. The ORBIS-Ownership database contains detailed information on owners of both

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<sup>15</sup>We use the Stata routine suggested in Petrin, Reiter, and White (2011).

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.).

#### *Direct ownership and Ultimate ownership*

A unit of observation in the Ownership section of ORBIS is the ownership link indicating that an entity A owns a certain percentage of firm B, which is referred as a “direct” ownership link. In addition, ORBIS contains information on-so called “ultimate” owners (UO) of the company by tracing the ownership pyramid beyond the direct owners. To find UOs of a company, BvD focuses on identifying the owners, if any, who exercise a greater degree of control over the company.

We prefer *direct ownership* because of the following considerations. First, most UO links are calculated by BvD but not reported by the original sources whereas the direct ownership links are taken from the direct sources and not altered by BvD. to identify UOs, BvD focuses on targets where at least one owner has more than 25 percent of direct ownership. For each such entity, BvD looks for the owner with the highest direct ownership stake. If this shareholder is “independent” (being owned less than 25 percent by any of its owners), it is defined as the UO of the company. If the shareholder with the largest ownership share is not independent, the process is repeated until BvD finds the UO. BvD admits that “even if the scope of the BvD ownership database is very wide, BvD cannot absolutely assert that all the existing links are recorded in the database. More importantly, because certain ownership structures can be very complex, trying to evaluate a controlling ultimate owner could be misleading” (Bureau van Dijk (2010)). Second, it is not possible to compute a satisfactory *continuous* ownership variable over time from the ultimate ownership links, exactly because of the uncertainty associated with construction of this variable. In contrast, large owners are almost always precisely identified



from our direct ownership variable. Finally, because the process of identifying the ultimate owner only uses the largest owners, foreign owners with stakes smaller than 25 percent are ignored, which leads to an incorrect classification of “foreign-owned” firms; we find that many foreign owners in our sample hold stakes that are smaller than 25 percent but not negligible.

*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.<sup>16</sup> 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 categorical variables indication direct ownership percentages into numeric format replacing 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 for country of residence of owners. 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 categorize the owner as foreign if the owner’s name suggest so. The remaining (typically small) owners of unknown origin are

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<sup>16</sup>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 Siems and Schouten (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.

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 company,” “mutual & pension fund/trust/nominee,” “other financial institution,” “pension/mutual fund,” “private equity firms,” or “Stichting.”<sup>17,18</sup>

Having identified foreign ownership links of a given type, we compute *Foreign Ownership* (FO) variable as follows: For a firm  $i$ ,  $FO_{i,t}$  is the sum of all percentages of direct ownership by foreigners in year  $t$ ;  $FO_{i,t}^F$  ( $FO_{i,t}^I$ ) is the sum of all percentages of direct ownership by foreigners of financial (industrial) type. For example, if a company A has three foreign owners with stakes 10 percent, 15 percent, and 35 percent; respectively, FO for this company is 60 percent. If the second owner is a bank, and the first and the third owner are industrial, the  $FO_{i,t}^F$  is 15% and ( $FO_{i,t}^I$ ) is 45%. 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 FO values to a 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. We drop a few firms where the computed total ownership (foreign and domestic) is larger than 102%. We replace  $FO \in [100, 102)$  by 100%.

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<sup>17</sup>For observations before 2001, the only owner type values available are “corporate” and “individual.” The finer division starts in 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.

<sup>18</sup>The other types of the owners could be “government,” 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 shareholders aggregated, miscellaneous, undefined company, unknown, n.a., or simply missing.

*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 includes all the information in the Zephyr database of Mergers and Acquisitions and adds to this because foreign ownership can change over time due to other reasons than 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 dataset which do not appear in Zephyr.

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 the 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. 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 infer this value from non-missing information of the initial and final stakes, if possible, and otherwise drop the observation.

In the next step, we 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. If there are multiple non-missing dates, we use the date when the deal was completed.

In the following step, we generate variables equivalent 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., industrial versus financial foreign ownership). 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 for each target firm-year cell, we merge it with the ORBIS-Ownership database. In order to obtain the best match, in a sense of filling-in the missing gaps in the ORBIS-Ownership dataset without overwriting with potentially 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 primary ownership information is from the ORBIS-Ownership dataset, we give priority to this dataset. Among other things, we do not replace non-missing ORBIS-Ownership information with Zephyr information. In other words, we only add ownership from Zephyr when the corresponding ownership information is missing in ORBIS-Ownership. With respect to filling-in the missing gaps in the data, gaps can be present in initial years, final years, or years in between. For gaps in initial (final) years of ownership, we assume that the ownership is the same as in the first (last) observation with non-missing data. For missing observations in periods between the first and last non-missing periods, we 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.

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