Gifted Kids or Pushy Parents?

Foreign Direct Investment and Plant Productivity in Indonesia

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Abstract

This paper analyzes the causal relationship between foreign ownership and various aspects of plant performance using micro data from the Indonesian Census of Manufacturing. It examines the implications of foreign ownership in two different contexts: foreign acquisitions and foreign privatizations. To control for the possible endogeneity of FDI decision propensity score matching is combined with a difference-in-differences approach. The results indicate that foreign ownership leads to significant productivity improvements in the acquired plants. The improvements become visible in the acquisition year and continue in subsequent periods. After three years, the acquired plants exhibit a 13.5 percent higher productivity than the control group. The rise in productivity is a result of restructuring, as acquired plants increase investment outlays, employment and wages. Foreign ownership also appears to enhance the integration of plants into the global economy through increased exports and imports. Finally, productivity improvements and evidence of restructuring are also found in the context of foreign privatizations.

Keywords: foreign direct investment, productivity, acquisitions, privatizations, emerging markets
JEL classification: F23, O33, D24

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The authors would like to thank Mona Haddad and Sjamsu Rahardja for making the data available and Kai Kaiser and Mary Amiti for sharing information on deflators. We are also indebted to Mary Amiti, Ana Fernandes, Ann Harrison, Hiroyuki Kasahara, Aart Kraay, Jan de Loecker, Philippe Martin, Margaret McMillan, Gianmarco Ottaviano, Kathryn Russ, Farid Toubal, Dan Trefler, three anonymous referees and seminar participants at the World Bank International Trade Seminar, the Inter-American Development Bank, the European Research Workshop on International Trade, Katholieke Universiteit Leuven, Syracuse University, the Fourth Workshop of the Regional Integration Network in Montevideo sponsored by LACEA, the World Bank-LSE Conference on Industrialization and Development in London and the Empirical Investigations in International Economics conference in Ljubljana for helpful suggestions. Moreover, we thank Edwin Leuven, Sascha Becker and Andrea Ichino for valuable advice on the empirical implementation and Hans Shrader for his support and advice. The views presented here are those of the authors and should not be held to represent those of the OECD.

1. Introduction

The conventional wisdom suggests that multinational companies are different from other firms. They tend to operate in industries where intangible assets, such as patents, new technologies and well established brand names, play an important role. In fact, they are responsible for most of the world's R&D expenditure (UNCTAD 2005). They tend to be heavily involved in international trade and often establish production and distribution networks spanning multiple countries or even continents. And perhaps more importantly, multinationals outperform their competitors at home as well as in host countries in terms of productivity.

The differences in characteristics of foreign affiliates and indigenous firms have been documented in numerous econometric studies.[1] But is the superior performance of foreign affiliates due to the intrinsic advantages of a 'pushy' foreign parent company, or are foreign investors simply good at picking the best performing local plants as acquisition targets (the 'gifted kids' in our metaphor)? Recently, the application of sophisticated econometric techniques to longitudinal micro data has cast some doubt on an intuitive positive answer to the former question, often taken for granted by economists and policymakers.[2] As Harris and Robinson (2003) remark, if foreign ownership *per se* is not associated with a productivity advantage, "then it is difficult to see how foreign direct investment (FDI) can have a positive impact on overall (..) productivity and thus growth" in the host country. While the present analysis cannot provide an answer to the question of how foreign ownership affects firms that do not receive FDI, it is nonetheless hard to imagine positive spillover effects unless foreign ownership is beneficial to those plants that are directly affected.

The existing literature has focused mainly on the link between FDI and productivity neglecting the examination of other aspects of firm operations, which arguably are equally important. For instance, is

[1] Aitken and Harrison (1999) found that foreign affiliates exhibit a higher productivity than domestic plants in Venezuela, Javorcik (2004) and Sabirianova et al. (2005) found the same pattern in Lithuania and the Czech Republic, respectively. Yasar and Paul (2007) show that foreign affiliates differ from Turkish plants in terms of productivity, size and wages paid.

[2] Surveying the empirical literature, Barba Navaretti et al. (2004, Chapter 7.3) stress that much of the available empirical evidence "supports a statistical association between foreign ownership and productivity, but not a causal link." They further report that in those studies where a more careful analysis of causality was conducted "differences in productivity between the two groups of firms are smaller than in earlier estimations and often insignificant." See Section 2 for a review of the literature.

there a causal relationship between foreign ownership and output growth, capital- and skill-intensity, reliance on export markets and imported inputs? If foreign ownership leads to a better performance, how does it happen? Is it related to restructuring, downsizing or lessening credit constraints?

This study analyzes a causal link between foreign ownership and different aspects of plant performance in Indonesia. Our analysis differs from the existing literature in three respects. First, rather than focusing on the narrow question of productivity, we consider a wider range of outcomes which can potentially be influenced by foreign owners. This allows us to understand what kind of changes are introduced (or not) by foreign owners and how they may translate into higher productivity. Second, we examine the implications of foreign ownership in two different contexts: foreign acquisitions and foreign privatizations.[3] Third, our analysis has an explicit focus on the direction of causality.

Disentangling correlation and causality in the context of foreign acquisitions and privatizations poses numerous challenges. If high productivity plants are chosen by foreign investors as acquisition targets, the ownership status becomes endogenous and a simple least-squares estimation invalid. This is why we use propensity score matching to assess the causal effect of foreign ownership on plant performance. The matching technique creates the missing counterfactual of an acquired plant had it remained under domestic ownership. It does so by pairing up each plant that will receive FDI in the future with a domestic plant with very similar observable characteristics operating in the same sector and year, where similarity is determined on the basis of those plant characteristics that have explanatory power in the acquisition decisions. Propensity score matching is then combined with a difference-in-differences approach. The causal effect of foreign ownership is hence inferred from the average divergence in the productivity paths between each acquired plant and its matched control plant, starting from the pre-acquisition year. This strategy allows us to control for observable and unobservable but constant differences between the acquired and the control plants. A similar challenge exists in the context of

[3] In the working paper version of this paper (Arnold and Javorcik 2009), we also look at the differences between greenfield FDI firms, domestic entrants and mature domestic firms. The results indicate that foreign-owned entrants outperform new domestic producers in terms of productivity, are larger, more capital- and skill-intensive, and more involved in international trade.

privatizations, and a similar solution is employed. Our difference-in-difference inferences on the matched sample comprise between 297 and 400 acquisition cases.

Our analysis, based on the plant-level data from the Census of Indonesian Manufacturing Plants, covering the period 1983-2001, shows that foreign ownership leads to significant and wide-ranging changes to plant operations and results in a higher total factor productivity (TFP) and a higher labor productivity. Our results suggest that the impact on productivity is a level rather than a growth effect.

Our analysis of acquisitions suggests that while better performing plants are more likely to be acquired by foreign interests, foreign ownership leads to a better performance in terms of TFP and labor productivity. The improvement is on the order of 13.5 percent for TFP and 63 percent for labor productivity. The productivity boost is achieved through restructuring involving an increase in the scale of production, hiring new labor, paying higher wages, massive investment in fixed assets, and in particular in machinery, and increased reliance on imported inputs and export markets.[4] Foreign ownership does not appear to affect capital- and skill-intensity. This suggests that new foreign owners may be introducing organizational and managerial changes that make the production process more efficient by reducing waste and using labor more effectively. Another possibility is that while foreign owners do not alter the skill composition of labor, they are able to attract the most experienced and motivated workers from local plants, which is in line with the observation that acquired plants hire a large number of new employees and raise the average wage. Yet another possibility is that the use of higher quality inputs or more suitable parts and components enhances productivity. This possibility is supported by the observation of FDI leading to a greater reliance on imported inputs. The positive effect of foreign ownership on plant TFP is found for acquisition targets which export while under foreign ownership as well as for those that do not so. This gives us confidence that our findings cannot be attributed to higher mark-ups producers may enjoy in export markets. It also suggests that FDI induces changes that go much beyond the creation of new markets for the plant's products.

[4] Our results, pointing to profound changes taking place in FDI recipients, are consistent with anecdotal evidence (see Moran 2001, Moran et al. 2005, and Arnold and Javorcik 2009).

The results for foreign privatizations are broadly similar to those found in the context of foreign acquisitions. We find that foreign privatizations result in a better performance than domestic privatizations. Two years after the ownership change, foreign privatizations lead to a 27 percent TFP premium relative to domestic privatizations. The difference is even larger (54 percent) when labor productivity is considered. Foreign privatizations also result in higher output. In contrast to foreign acquisitions, foreign privatizations do not lead to higher employment. The lack of appetite of foreign owners for increasing employment may be due to the fact that publicly owned companies are often overmanned. Where foreign owners do make a difference is the average wage and the skill composition of labor. Foreign ownership leads to an 8 percentage point higher share of skilled workers.

The remainder of the paper is structured as follows. The next section reviews the existing literature. Section 3 outlines our empirical strategy for identifying the causal relationship of foreign acquisitions, while Section 4 describes the Indonesian Census of Manufacturing. Section 5 explains the details of propensity score matching and the difference-in-differences technique. Section 6 presents the main results and a set of robustness checks. Section 7 focuses on foreign privatizations, and the final section concludes.

2. Existing Literature

The existing literature focusing on the causal effects of foreign ownership on plant performance falls into two broad areas: studies examining the link between FDI and productivity and studies focusing on the implications for wages.

Starting with the former literature, the few studies examining the causal relationship between foreign ownership and firm performance have produced mixed conclusions. Harris and Robinson (2003) and Benfratello and Sembenelli (2006), using data from the UK and Italy, respectively, find that foreigners tend to acquire the best performing local firms and that foreign ownership does not lead in general to an improved performance of the acquired firm. In contrast, Conyon et al. (2002) conclude that

acquisitions have a positive effect on the labor productivity of the acquisition targets in the UK. A similar conclusion is reached by Girma and Görg (2007a), who focus on food and electronics sectors in the UK and Griffith (1999) who considers the British car industry. The only study not set in a developed country context is by Djankov and Hoekman (2000) who focus on publicly traded firms in the Czech Republic and conclude that foreign ownership contributes to better performance.[5]

The second strand of the literature, dealing with the implications of foreign ownership for wages, also fails to produce a consistent message. Lipsey and Sjöholm (2004) pursue an instrumental variable strategy and find that foreign-owned establishments pay a higher price for labor of a given educational level, relative to domestic establishments in Indonesia, and that most of this wage differential is attributable to ownership rather than plant characteristics. Girma and Görg (2007b), who focus on food and electronics sectors in the UK, find that acquisitions by US multinationals have sizable effects on skilled and unskilled wages. No such effects are found for acquisitions by European multinationals. Based on matched employer-employee data from Portugal, Almeida (2007) shows that foreign acquisitions of domestic firms have small effects on the human capital and on average wages of the acquired firms. Instead, foreign investors tend to "cherry pick" domestic firms that are already very similar to foreign firms.

Our paper differs from the existing literature in two respects. First, we consider the causal implications of foreign ownership in two different contexts: foreign acquisitions and foreign privatizations. Second, rather than focusing on one outcome, we examine many different aspects of plant performance which shed light on the many dimensions in which foreign producers differ from indigenous ones.

[5] Djankov and Hoekman employ the Heckman selection model to control for the selection of FDI recipients using firm-specific information from the first year available in the sample, which is not necessarily the year preceding FDI inflow.

3. Empirical Strategy

Our empirical strategy to assess the causal effect of foreign ownership on plant performance relies on three pillars. First, we focus on changes from domestic to foreign ownership taking place within the same plant. Naturally, this approach implies a substantial reduction in the number of plants considered. However, our data set is large enough that we are still left with a sufficient number of observations to generalize our results with confidence (we have between 297 and 392 acquisition cases, depending on the specification). Second, we use a difference-in-differences method to compare the performance of acquired plants with the performance of plants remaining in domestic hands. In this way, we eliminate the influence of all observable and unobservable non-random elements of the acquisition decision that are constant or strongly persistent over time.[6] This comparison, however, is still vulnerable to problems of non-random sample selection. To address the selection issue, we combine the difference-in-differences approach with propensity score matching, which constitutes the third pillar of our empirical strategy.[7]

The propensity score matching technique controls for the selection bias by restricting the comparison to differences within carefully selected pairs of plants with similar observable pre-acquisition characteristics. Its purpose is to construct the missing counterfactual of how the acquired plants would have behaved had they not been acquired. The underlying assumption for the validity of the procedure is that conditional on the observable characteristics that are relevant for the acquisition decision, potential outcomes for the treated (FDI recipients) and non-treated plants (those remaining in domestic hands) are orthogonal to treatment status.[8]

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[6] Conyon et al. (2002) and Girma and Görg (2007a, 2007b) also use a difference-in-differences approach to examine within-plant ownership changes. The latter two papers additionally use propensity score matching. The other studies reviewed in Section 2 do not rely on either approach.

[7] Apart from its original applications in labor economics, the matching estimator has become increasingly popular in causal analyses in other areas of economics. For instance, Arnold and Hussinger (2005) and De Loecker (2007) apply this technique to examine the relationship between firm productivity and exporting..

[8] Propensity score matching is particularly attractive in this application because the dimensionality of the observable characteristics is high, i.e. a number of variables have significant predictive power in determining whether a given plant will become an acquisition target. Rosenbaum and Rubin (1983) and Dehejia and Wahba (2002) demonstrate that the propensity score, i.e., the predicted probability of treatment, "provides a natural weighting scheme that yields unbiased estimates of the

In the context of our study, the propensity score is the predicted probability of a plant receiving FDI. In constructing the pairs of observations matched on the propensity score, we make sure that the matched control observations are assigned only from the same year and the same sector as the acquired plant. This eliminates the possibility that differences in productivity or other aspects of plant operations observed across sector-year combinations exert influence on our estimated effects.

The combination of matching and a difference-in-differences approach means that we look for divergence in the paths of performance between the acquired plants and the matched control plants that had similar characteristics in the pre-acquisition year. The performance analysis begins in the pre-acquisition period and focuses on the (cumulative) change in performance over the following year and then each of the subsequent two periods. While matching accounts for differences in observable characteristics, its combination with difference-in-differences analysis provides "scope for an unobserved determinant of participation as long as it can be represented by separable individual- and/or time-specific components of the error term." (Blundell and Costa Dias, 2000).

4. Data

Indonesia is a suitable choice for studying the effects of FDI, as the country has received significant inflows of FDI during the last several decades. The attitude towards FDI has been generally welcoming since the late 1960s. A surge in FDI took place as economic policy began to reduce trade barriers and deregulate industry in the early 1980s. During the period 1990-1996, the country was the fifth largest developing country recipient of FDI (IFC 1997, p.17).

Our data come from the "Survei Manufaktur", the Indonesian Census of Manufacturing conducted by the National Statistical Office (BPS) on annual basis since 1975. The census surveys all

treatment impact." Since conditioning on the propensity score is equivalent to conditioning on all variables in the treatment model, the dimensionality problem can be solved by conditioning on the propensity score rather than a vector of variables.

registered manufacturing plants with more than 20 employees.[9] It contains detailed information on a large number of variables pertaining to input and output flows. We have access to the data covering the period 1983-2001 and containing more than 308,439 plant observations, of which about 5.5 percent belong to foreign-owned plants. The average spell a plant remains in our sample is about 11 years.

One of the key variables of interest is plant productivity. We measure total factor productivity (TFP) using a multilateral index suggested by Aw, Chen and Roberts (2001). This index is an extension of the multilateral TFP index derived by Caves et al. (1982). It allows for consistent comparison of TFP in plant-level data with a panel structure.[10] To guarantee that comparisons between any two plant-year observations are transitive, the index expresses each individual plant's output and inputs (capital, labor, materials and energy) as deviations from a single reference point. As the reference point, the index uses a hypothetical plant operating in the base time period (the first year of the data 1983) and having average input costs shares, average logarithm of inputs and average logarithm of output. The index is calculated separately for each of 66 manufacturing sectors, which is equivalent to the 4-digit ISIC level.[11]

More specifically, we use the following formula:

$$\ln TFP_{it} = (\ln Y_{it} - \overline{\ln Y_t}) + \sum_{\tau=2}^{t} (\overline{\ln Y_\tau} - \overline{\ln Y_{\tau-1}})$$
$$-[\sum_{j=1}^{m} \frac{1}{2}(S_{jit} + \overline{S_{jt}})(\ln X_{jit} - \overline{\ln X_{jt}}) + \sum_{\tau=2}^{t}\sum_{j=1}^{m} \frac{1}{2}(\overline{S_{j\tau}} + \overline{S_{j\tau-1}})(\overline{\ln X_{j\tau}} - \overline{\ln X_{j\tau-1}})] \quad (4)$$

[9] Since regional statistical offices in Indonesia have financial incentives to obtain the relevant information from all active firms, we can be reasonably confident that the entire manufacturing sector above the 20 employee threshold is included in our sample. The survey questionnaires can be accessed online at http://www.rand.org/labor/bps.data/webdocs/statistik_industri/si_main.htm.

[10] This approach allows for flexible and heterogeneous production technology. A comparison of the robustness of five widely used productivity measures (index numbers, data envelopment analysis, stochastic frontiers, GMM and semiparametric estimation) suggests that the approach we chose tends to produce very robust results across the different experiments (see van Biesebroeck 2007).

[11] The industry breakdown was adjusted to eliminate inconsistencies caused by the fact that BPS had removed several sectors and introduced a few others into the classification during the period of interest. In such cases, plants were regrouped into the corresponding ISIC Rev. 2 industries. Two petroleum sectors (ISIC 3530 and 3540) were dropped from the sample because of a very small number of observations. Similar sectors with a small observation numbers were combined for the purposes of TFP calculation, which is performed on 66 rather than 74 sectors. For instance, as sector 3720 (Non-ferrous metal industries) came into existence only in 1990, we combined it with 3710 (Iron and steel industries).

where *i* denotes plant, *t* year, *j* type of input. *Y* denotes output, which is measured in real terms.[12] Inputs (*X*) include labor (number of employees), materials (real value of material costs), energy usage (real value) and capital stock. *S* denotes input shares, that is, the ratio of wage bill (or material or energy costs) to output. The first term in the definition of the index expresses plant output in year t as a deviation from the mean output in that year, thus capturing information on the cross-sectional distribution of output. The second term sums the change in the mean output across all years and captures the shift of the output distribution over time by chain-linking the movement in the output reference point. The remaining terms repeat the exercise for each input j. The inputs are summed using a combination of the input revenue share for the plant (S_{jit}) and the average revenue share in each year as weights. Thus the index is a measure of the proportional difference in TFP for plant i observed in year t relative to the hypothetical plant in the base year.

The capital stock variable used in TFP calculation has been newly constructed using the perpetual inventory method, making use of detailed data on investment in land, buildings, machinery, vehicles and other fixed assets.[13] To each investment data series (land, buildings, etc.) we applied estimated depreciation rates from Harris et al. (1994).[14] The capital share is obtained from the assumption of constant returns to scale.[15,16] Given a substantial number of missing values in our data set, we are able to

[12] When we compare plants operating within the same industry-year cells, the second term in equation 4, which sums the change in the mean output across all years, will cancel out.

[13] We used the earliest available information on self-reported replacement values of each capital category as an anchor for the perpetual inventory method. Where a plant did not report the replacement values of its assets, we used the self-reported book values instead. Plants that never report capital stocks were dropped from our sample. Since the investment question was not asked in 1996, for that year we used linear extrapolation on the basis of real investment figures reported for the earlier years.

[14] The assumed annual depreciation rate for buildings is 3.3 percent, for machinery 10 percent, and for vehicles and other fixed assets 20 percent. For land, we assumed no depreciation.

[15] This is a reasonable assumption. In the earlier version of the paper (Arnold and Javorcik 2005), we used the Levinsohn-Petrin (2003) method to obtain TFP. The production functions estimated at the 4-digit ISIC level indicated that in 77 percent of sectors constant returns to scale could not be rejected.

[16] Since the data contain no information on physical quantities of inputs used or output produced by plants, we are forced to start with nominal values instead. These are deflated using a set of 192 wholesale price indices for manufactured commodities, published by the Indonesian Statistical Office. The commodity indices are mapped to the 5-digit ISIC classification, using a concordance table provided by the Statistical Office, and applied to plant output and material inputs. In cases where deflators for 5-digit industries are not available, we use deflators for 2-digit industries. Figures on investment and capital are deflated as follows. For buildings, we use a wholesale price index for residential and commercial buildings (WPI) published in the Statistical Yearbook of Indonesia, and for machinery and vehicles the average of the WPIs for 5-digit sectors producing machinery and vehicles, respectively. For other assets, we employ the economy-wide WPI. Unfortunately, the Indonesian Statistical Office does not publish a wholesale price index for energy, so we are constrained to use a CPI specific to energy instead. See Table 1 for summary statistics.

obtain TFP for about 200,000 plant observations. This number gives us a large choice of control units for our matching procedure.

A foreign acquisition is defined as a situation where a foreign ownership share increases above 20 percent. In practice, however, the exact value of the threshold does not matter much because in more than 99 percent of cases the foreign capital share in the pre-acquisition period is equal to zero. Similarly, in 95 percent of cases, the foreign ownership share in the year of acquisition is above 25 percent and in 78 percent of cases it is at least 50 percent. Ownership changes occur in each 2-digit manufacturing sector and in each year during the 1985-99 period.[17]

We perform our core analysis on a set of manufacturing plants that switched from domestic to foreign ownership and remain in the data sufficiently long to be observed two years before the acquisition, in the acquisition period and in two subsequent years.[18] When the outcome under consideration is labor productivity, output, employment or average wage, we are able to use data on 392 acquisitions. However, when TFP is the outcome of interest, we can consider only 297 cases due to missing observations for the information needed to calculate TFP for the five-year period surrounding the acquisition.[19]

[Table 1 about here]

5. A Simple Empirical Model of Foreign Acquisitions

Foreign plants are typically different from domestic plants and tend to outperform them in a number of dimensions. In particular, our data reveal substantial performance premiums in terms of TFP, labor productivity, output and employment associated with foreign ownership. In addition, foreign plants tend to pay higher wages, invest more, use more capital-intensive production technologies, and export and

[17] A breakdown of acquisitions across sectors and years, as well as the distribution of foreign ownership shares after acquisitions is available in the working paper version of this article (Arnold and Javorcik 2009).

[18] In the raw data, we start with 772 acquisition cases. This number drops to 392 due to missing observations on the variables required to obtain the propensity score. The variables required are those included in Table 2.

[19] The number of acquisition cases available also varies depending on the number of missing observations for other outcomes considered. Moreover, some variables were not included in the census in all years. For instance, information on capacity utilization and exports is only available for 1990-98 and 1990-99, respectively. To put these numbers into perspective, note that Conyon et al. (2000) find 129 cases of foreign acquisitions with sufficient data in a study analyzing a large developed country (the UK) and covering a five-year period (1989-94).

import a larger share of their output and inputs.[20] However, these apparent differences say little about the direction of causality. We address the causality question by applying the matching estimator on within-firm ownership changes, as described in Section 3. As a first step, we model empirically the transition of potential acquisition targets from domestic to foreign ownership. We do so by estimating a probit model of the binary outcome of a plant becoming acquired by foreigners, with observable plant characteristics as explanatory variables. All explanatory variables (except for age) are lagged one year and thus pertain to the pre-acquisition period.[21] We believe that observable characteristics are a good starting point as potential foreign investors rely heavily on basic observable information on plants, such as their age, size, employment composition, machinery and equipment available, productivity, etc. to narrow down the number of potential acquisition targets. They may also judge suitability of plants based on their reliance on imported inputs which may indicate the sophistication level of the technology used. Finally, the fact that an establishment has received a bank loan (and its magnitude) may also contain information on financial institutions' perceptions about trustworthiness and future prospects of an establishment.

The results from the acquisition model, presented in Table 2, indicate that plants acquired by foreign investors differ systematically from other domestic plants. The model suggests that better performers in terms of the TFP level are more attractive to foreign investors. The coefficient on the TFP level is significant at the five percent level. To account for pre-acquisition trends in plant performance, the model also includes pre-acquisition TFP growth. The coefficient on this variable, however, does not appear to be statistically significant. We find that younger and larger (in terms of employment) plants are more likely to be acquired. The model allows for nonlinear effects of these two variables which indeed appear to be statistically significant. The data also show that plants with higher capital-labor ratios, exporters, plants engaged in sourcing inputs from abroad and plants with a higher fraction of white-collar employees tend to be more attractive to foreign investors. High capital-labor ratios appear to matter less for exporting plants.

[20] See the working paper version (Arnold and Javorcik 2009) for some descriptive statistics about these differences.
[21] In order to increase the precision of our model, we dropped all 4-digit sectors and all regions (kabupatens) in which no foreign acquisitions occurred during the whole period under study.

The probit model also includes investment outlays lagged one period. This ensures that matches assigned on the basis of the propensity score will be homogenous with respect to previous investment behavior, and hence eliminates the possibility that improvements observed after the ownership change may be due to investments undertaken by plants prior to or in preparation for a foreign acquisition. This variable, however, has a statistically significant negative sign.

To attenuate the possibility that the effect of FDI works purely through easing access to credit, the probit model also controls for the value of loan-financed investment (normalized by output), but the estimated coefficient does not reach conventional significance levels. Further, we find that plants with public ownership (as proxied by a dummy variable) are less likely to be acquired. Finally, the data show that the period of the Asian financial crisis (1997-99) was associated with an increase in foreign acquisitions.

[Table 2 about here]

The predicted probability of becoming an acquisition target, or the propensity score, resulting from the model in Table 2, forms the basis of our matching procedure. We use one-to-one nearest neighbor matching and impose the additional requirement that the matched plant observations come from the same sector and year.[22]

To assess how well the propensity score matching performs in our case, we perform a series of tests collectively known as the tests of the balancing hypothesis.[23] As there does not appear to be a consensus in the literature about which of the existing tests to use, we perform several tests whose description and results can be found in the Appendix. The first test applies the regression framework to the full sample (treated observations and *all* potential controls, not just those assigned based on the nearest-neighbor matching procedure) and indicates that there are no statistically significant differences between the treated and the control group in terms of plant characteristics, once the propensity score is

[22] Our matching procedure is implemented in Stata 9 using a modified version of the procedure described in Leuven and Sianesi (2003). The modifications were necessary to make sure that matched pairs come from the same year and sector. There are 74 distinct 4-digit ISIC sectors in our data within which matched pairs are assigned. In our matching procedure, we also exclude observations outside the common support. The common support is bound by the lowest propensity score of a treatment observation and the highest propensity score of a control observation.

[23] For a description of various tests available see, for instance, Smith and Todd (2005) and Dehejia and Wahba (2002).

taken into account, except for the share of imported inputs.[24, 25] The second test compares the sample means between the treated group and the group of controls *actually* assigned using the nearest-neighbor matching procedure. It indicates that there is no statistically significant difference in the means of all the variables included in the matching procedures (including the ratio of imported inputs) between the treated and the control group. The weakest result is found for the loan variable for which the hypothesis of no difference can only be rejected at the 8 percent level.[26] The third test is a Hotelling T^2 test of the joint null of equal means of all the variables. It is applied to the treated and the matched control group and shows that the hypothesis that vectors of means are equal for the two groups cannot be rejected.

Moreover, our matched pairs of plants are on average only 0.24 percentage points apart in terms of the propensity score, a measure that is theoretically bound between 0 and 100 percent. Although there is no established metric for a successful propensity score matching process, these observations give us confidence that our approach is capable of grouping together relatively homogeneous plants.

6. Results from the Difference-in-Differences Analysis on the Matched Sample

(a) Productivity

The first outcome of interest is the TFP. As can be seen in Table 3, our matching procedure performs very well with respect to this variable. The average TFP observed in the treated and control groups in the period when matches are assigned is 0.864 and 0.867, respectively. While the matched pairs start with almost identical productivity levels, their TFP diverges quickly. During the first year of foreign ownership, the acquired plants have the TFP level equal to 1.079 as opposed to 0.976 for the control observations. In the third year under foreign ownership, the figures increase to 1.215 and 1.083,

[24] Note that in the robustness checks we show that our results continue to hold if we restrict our attention to plants not using any imported inputs.

[25] An alternative test applied to the full sample, not reported to save space, follows Dehejia and Wahba (2002, appendix). It splits the sample into 9 bands of the propensity score and within each band compares the means of plant characteristics between the treated and the control group. We do not find statistically significant differences between the treated and control group in terms of TFP level, TPF growth rate, employment, skilled labor share, average wage, imported input share, age, capital per worker and the loan-financed investment normalized by output.

[26] To rule out any influence of this difference on our findings, we run an additional robustness check in which we match on a Mahalanobis measure constructed from the propensity score and information on the use of loans before the acquisition. We find that the results are robust to this alternative specification (see Section 6).

respectively. Both groups increase their TFP levels, but the increase is substantially higher for the acquired plants. This is clearly visible when we consider the average difference in TFP in the matched pairs, net of the average initial difference in the pre-acquisition period, reported in Table 3 as the average treatment effect on the treated (ATT). In the year of acquisition, the ATT is equal to 0.106, i.e., after taking into account the initial difference between the two groups, acquired plants have 10.6 percent higher TFP. In the second year under foreign ownership, the productivity advantage of acquired plants increases to 12.2 percent. By the third year it reaches almost 13.5 percent. All three effects are statistically significant at the one percent level.

Next we focus on labor productivity, defined as the logarithm of value added per worker, as an alternative measure of performance. The matched pairs exhibit very similar labor productivity levels in the pre-acquisition period. But as early as in the year of acquisition, the acquired plants have a 32 percentage advantage over the control observations.[27] By the last year considered the advantage increases to 63 percent suggesting that foreign ownership leads to a significant and steady boost to plant performance (see the lower panel of Table 3).[28]

[Table 3 about here]

(b) Evidence of restructuring: changes introduced by foreign investors

If our findings of improved productivity following FDI are caused by foreign ownership, we would expect to observe foreign owners introduce other changes to plant operations. And, indeed, we find evidence that acquired plants undergo a deep restructuring process. We start by considering three outcomes: output, employment and the average wage paid by the plant (see Table 4). Acquired and

[27] Note as the ATT is calculated for the log of labor productivity, the percentages reported in the text are obtained by taking the exponent of the ATT and subtracting one.

[28] There are two potential sources of upward bias to our productivity estimates. First, our productivity measures do not take into account services inputs. If foreign ownership leads to higher purchases of services from the foreign parent, then our productivity measures will systematically overstate productivity gains in the acquired plants. Second, our analysis focuses on acquired plants that remained under foreign ownership for at least three years. Cases of foreign owners reselling their Indonesian plants to domestic owners a year or two after the acquisition might be a result of low productivity gains. To investigate this issue, we conducted a new matching exercise which included *all* acquisition cases (297 cases included in the top panel of Table 3 and 139 cases of short-lived acquisitions). In this exercise, we examined the effects of foreign acquisitions on plant performance treating cases of resold plants as if they had remained under foreign ownership for at least three years. The results presented in Table B in Appendix II suggest that foreign acquisitions lead to an improved performance (measured both in terms of TFP and labor productivity) but the magnitude of the effect is lower than that found in Table 3.

control plants start with the same average output level, but while the acquired plants produce a higher level of output year after year, the control group experiences a small but steady decline in the level of output.[29] In the acquisition year, the difference between the two groups is equal to 64 percent. By the third year of foreign ownerships it increases to 101 percent. The ATT is statistically significant at the one percent level.

Foreign ownership also appears to lead to increases in the employment level and the average wage. Acquired plants hire extensively during the first two years under foreign ownership. Control plants also increase their labor force, albeit only slightly. After three years under foreign ownership, the acquired plants have 24 percent higher employment than the control group, after taking into account the initial difference between the two groups. In terms of wages, both acquired and control plants increase the average wage over time, but plants under foreign ownership do so considerably faster. A 31 percent difference in year of acquisition translates into a 41 percent difference two years later.[30] Both employment and wage differentials are statistically significant at the one percent level.

[Table 4 about here]

Next we turn our attention to investment. Evidence of foreign investors bringing in new technologies and modern production lines would strengthen the finding of FDI leading to productivity improvements. In Table 5, we examine two outcomes: total investment (which includes investment in land, buildings, machinery, vehicles and other fixed assets) and investment in machinery. In both cases, we find very large and statistically significant differences in behavior of acquisition targets and control plants. After taking into account the initial difference between the two groups, we find that acquired plants invest in general (or just in machinery) between twice and more than three times as much as plants remaining in domestic hands.[31]

[29] Recall that our matches are assigned within the same 4-digit industry and year, thus this pattern cannot be attributed to considering different time periods for two groups.

[30] This finding is consistent with the existing literature which has documented that foreign establishments tend to pay higher wages than domestic plants. See Lipsey and Sjöholm (2004) for a careful analysis of the Indonesian case.

[31] The number of acquisition cases examined differs depending on the outcome considered. This is due to missing observations for a given outcome and not to the inability to find suitable control observations. We repeated all the exercises presented in this

These findings suggest that foreign acquisitions lead to a substantial restructuring in acquired firms, which is consistent with the anecdotal evidence and with the experience of other regions in the world.[32]

[Table 5 about here]

(c) FDI and international production networks

Our results also indicate that foreign ownership affects participation of the acquired plants in international markets. As illustrated in Table 6, in the pre-acquisition period control plans export a slightly higher share of their output, 23.6 percent, as compared to 22.3 percent for the future acquisition targets. While this share goes down a bit for the control plants, acquisition targets see a steady increase over time (29.6 percent two years after the acquisition and 33.4 percent in the following year). The difference between the two groups is not statistically significant in the year when FDI takes place. But it becomes significant at the one percent level in the following two years and reaches 10.3 and 13.9 percentage points, respectively.[33]

The increases in the production volume and the export share observed among acquired plants indicate an increase in the volume of exports. Two factors may be responsible for this phenomenon. First, sizable investments in new machinery observed in the acquired plants may lead to upgrading of the quality of products and thus make them suitable for export markets.[34] Second, foreign parents may integrate acquired plants into their worldwide production and distribution networks.

The introduction of new production lines may require higher quality inputs that need not be available locally. In that case, we would expect FDI to lead to an increased reliance on imported inputs, and the data indicate that this is indeed happening. While in the pre-acquisition period, both the treated and the control plants import about a quarter of their inputs, this figure jumps to 37.6 percent among

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subsection for the sample of acquired plants for which TFP is available. As the results we obtained were very close to those reported, we do not present them here.

[32] See Arnold and Javorcik (2009) for examples of such anecdotal evidence.

[33] The increase in the average export share is a result of both increased export intensity of previously exporting plants and of plants entering foreign markets for the first time after the acquisition.

[34] Mexican plant-product level data suggest that future export product experience an increase in unit values prior to their introduction into export markets and that this increase is associated with higher investment outlays at the plant level (Iacovone and Javorcik 2008).

acquired plants in the year when FDI takes place. In contrast, reliance on imported inputs remains unchanged in the control group. Interestingly, this seems to be a one-time adjustment, as in the subsequent years the input share remains stable. Differences between the treated and the control group (equal to 10-11 percentage points) are statistically significant at the one percent level.

[Table 6 about here]

(d) What foreign owners do not change or change little

The profound changes taking place in the acquired plants, documented so far, do not extend to all aspects of plant operations. Additional matching results, not reported to save space, show that FDI does not appear to induce increases in the skill intensity of the labor force (defined as the share of white collar workers in total employment) or the capital-labor ratio. Acquired plants register hardly any changes in the skill intensity of the labor force. The share of white collar workers actually contracts slightly, and the ATT never appears to be statistically significant. A similar picture emerges with respect to capital-labor ratio, which is relatively stable in both the treatment and control groups. Acquisitions appear to bring about a 2 percent decline in capital intensity, two years after the change of ownership, but the effects is not statistically significant (recall that both employment and investment are affected positively by FDI).[35]

How can we reconcile an increase in TFP, labor productivity and wages with no evidence of changes to skill composition or the capital-labor ratio? One possibility is that new foreign owners introduce organizational and managerial changes that make the production process more efficient by reducing waste, lowering the percentage of faulty product and using labor more effectively.[36] Another possibility is that while foreign owners do not alter the skill composition of labor, they are able to attract more experienced and motivated workers.[37] They may also substitute expatriate staff for local managers

[35] See Arnold and Javorcik (2009) for these and other results that are discussed but not reported to save space.

[36] A relevant example of organizational changes introduced by a foreign investor in its Chinese affiliate is presented in Sutton (2005). According to the interviewed engineer, what mattered was not the obvious alternation to the physical plant, but rather inducing a shift in work practices. This shift involved a move away from traditional notions of inspection at the end of the production line to a system in which each operator along the line searched for defects in each item as it arrived and as it departed. The idea of such constant monitoring was in part to avoid adding value to defective units. More importantly, this system allowed for a quick identification and rectification of sources of defects.

[37] About 10 percent of Czech firms surveyed by the World Bank in 2003 reported that they lost employees as a result of FDI entry into their sector (Javorcik and Spatareanu 2005).

and introduce pay scales linked to performance in order to motivate their staff.[38] This possibility is in line with the earlier observation that acquired plants hire a large number of new employees and raise the average wage. Further, foreign owners may invest more in staff training, which is consistent with international experience.[39] Yet another possibility is that the use of higher quality inputs or more suitable parts and components translates into higher productivity.[40] This possibility is supported by the observation of FDI leading to a greater reliance on imported inputs.

One may wonder if the observed improvements in productivity attributed to foreign ownership are due to an increased capacity utilization. The evidence, however, suggests that capacity utilization plays a limited role. Information on capacity utilization is available in the Census for the 1990-98 period. In the acquisition year and in the following year, we do not find a statistically significant difference in capacity utilization between the treated and the control group. In the last year considered, we observe a difference of 8 percentage points which is significant at the 10 percent level. Part of this difference is attributed to a better use of capacity among acquisitions targets and part is due to a worsening utilization in the control group.

(e) Is it only about easing credit constraints?

While the transfer of know-how and technology accompanied by improvements in management is a plausible explanation for the results presented so far, benefits from foreign ownership could also come from easier access to financing. It is possible that foreign investors pick plants that would have done well without foreign ownership, had they had sufficient access to credit. To address this possibility we accounted in the construction of the propensity score for the value of loan-financed investment (normalized by output) as well for the value of total investment undertaken by the plant during the year preceding a foreign acquisition (see Table 2). Our matching analysis is thus conditional on these two

[38] Lipsey and Sjöholm (2004) find that foreign affiliates in Indonesia pay higher wages to workers with a given educational level than domestic producers.

[39] Filer et al. (1995) found that in foreign-owned firms in the Czech Republic spent 4.6 times more than domestic firms on hiring and training. A study focusing on Malaysia also showed that foreign-owned firms provide more training to their workers than domestic enterprises (World Bank 1997).

[40] For instance, a lower percentage of faulty inputs translates into fewer final products that must be rejected at the quality control stage.

variables. However, to explore this issue further, we employ an alternative matching technique where we match plants on a Mahalanobis distance measure that consists of both the propensity score and an indicator for firms having a bank loan in the pre-acquisition period, identified on the basis of whether or not a plant was making interest payments.[41] The results, presented in Table 7, support our earlier conclusion of foreign ownership leading to better performance. In all years, the effect of FDI is positive and statistically significant.

Next, we approach this issue from a somewhat different direction. Again we employ Mahalanobis matching, but this time the additional matching variable is the average investment per employee incurred during the *post-acquisition* period. This allows us to construct a new control group with the following characteristics: (i) similarity to the treatment group in terms of observable characteristics (considered earlier) prior to the acquisition, and (ii) similarity in terms of investment undertaken in the years under foreign investment is received. The logic behind this exercise is that if plants from the same industry with similar observable characteristics exhibit a similar investment pattern, something other than credit constraints should be responsible for a divergence in performance. The results from the difference-in-differences approach applied to this new control group suggest that credit constraints are unlikely to be responsible for the productivity boost associated with the change in ownership (see Table 7).

Finally, in non-reported results, we check whether the acquired plants experienced a larger increase in the amount of loan-financed investment than the control group. Again we use Mahalanobis matching, with the additional matching variable being the value of investment financed by loans (normalized by output) in the pre-acquisition period. Loan-financed investment (normalized by output) is also the outcome considered. We do not find a statistically significant difference between the acquired and the control plants. In sum, we conclude that the positive effect of FDI on the performance of acquired plants cannot be attributed to foreign owners lessening credit constraints of the acquisition targets.

[41] See Rubin (1980) for a description of the use of Mahalanobis distance measures in the context of matching estimators. As Mahalanobis matching is a more demanding procedure, the only restriction we impose on the matches is that they come from the same 2-digit sector. This is true of all Mahalanobis matching results used in the paper. This changes the interpretation of the results, as the outcome variable, the TFP index, should now be thought of as a *relative* rather than an absolute TFP level. This is because the index is defined relative to a hypothetical average plant operating in the same 4-digit sector (recall the description of the TFP index in Section 4).

[Table 7 about here]

(f) Do productivity benefits accrue only to exporters?

The increase in productivity associated with foreign ownership could potentially reflect higher mark-ups that acquired plants may enjoy as a result of entering export markets.[42] To examine this possibility we split the acquired plants into two groups: (i) exporters: defined as plants that export at least 10% of their output in one or more years while under foreign ownership; and (ii) non-exporters defined as plants that do not export (or export less than 10% of their output) while under foreign ownership. Finding the productivity advantage only among exporters would support the mark-up story. The results, not reported to save space, indicate however that mark-ups are not driving the observed productivity pattern. Foreign ownership appears to improve TFP in both exporting and non-exporting plants. The effects are statistically significant in all cases, and the performance differential between the acquired and the control group increases over time. Moreover, the boost to TFP appears to be larger among non-exporters (16.2 percent as opposed to 11.6 percent among exporters in the last year considered).[43]

(g) Level versus growth effect

To examine whether the impact of FDI on plant productivity is a level or a growth effect, we focus on the change in the TFP index as the outcome variable. The results (not reported to save space) suggest that the observed boost in productivity enjoyed by acquired plants is mostly a level effect. While in all post-acquisition years the treated plants experience a faster productivity increase than the control observations, the growth effect of foreign ownership is statistically significant only in the year of foreign ownership.[44]

[42] This is because in the absence of perfect competition, the use of deflated sales as a proxy for output is problematic (see Klette and Griliches (1996) for a discussion).

[43] Our finding of TFP improvement in acquired plants not being driven by presence in export markets is consistent with the results obtained by Baldwin and Gu (2003) for Canada. They show that entry into exporting leads to productivity improvements in domestic but not in foreign-owned plants and that increases in export intensity are associated with the same magnitude of productivity improvements in both types of producers.

[44] This is consistent with the findings of Aitken and Harrison (1999) who compared productivity growth rates of domestic and foreign plants in Venezuela.

(h) Additional robustness checks

Two additional robustness checks are worth mentioning, even if we refer to our working paper version for the full results of these tests. First, we included the TFP level in the pre-acquisition period as an additional variable in a Mahalanobis distance measure, and match on this measure rather than on the propensity score alone. This creates homogeneous pairs with respect to pre-acquisition productivity. As before, the effect of foreign ownership is significant at the one percent level in all cases, and the magnitude of the effect is somewhat larger. Second, we restrict our attention to acquired plants whose TFP is observed in each of the 6 years starting with the ownership change, to verify that our results are valid even over a longer time horizon. The results suggest that foreign ownership has a lasting impact on the plant productivity: Acquired plants enjoy a 14 percent productivity advantage in the year of acquisition, which increases to 20 percent two years later and 24 percent in the sixth year of foreign ownership. The effect is statistically significant in all years considered.

7. Privatizations

By definition, an acquisition—regardless of the nationality of the acquiring firm—always involves a change in ownership. Hence it remains to be shown that it is not the change in ownership *per se* that drives our findings about performance improvements and restructuring. The only kind of variation in our data that enables us to separate out the effects of foreign acquisitions from a change in ownership involving no foreign investors can be found in privatization cases: Our data allow us to identify ownership changes from public owners to private owners, where some of the privatized firms were acquired by private domestic investors, while others were acquired by private foreign companies.[45] We exploit this variation to examine the causal effect of foreign ownership on the performance of privatized plants, conditional on the change in ownership that all privatization cases have undergone. We understand

[45] This analysis is similar to Bartel and Harrison (2005) who also compare these two types of privatization cases.

this as an additional test whether the positive effect of foreign acquisitions on plant performance is indeed driven by *foreign* ownership rather than a change in ownership in general.[46]

We define a privatization as a change leading to the public (central and/or local government) ownership share dropping to less than 20 percent. As foreign privatizations we consider cases where foreign ownership share in the post-privatization period is at least 20 percent, consistent with the cutoff we used in other parts of the study. If what matters for plant performance is *any* change in ownership rather than the presence of foreign owners, we would expect to find no difference in performance between the two types of privatizations.

We apply a similar matching estimator to the privatization cased as the one used before for acquisitions.[47] The number of foreign privatization cases depends on the outcome considered and ranges from 80 for output, to 59 for TFP and 46 for export share. Due to the small number of potential controls, we do not impose a restriction that treated and control observations come from the same industry-year cell. Thus we should think of the outcome variable as the *relative* rather than absolute TFP index (recall that the index is defined relative to the average hypothetical plant in each industry).

As illustrated in Table 8, the results obtained support the conclusion that foreign ownership rather than ownership change in general leads to productivity improvements. We find that foreign privatizations result in a better performance than domestic privatizations. Two years after the ownership change, foreign privatizations lead to a 27 percent TFP premium when compared to domestic privatizations. The

[46] Ideally, we would like to compare our results to the effects of domestic acquisitions on plant performance. Unfortunately, our data do not allow us to identify domestic acquisitions. Using other sources we were able to identify a handful of domestic acquisitions and found that they were associated with a *deterioration* rather than an improvement in plant performance (see Appendix in Arnold and Javorcik 2005). This view is also supported by the evidence from Malaysia presented by Fauzias and Shamsubaridah (1995) who find a statistically significant decline in the performance (measured in terms of earnings per share and return to capital) of establishments acquired by domestic companies. Finally, Conyon et al. (2002) document a positive effect of foreign acquisitions on labor productivity in the UK but fail to find a similar effect of domestic acquisitions.

[47] The empirical model is not reported here but available in the working paper version. To obtain the propensity score, we model foreign privatizations (as distinct from domestic privatizations) as a function of pre-privatization TFP, plant size (measured in terms of employment), age and age squared, capital-worker ratio, reliance on imported inputs, investment, skill intensity, average wage, exporter dummy, exporter dummy interacted with capital-worker-ratio, time trend and a dummy for crisis years. The model indicates a significant positive link between TFP, plant size, exporter status, reliance on imported inputs, average wage and foreign privatizations. The model satisfies the balancing hypothesis.

difference is even larger (54 percent) when labor productivity is considered. In all years, the effects are positive and statistically significant.[48]

[Table 8 about here]

Furthermore, we find evidence of more intense restructuring in the case of foreign, as compared to domestic, privatizations. As evident from Table 9, foreign privatizations result in higher output. The divergence in output between the two types of privatizations is already visible in the year of ownership change and continues for the following two years. In all the years, the effect is statistically significant. In contrast to our results on foreign acquisitions, foreign privatizations do not appear to lead to higher employment. Foreign privatizations are characterized by rather stable employment, as opposed to a small increase registered in the case of domestic privatizations. The difference between the treated and the control group is not statistically significant in any of the years considered. The lack of appetite of foreign owners for increasing employment may be due to the fact that publicly owned companies are often overmanned.

Where foreign owners do make a difference is the average wage and the skill composition of labor. There is a steady divergence in the average wage between privatizations with foreign and domestic interests. Employees of plants undergoing foreign privatizations receive on average a 46 percent higher wage in the year of ownership change, when compared to their counterparts in plants privatized without FDI. Two years later the difference reaches 80 percent. In all years, the effect is statistically significant at the one percent level. This difference appears to come from the changing composition of the labor force.[49] In the case of foreign privatizations, we see a steady increase in the share of white collar workers in total employment. In domestic privatizations, the opposite trend is registered. The results in Table 9 indicate that foreign ownership leads to an 8 percentage point higher share of skilled workers. This effect is statistically significant in the first and second year following the privatization.

[48] Our results confirm the conclusions of Bartel and Harrison (2005) who study the effects public ownership and privatization in Indonesia.

[49] Foreign owners may also be increasing wages for other reasons, e.g. to motivate workers and to avoid turnover which may costly in terms on investment in training and knowledge leakage to competing plants.

The privatization analysis leads to other interesting observations which we describe only verbally to save space. There is no statistically significant difference between foreign and domestic privatizations in terms of investment and export share, which contrasts with the results for acquisitions. In other respects, our results are similar to those obtained when studying foreign acquisitions. Foreign ownership does not appear to lead to a higher capital intensity, higher capacity utilization or faster TFP growth. It leads to a greater reliance on imported inputs, though the effect is statistically significant only in the last year considered.

[Table 9 about here]

8. Conclusions

A large empirical literature searches for a link between foreign direct investment and economic growth that goes beyond the contribution of multinationals to investment in physical capital. Implicit to this analysis lies the assumption that foreign ownership *per se* brings some intangible advantages that enhance economic growth and whose proximity can be beneficial to domestic producers. If, however, foreign investors are mainly good at choosing the best domestic firms as acquisition targets, this assumption may not hold true.

This study aims to shed some light on this issue by examining the causal relationship between foreign ownership and plant performance in a Census of Indonesian Manufacturing Plants. We identify causality by controlling for the possible endogeneity of plant ownership status, using a difference-in-differences approach in combination with propensity score matching. Our analysis differs from the existing literature in three ways. First, rather than focusing on the narrow question of productivity, we consider a wider range of outcomes that can potentially be influenced by foreign owners. This allows us to understand what kind of changes are introduced by foreign owners and how they may translate into higher productivity. Second, we examine the implications of foreign ownership in two different contexts: foreign acquisitions and foreign privatizations. While comparing these settings is interesting in its own

right, obtaining consistent findings from both gives us confidence that we are drawing the right conclusions from our findings. Third, our analysis has an explicit focus on the direction of causality.

Our results can be summarized as follows. First, the evidence on foreign acquisitions shows that foreign ownership leads to significant productivity improvements in the acquired plants. The improvements become visible in the acquisition year and continue in subsequent periods. After three years, the acquired plants exhibit a 13.5 percent higher productivity than the control group. The rise in productivity is a result of restructuring, as acquired plants increase investment outlays, employment and wages. Foreign ownership also appears to enhance the integration of plants into the global economy through increased exports and imports. Second, productivity improvements and evidence of restructuring are also found in the context of foreign privatizations.

Many developing countries strive to attract FDI inflows in the hope of stimulating economic growth through knowledge transfer. Our results strengthen the view that foreign ownership *per se* lies at the root of substantial benefits for plant performance in Indonesia and other developing countries. This finding is important, as the existence of a positive direct effect is a precondition for knowledge spillovers from FDI. Although the evidence of such spillovers is mixed (Haddad and Harrison 1993, Aitken and Harrison 1999), some studies with a focus on vertical spillovers have identified positive effects of FDI further down the value chain (Javorcik 2004), also in Indonesia (Blalock and Gertler 2008). Such spillover effects, however, would be hardly credible if there was not a causal link between FDI and above-average performance. This paper has provided evidence that foreign ownership can indeed be at the root of high performance in developing economies such as Indonesia.

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Table 1. Summary statistics

Variable	No. of obs.	Mean	Std dev
ln(TFP index)	199,479	0.61	0.82
Δln(TFP index)	164,130	0.09	0.40
ln(Labor productivity)	308,358	2.89	1.25
ln(Output)	308,439	7.83	2.05
ln(Employment)	308,439	4.14	1.16
ln(Average wage)	308,434	7.15	1.18
ln(Investment)	304,938	1.60	3.14
ln(Investment in machinery)	283,771	1.11	2.47
Exporter dummy	308,439	0.09	0.29
Export share (%)	212,727	10.54	28.24
Share of imported inputs (%)	295,793	9.42	24.52
ln(Capital stock/employment)	203,264	3.28	1.50
White collar workers/Total workers	252,447	0.14	0.15
Capacity utilization (%)	171,915	67.39	27.67
Age	291,806	13.26	14.19
Loan-financed investment/Output	252,897	10.93	564.26
Year	308,439	1993	5.06

Table 2. Probit results. Predicting foreign acquisitions

TFP_{t-1}	0.060**	$Capital\ per\ worker_{t-1}$	0.126***
	(0.030)		(0.020)
ΔTFP_{t-1}	-0.009	$Capital\ per\ worker_{t-1}$ * Age	-0.001
	(0.047)		(0.001)
$Employment_{t-1}$	1.009***	$Capital\ per\ worker_{t-1}$ * $Exporter_{t-1}$	-0.061**
	(0.129)		(0.028)
$Employment_{t-1}^2$	-0.073***	$Exporter_{t-1}$	0.326***
	(0.012)		(0.122)
$Skilled\ labor\ share_{t-1}$	0.493***	$Public\ ownership_{t-1}$	-0.259***
	(0.120)		(0.096)
$Average\ wage_{t-1}$	0.133***	$Investment_{t-1}$	-0.010**
	(0.032)		(0.005)
$Imported\ input\ share_{t-1}$	0.312***	$Loan\text{-}financed\ investment_{t-1}/Output_{t-1}$	0.00003
	(0.057)		(0.00008)
Age_t	-0.036***	Time trend	0.010
	(0.006)		(0.009)
Age_t^2	.0004***	Crisis	0.144**
	(0.000)		(0.062)
No. of obs.	107,183		
Chi^2	859.97		
$Prob > Chi^2$	0.00		
Pseudo R^2	0.17		

The table reports probit coefficients followed by standard errors in parentheses.
*, **, *** indicate statistical significance at the 10, 5 and 1% level, respectively. The model includes an intercept which is not reported.

Table 3. Matching results for productivity

		ln(TFP)		
	Pre-acquisition Year	Acquisition year[(a)]	One year later[(b)]	Two years later[(c)]
Treatment group	0.864	1.079	1.142	1.215
Control group	0.867	0.976	1.022	1.083
ATT		**0.106*** (0.034)**	**0.122*** (0.045)**	**0.135*** (0.051)**
No. of matched pairs		297	297	297
		ln(Labor Productivity)		
Treatment group	4.28	4.50	4.60	4.62
Control group	4.20	4.14	4.06	4.05
ATT		**0.280*** (0.072)**	**0.459*** (0.074)**	**0.489*** (0.088)**
No. of matched pairs		392	392	392

The first two lines present the outcomes observed in the given time period. Average Treatment Effect on the Treated (ATT), bootstrapped standard errors in parentheses. *, **, *** indicate statistical significance at the 10, 5 and 1% level, respectively.

(a) $ATT = \frac{1}{n}\sum_1^n\left(\ln TFP^{treated}_{acquisition\ year} - \ln TFP^{control}_{acquisition\ year}\right) - \frac{1}{n}\sum_1^n\left(\ln TFP^{treated}_{pre\text{-}acquisition\ year} - \ln TFP^{control}_{pre\text{-}acquisition\ year}\right)$

(b) $ATT = \frac{1}{n}\sum_1^n\left(\ln TFP^{treated}_{acquisition\ year-1} - \ln TFP^{control}_{acquisition\ year-1}\right) - \frac{1}{n}\sum_1^n\left(\ln TFP^{treated}_{pre\text{-}acquisition\ year} - \ln TFP^{control}_{pre\text{-}acquisition\ year}\right)$

(c) $ATT = \frac{1}{n}\sum_1^n\left(\ln TFP^{treated}_{acquisition\ year-2} - \ln TFP^{control}_{acquisition\ year-2}\right) - \frac{1}{n}\sum_1^n\left(\ln TFP^{treated}_{pre\text{-}acquisition\ year} - \ln TFP^{control}_{pre\text{-}acquisition\ year}\right)$

Table 4. Matching results for output, employment and wages

	Pre-acquisition Year	Acquisition year	One year later	Two years later
		ln(Output)		
Treatment group	10.62	11.06	11.16	11.18
Control group	10.59	10.55	10.52	10.46
ATT		**0.493*** (0.078)**	**0.618*** (0.070)**	**0.696*** (0.076)**
No. of matched pairs		392	392	392
		ln(Employment)		
Treatment group	5.55	5.76	5.79	5.78
Control group	5.60	5.62	5.63	5.61
ATT		**0.188*** (0.044)**	**0.205*** (0.048)**	**0.217*** (0.039)**
No. of matched pairs		392	392	392
		ln(Average wage)		
Treatment group	8.02	8.44	8.65	8.75
Control group	8.01	8.16	8.32	8.40
ATT		**0.272*** (0.043)**	**0.320*** (0.048)**	**0.344*** (0.055)**
No. of matched pairs		392	392	392

The first two lines present the outcomes observed in the given time period,, followed by the Average Treatment Effect on the Treated (ATT), with bootstrapped standard errors in parentheses. *, **, *** indicate statistical significance at the 10, 5 and 1% level, respectively.

Table 5. Matching results for total investment and investment in machinery

	Pre-acquisition Year	Acquisition year	One year later	Two years later
		ln(Investment)		
Treatment group	3.644	4.662	4.145	3.641
Control group	4.041	3.857	3.672	3.053
ATT		**1.201*** (0.402)**	**0.869** (0.402)**	**0.984** (0.391)**
No. of matched pairs		366	366	366
		ln(Investment in machinery)		
Treatment group	3.388	4.038	3.623	3.218
Control group	3.620	3.302	2.836	2.662
ATT		**0.969** (0.434)**	**1.019** (0.441)**	**0.789* (0.434)**
No. of matched pairs		219	219	219

The first two lines present the outcomes observed in the given time period,, followed by the Average Treatment Effect on the Treated (ATT), with bootstrapped standard errors in parentheses. *, **, *** indicate statistical significance at the 10, 5 and 1% level, respectively.

Table 6. Matching results for export and import shares

	Pre-acquisition Year	Acquisition year	One year later	Two years later
		Export share (%)		
Treatment group	22.3	25.8	29.6	33.4
Control group	23.6	23.8	20.7	20.9
ATT		**3.3**	**10.3*** **	**13.9*** **
		(2.8)	**(2.5)**	**(2.6)**
No. of matched pairs		331	331	331
		Share of imported inputs (%)		
Treatment group	27.4	37.6	37.3	36.7
Control group	26.6	26.8	26.2	24.8
ATT		**10.0*** **	**10.3*** **	**11.0*** **
		(2.0)	**(2.5)**	**(2.0)**
No. of matched pairs		374	374	374

The first two lines present the outcomes observed in the given time period,, followed by the Average Treatment Effect on the Treated (ATT), with bootstrapped standard errors in parentheses. *, **, *** indicate statistical significance at the 10, 5 and 1% level, respectively.

Table 7. Mahalanobis Matching results for TFP

Matching on Mahalanobis distance including a loan dummy for the pre-acquisition period				
	Pre-acquisition year	Acquisition year	One year later	Two years later
Treatment group	0.860	1.078	1.140	1.213
Control group	0.828	0.897	0.972	1.085
ATT		**0.148*** **	**0.135** **	**0.096* **
		(0.046)	**(0.057)**	**(0.056)**
No. of matched pairs		298	298	298
Matching on Mahalanobis distance including the average investment in the post-acquisition years				
	Pre-acquisition year	Acquisition year	One year later	Two years later
Treatment group	0.855	1.068	1.123	1.199
Control group	0.859	0.899	0.972	1.072
ATT		**0.173*** **	**0.156** **	**0.130* **
		(0.055)	**(0.073)**	**(0.072)**
No. of matched pairs		279	279	279

The additional matching variable in the top panel is a dummy taking on a value of one if a plant was making interest payments in pre-acquisition (matching) period, and zero otherwise.The first two lines present the outcomes observed in the given time period,, followed by the Average Treatment Effect on the Treated (ATT), with bootstrapped standard errors in parentheses. *, **, *** indicate statistical significance at the 10, 5 and 1% level, respectively.

Table 8. Foreign versus domestic privatizations.
Matching results for TFP and labor productivity

	Pre-acquisition year	Acquisition year	One year later	Two years later
		ln(TFP index)		
Treatment group	0.880	0.915	1.029	1.115
Control group	1.067	0.881	0.908	1.035
ATT		**0.220****	**0.308****	**0.267***
		(0.104)	**(0.140)**	**(0.149)**
No. of matched pairs		59	59	59
		ln(Labor productivity)		
Treatment group	4.656	4.691	4.708	4.780
Control group	4.765	4.412	4.428	4.456
ATT		**0.388****	**0.390***	**0.434****
		(0.169)	**(0.205)**	**(0.221)**
No. of matched pairs		80	80	80

The first two lines present the outcomes observed in the given time period,, followed by the Average Treatment Effect on the Treated (ATT), with bootstrapped standard errors in parentheses. *, **, *** indicate statistical significance at the 10, 5 and 1% level, respectively.

Table 9. Foreign versus domestic privatizations,
Matching results for output, employment, wages and skill intensity

	Pre-acquisition Year	Acquisition year	One year later	Two years later
		ln(Output)		
Treatment group	10.96	11.03	11.12	11.15
Control group	11.17	10.82	10.86	11.02
ATT		**0.416****	**0.464****	**0.333***
		(0.177)	**(0.190)**	**(0.196)**
No. of matched pairs		80	80	80
		ln(Employment)		
Treatment group	5.57	5.60	5.66	5.65
Control group	5.67	5.76	5.79	5.85
ATT		**-0.065**	**-0.034**	**-0.107**
		(0.092)	**(0.120)**	**(0.123)**
No. of matched pairs		80	80	80
		ln(Average wage)		
Treatment group	8.36	8.40	8.64	8.80
Control group	8.80	8.46	8.51	8.66
ATT		**0.382*****	**0.579*****	**0.589*****
		(0.145)	**(0.140)**	**(0.179)**
No. of matched pairs		80	80	80
		Share of while collar workers		
Treatment group	0.264	0.258	0.264	0.272
Control group	0.275	0.229	0.193	0.206
ATT		**0.040**	**0.082***	**0.078***
		(0.035)	**(0.047)**	**(0.045)**
No. of matched pairs		47	47	47

The first two lines present the outcomes observed in the given time period,, followed by the Average Treatment Effect on the Treated (ATT), with bootstrapped standard errors in parentheses. *, **, *** indicate statistical significance at the 10, 5 and 1% level, respectively.

Appendix I: Balancing tests

The first test examines the balancing hypothesis by regressing each variable included in the propensity score on the quartic function of the propensity score and its interactions with the treatment dummy. The statistic of interest pertains to the null that the coefficients on all of the terms involving the treatment dummy are equal to zero. Essentially, the test examines whether the treatment dummy provides any information about the explained variable, conditional on a quartic in the estimated propensity score. If the propensity score satisfies the balancing condition, it should not. The test is applied to the sample of the treated observations and all potential controls. In the table below, the results of the test appear under the heading of regression approach.

The second test is the simple t-test of the equality of means between the treated group and the matched control group.

The third test is a Hotelling T^2 test of the joint null of equal means of all the variables. It is applied to the treated and the matched control group.

Table A. Balancing tests

	Regression approach		**t-test on the matched sample**			
	F-stat	**p-value**	**Treated group mean**	**Control group mean**	**t-test**	**p-value**
ln TFP index lag	0.11	0.735	0.864	0.867	0.043	0.966
Change in ln TFP index lag	2.41	0.121	0.116	0.132	0.452	0.651
ln Employment lag	1.23	0.267	5.632	5.630	-0.016	0.987
ln Capital per worked lag	0.23	0.630	4.462	4.382	-0.593	0.553
% imported materials lag	6.94	0.008	0.277	0.258	-0.641	0.522
ln Investment lag	0.19	0.665	3.903	4.309	1.095	0.274
Share white collar workers lag	0.01	0.923	0.232	0.242	0.653	0.514
Public ownership dummy lag	0.05	0.830	0.040	0.061	1.124	0.262
Age lag	0.00	0.952	10.283	10.599	0.326	0.744
Exporter lag	0.67	0.415	0.273	0.300	0.725	0.469
Loan amount/Output lag	0.00	0.947	2.306	0.516	-1.751	0.080
ln Average wage lag	0.13	0.723	8.077	8.025	-0.743	0.458
No. of obs.	107183		297	297		

	T^2	**F-stat**	**p-value**	**No. of obs.**
Hotelling test	9.542	0.780	0.671	594

Appendix II: Including short-lived acquisitions

Table B. Matching results for productivity including short-lived acquisitions

		ln(TFP)		
	Pre-acquisition Year	Acquisition year	One year later	Two years later
Treatment group	0.819	0.975	1.046	1.125
Control group	0.790	0.863	0.931	1.023
ATT		**0.084*** **	**0.086*** **	**0.073** **
		(0.020)	**(0.015)**	**(0.032)**
No. of matched pairs		436	436	436
		ln(Labor Productivity)		
Treatment group	4.11	4.26	4.32	4.28
Control group	4.00	3.91	3.88	3.93
ATT		**0.244*** **	**0.333*** **	**0.245*** **
		(0.036)	**(0.085)**	**(0.063)**
No. of matched pairs		609	609	609

The first two lines present the outcomes observed in the given time period. Average Treatment Effect on the Treated (ATT), bootstrapped standard errors in parentheses. *, **, *** indicate statistical significance at the 10, 5 and 1% level, respectively.