Pollution Havens or Halos?
Evidence from Foreign Acquisitions in Indonesia

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Abstract

The link between foreign ownership and environmental performance remains a controversial issue. This paper contributes to our understanding of this subject by analyzing the impact of foreign acquisitions on plant-level environmental performance. The analysis applies a difference-in-differences approach combined with coarsened exact matching (CEM) to the data from the Indonesian Manufacturing Census for the period 1983-2001. It covers 264 acquisition cases where an acquired plant is observed a year before and at least three years after an ownership change and for which a carefully selected control plant exists. The results suggest that while foreign ownership increases the overall energy usage, due to expansion of output, it decreases the plant's energy intensity.

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1 Introduction

For many developing countries, foreign direct investment (FDI) can serve as an important source of economic development. In addition to bringing capital and creating jobs, FDI stimulates economic growth by enhancing firm-level efficiency. It does so directly by transferring cutting-edge technologies and management practices to its affiliates (Arnold and Javorcik, 2009; Chen, 2011; Javorcik and Poelhekke, 2016) and by encouraging product and process innovation (Guadalupe et al., 2012) as well as indirectly through knowledge spillovers (Javorcik, 2004).

The spectacular growth in FDI flows, along with the increasing importance of developing countries as host countries, has raised concerns about the potential effect of FDI on the natural environment (Zarsky, 1999). On the one hand, environmentalists argue that highly polluting multinationals relocate to countries with weaker environmental standards in order to circumvent costly regulations in their home country and in this way increase pollution levels not only in host countries but also globally. This notion has been labelled as "pollution haven hypothesis".[1] On the other hand, supporters of globalization point out that FDI has a positive effect on natural environment because multinationals often have more efficient and cleaner technologies than their domestic counterparts. This possibility is referred to as "pollution halo hypothesis".[2] Since the existing literature (reviewed below) has produced mixed results, the issue remains controversial.

This study contributes to our understanding of the link between FDI and environmental protection by taking a novel approach. Rather than examining whether FDI flows are influenced by environmental standards in the destination countries or whether polluting industries are more likely to engage in FDI, we examine the impact of foreign acquisitions on environmental performance of acquired plants. We use plant-level panel data from the Indonesian Manufacturing Census covering the period 1983-2001. To establish a causal effect of foreign acquisitions on plant performance, we combine a difference-in-differences approach with coarsened exact matching (CEM). This allows us to account for selection on observables and to control for unobservable time-invariant plant heterogeneity. To the best of our knowledge, this study is the first to employ such an approach in determining the effect of foreign ownership on plant-level environmental performance.

Our analysis is based on 264 foreign acquisition cases where an acquired plant is observed a year before and at least three years after an ownership change and for which a carefully selected control plant exists. The results suggest that while foreign ownership increases total energy use and carbon dioxide (CO_2) emissions in acquired plants due to expansion of the production scale, it lowers the

[1] Anecdotal evidence abound. For instance, in 2013, the smoke haze from Indonesia's palm oil production, which was dominated by foreign investors, elevated to dangerous levels and caused significant health hazards not only in Indonesia, but also in Malaysia and Singapore (Chachavalpongpun, 2013).

[2] Rondinelli and Berry (2000) list a number of examples showcasing how multinationals and their affiliates help improve the environmental condition of their host country.

energy- and therefore emission-intensity of output. We also find that, in Indonesia, acquired firms rely more on electricity in expanding its production, most likely due to the relatively low unit cost of this energy source.

The results of our study have broader implications, particularly in terms of promoting "green growth" in response to the threats of climate change and environmental degradation.[3] Recently, there has been an increasing recognition of the role of FDI in fostering green growth (Golub et al., 2011). Our results show that FDI can serve as a channel for international transfer of environmentally-friendly technologies and practices, thus directly contributing to environmental progress. Our results also provide direction on how to maximize the positive environmental benefits of FDI, which not only includes attracting foreign investors but also formulating policies that directly affect factor prices (e.g., electricity rates).

Our paper contributes to the literature examining how foreign ownership influences plant-level environmental performance. There are very few studies in this literature, and the evidence is still mixed. In a pioneering study, Eskeland and Harrison (2003) use plant-level data from Cote d'Ivoire, Mexico and Venezuela and find that the energy share, i.e., the cost of energy use divided by the total value of the plant's output, is negatively related to foreign ownership. Using plant-level data from Ghana, Cole et al. (2008) find that foreign ownership does not influence fuel use or total energy use but is found to increase electricity use. Due to data limitations, neither of these studies is able to take into account selection into foreign ownership (the possibility that foreign investors choose to acquire local plants with better environmental performance) or unobservable plant heterogeneity, which an improvement we implement in our analysis. Unlike these studies, we are also able to measure energy use in physical units and provide a more detailed analysis on the types of energy used.[4]

Our study is also related to the broader literature which asks whether FDI (and particularly FDI in polluting industries) is attracted to countries or locations within countries with weaker environmental standards. The studies that consider FDI from industrialized countries to developing economies find no or very little support for the pollution haven hypothesis (Eskeland and Harrison, 2003; Javorcik and Wei, 2004; and Dean et al., 2009). In contrast, Keller and Levinson (2002), who study pattern of international investments into the US states, conclude that abatement costs have moderate deterrent effects on foreign investment.[5]

[3]The OECD defines green growth as the pursuit of economic growth and development, while preventing costly environmental degradation, climate change, biodiversity loss and unsustainable natural resource use.

[4]In a related study, Cole et al. (2011) consider per-capita emissions of pollutants in 112 major Chinese cities during the 2001-4 period. They find that the share of output of foreign-owned firms increases emissions while output of firms from Hong Kong, Macao, and Taiwan either reduces pollution or has no effect. The aggregated nature of the data (city level) makes it difficult to draw conclusions about pollution haven or halo hypothesis.

[5]There is also a related literature investigating the impact of environmental regulations on trade flows (e.g. see, for example, Ederington et al., 2005; Levinson and Taylor, 2008; Kellenberg, 2009).

Finally, our work makes a contribution to the relatively new literature examining the effects of foreign acquisitions on the acquired plants (Arnold and Javorcik, 2009; Chen, 2011; Guadalupe et al., 2012; Wang and Wang, 2015). We enhance our understanding of this issue by pointing out the positive impact of foreign ownership on plant-level environmental performance, an outcome that has not been considered by the existing studies.

The rest of the paper is organized as follows. Sections 2 and 3 describe the data and empirical strategy, respectively. Section 4 discusses the results. Section 5 concludes the paper and discusses its policy implications.

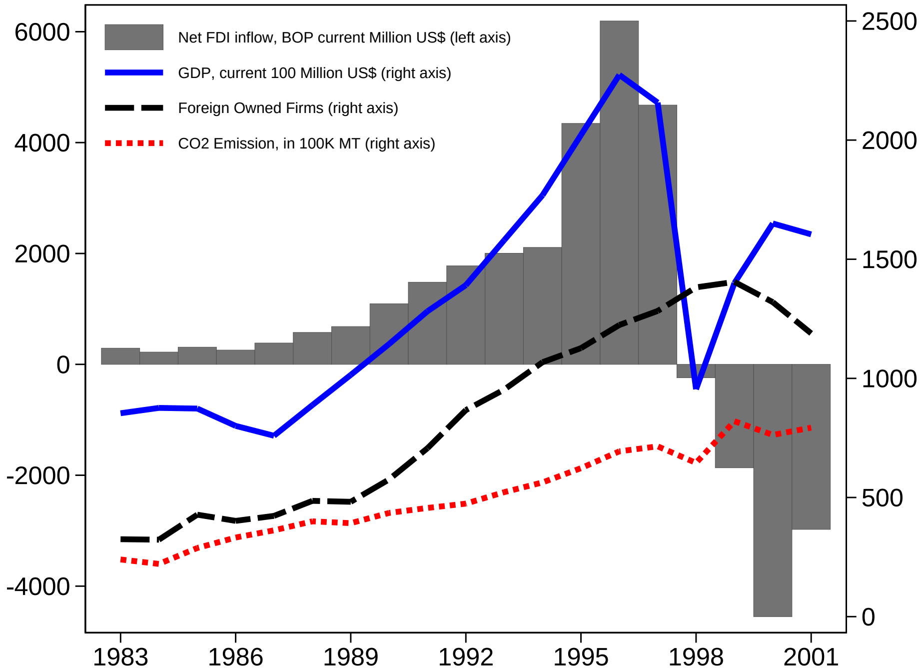
2 Data

2.1 Background information

Indonesia is a suitable setting for studying the effects of foreign acquisitions on plant-level environmental performance for two reasons. First, the country received significant inflows of FDI, ranking as the 5^{th} largest recipient of FDI among developing countries in the mid 1990s (see Arnold and Javorcik, 2009). The influx of FDI was in part driven by significant reductions in trade barriers and industrial deregulation in the early 1980s and 1990-1996. The period of high capital inflows also coincided with economic recessions in the United States, Japan and some European countries. During this period, competing FDI destinations, such as Thailand, experienced a rise in labor cost and had limited infrastructure, which may have prompted investors to reallocate their portfolios to other emerging economies, including Indonesia. Second, as pointed out by Garcia et al. (2007), environmental protection in Indonesia was generally weak and ineffective during the country's impressive industrial growth in the 1980s and 1990s. Thus the results of our analysis will not be influenced by pollution-related policies in the host country and will give us a cleaner picture of the impact of FDI on environmental performance.

Figure 1 illustrates Indonesia's net FDI inflows, Gross Domestic Product (GDP), CO_2 emissions and the number of foreign-owned plants from 1983 to 2001. The vertical bars represent the net FDI inflows from balance-of-payment statistics measured in million US$ (left axis), the solid line indicates the country's GDP in 100 million US$, the dashed line is the number of foreign-owned plants (calculated based on the Census of Manufacturing) and the dotted line is the CO_2 emission in 100,000 metric tons (MT), all scaled by the right axis. The graph shows an upward trend in all the variables, with the number of foreign plants picking up in 1984, followed by GDP and net FDI flows around 1987. Interestingly, GDP increased at a much faster pace than did emissions, suggesting that emissions per dollar unit of output may have declined during the period. Both GDP and FDI inflows experienced a significant decline following the 1997-1998 Asian financial crisis.

Figure 1: Indonesia's Net FDI inflows, Gross Domestic Product, CO_2 Emissions and Foreign-Owned Firms, 1983-2001



Sources of Data: The World Bank, Oak Ridge National Laboratory, Indonesian Census of Manufacturing

2.2 Data sources

We use data from *Survei Manufaktur*, the Indonesian Census of Manufacturing conducted by the National Statistical Office (BPS). The data encompass all manufacturing plants with 20 or more employees on an annual basis since 1975. The census has detailed information on fuel and electricity use, both in terms of values and physical quantities.[6] The sample available to us spans the period from 1983 to 2001 covering about 40,000 plants with 300,893 plant-year observations, of which 11,436 observations belong to plants that are owned by foreign companies during the period.

Following Arnold and Javorcik (2009), we define foreign acquisition as a change in the foreign ownership share from below 20% to at least 20%. The exact value of the threshold does not matter because more than 99% of the future acquisition targets have foreign capital share equal to zero in the pre-acquisition period. And in 95% of the cases, the post-acquisition foreign ownership shares is at least 25%. In more than 75% of cases, it is at least 50% (Figure 2).

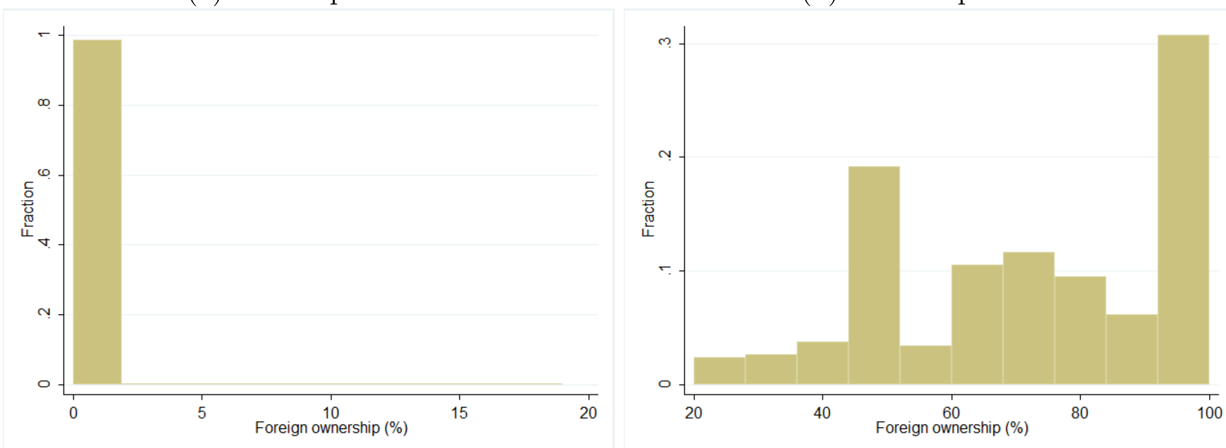
Foreign acquisitions are distributed across a wide range of industries. The main one is manufactur-

[6]The survey questionnaires and other relevant information about the dataset can be accessed online at http://www.rand.org/labor/bps/statistik_industri.html.

ing of fabricated metal products, machinery and equipment which comprises 22.48% of the plants in the sample data. 22.09% of the plants are involved in textile and wearing apparel industries, while 20.08% are involved in manufacturing chemical products.[7]

Figure 2: Distribution of Foreign Ownership, 1983-2001.

(a) Pre-Acquisition (b) Post-Acquisition



Source: Indonesian Census of Manufacturing

Table 1 provides summary statistics for foreign-owned and domestic plants. Foreign-owned plants dominate domestic plants in almost all economic variables. For example, plants under foreign ownership are on average much bigger, have more skilled labor, rely more on international markets and are more capital intensive. In terms of environmental attributes, they spend more on energy and emit more CO_2. Their production process is, however, less energy intensive and produces lower CO_2 emissions per 1000 Rps. of output.

2.3 Measuring Energy Usage and Emissions

The data set includes plant-level expenditures (in Rps) and physical usage (e.g. in metric tons or liters) of each energy input. The energy inputs consist of fuels and lubricants and electricity use. Fuels and lubricants are divided into more detailed inputs, which include gasoline, diesel, diesel oil, kerosene, lubricant, bunker oil, coal, coke, public gas, liquefied petroleum gas (LPG), firewood, and charcoal. We have information on the amount of fuels and lubricants that are used for electricity generation, as some of the plants produce electricity for their own consumption and for sale to other end users.

Our data set also includes information on the amount of electricity sold and the amount bought from the state-owned power company Perusahaan Listrik Negara (PLN) and from other independent

[7] For more description on the distribution of foreign-owned plants by industry, see Figure A.I in the Appendix.

Table 1: Summary Statistics

Variables	Domestic plants			Foreign-owned plants		
	Obs	Mean	Std. Dev.	Obs	Mean	Std. Dev.
Economic						
Output (in Million RP)	288,988	25.364	280.392	27,142	172.487	550.806
Employment (no. of workers)	288,973	150.490	572.316	27,136	471.725	835.262
Unskilled workers	238,225	119.925	472.837	20,639	374.13	689.481
Skilled workers	237,822	25.324	134.587	20,580	78.109	159.290
Capital (in MillionRP)	189,156	25.624	1,773.008	17,896	132.54	1,530.973
Materials (in Million RP)	288,990	13.259	135.387	27,142	87.382	319.038
Per worker wage (in Million RP)	288,990	2.587	36.978	27,142	8.544	41.578
Investment in machineries (in Million RP)	233,694	9.215	268.481	23,705	57.05	780.722
Exporter Dummy	289,266	0.082	0.274	27,182	0.273	0.446
Share of exports	289,266	6.310	22.410	27,182	21.449	37.612
Share of imported materials	289,266	0.117	0.286	27,182	0.382	0.405
Capital-Labor ratio	189,146	117.450	7,439.627	17,894	326.254	3630.247
Share of skilled workers	237,822	0.136	0.145	20,580	0.218	0.186
Public ownership dummy	289,266	0.032	0.177	27,182	0.038	0.192
Age	273,844	13.406	14.196	25,098	11.942	14.935
Environmental						
Energy Expenditure (in Million RP)	228,153	0.695	9.257	27,132	2.763	14.33
Energy Use ('000 MBTUs)	228,153	16.536	291.464	20,631	89.977	536.51
CO2 Emission (M Kg)	228,151	1.280	22.283	20,631	7.295	45.773
Energy Expenditure Intensity	228,153	0.048	0.072	27,132	0.027	0.05
Energy Use Intensity (MBTUs/RP)	228,153	0.986	1.758	20,631	0.736	1.71
Emission Intensity (KgCO2/RP)	228,151	78.428	141.848	20,631	57.857	127.237
No. of Plants		39,652			2,970	

Source: Indonesian Census of Manufacturing

power producers (non-PLN). In terms of calculating total energy used, we use total electricity net of electricity sold. In principle, we should have adjusted the total amount of fuel used to account for fuel used to generate electricity that was sold. However, none of the plants in the matched sample has been engaged in selling electricity.[8]

The original data set includes 300,893 observations. 61,561 observations in our data set contain positive energy expenditure on a particular energy input but do not include the information on energy use in physical units. We impute the plant-level physical energy consumption using the following equation:

$$lny_{it} = \beta lnCost_{it} + ISIC_k + PROV_l + YEAR_m + u_{it} \quad (1)$$

[8] Of the 40,773 plants in the original dataset, 17,148 plants have produced some amount of electricity, of which 59 plants have sold electricity.

where y_{it} is the physical measure of energy inputs (e.g. gasoline in liters) and $Cost_{it}$ is total cost of energy inputs (e.g. gasoline in '000 Rps). $ISIC$, $PROV$ and $YEAR$ are industry (ISIC 4-digit level), province and year fixed effects, respectively. We estimate this specification separately for each energy input.[9] In this way, we impute the usage of each energy input in physical units. Except for kerosene, the model predicts more than 90% of the variation of energy use in physical units.[10]

The energy content of each energy input (in British Thermal Units or BTUs)[11] is calculated using conversion factors from reliable US agencies and institutions found in Table A.II.[12]

Among the key variables of interest are energy intensity (defined in two ways), and pollution intensity. Following Eskeland and Harrison (2003), we first define energy intensity as total expenditure on energy per 1000 Rps of output.[13] It is plausible that acquired firms, possibly due to greater reliance on international markets, use technologies that utilize more expensive but cleaner and more energy-efficient energy inputs. Thus, energy expenditure per unit of output may remain constant (or even increase) but actual energy use (in BTUs) per unit of output may decline. In order to address this issue, we also express energy intensity as the total physical energy use (in MBTUs) per currency unit of output. We replicate the same process to calculate a plant's pollution intensity, which is defined as total carbon dioxide emissions (in kg CO_2) per currency unit of output. See Table 1 for summary statistics.

3 Empirical Strategy

The empirical strategy used to identify the causal effect of foreign ownership on plant-level environmental performance is anchored on three foundations. First, the study focuses on the changes from domestic to foreign ownership taking place within the same plant. In particular, we consider

[9] Table A.I reports the list of energy inputs as well as the goodness-of-fit in estimating equation 1.

[10] There are also observations where there are physical units but total cost is missing. We regard these observations as missing in the data.

[11] British Thermal Unit (BTU) is a traditional unit of energy. The US-EIA interprets BTU as the amount of energy needed to heat one pound of water from 39 to 40 degrees Fahrenheit (EIA, 2011).

[12] A sample calculation of the energy usage of a plant using 100 barrels of diesel fuel at a certain time period is illustrated below:

$$\text{100 barrels diesel x } \frac{\text{5.825 million BTUs (MBTUs)}}{\text{1 barrel}} = \text{582.50 MBTUs}$$

We follow the same procedure for calculating CO_2 emission (in kg CO_2). Using the same example above, we calculate the CO_2 emission as below:

$$\text{582.50 MBTUs x } \frac{\text{71.80 kg CO}_2}{\text{1 MBTU}} = 41,845.04 \text{ kg CO}_2$$

[13] Except for energy, all inputs and outputs are deflated using a set of 192 wholesale price indices for manufactured commodities published by the BPS. Energy expenditure is deflated using a CPI specific to energy (Arnold and Javorcik, 2009).

plants that are observed for at least four consecutive years with initially less than 20% foreign equity and at least 20% of equity belonging to foreign owners thereafter. By focusing on ownership change we are able to take into account the selection bias that would plague a comparison of domestic plants to all foreign plants, due to the possibility that foreign affiliates may choose the most energy-efficient domestic plants. This approach, however, dramatically reduces the number of observations that can be considered. Fortunately, thanks to large FDI inflows into Indonesia during the sample period, we are able to observe 264 acquisition cases, which is in our view a large enough number to allow us to generalize the results with confidence.

Second, we use a difference-in-differences approach to compare the performance of foreign-acquired plants with the performance of plants remaining in domestic hands. This approach eliminates the influence of all unobservable non-random elements of the acquisition decision that are constant or strongly persistent over time.

A key challenge is how to develop a reasonable estimate of the counterfactual, that is, the change in the variables of interest that would have been observed had the acquisition not occurred. We employ a one-to-one coarsened exact matching (CEM) procedure following Iacus et al. (2009) and Iacus et al. (2011) to identify a control plant for each plant acquired by foreign investors. We choose CEM over methods that rely on estimating a propensity score matching because CEM guarantees balance on all higher order moments and interactions on all variables.[14]

We ensure that each acquired plant is paired with a domestic plant that is operating in the same sector and year and has very similar preacquisition output, energy use, emission level, and trends of energy consumption and emissions (see Table 2 for a list of variables used in matching samples). With these similarities in characteristics, we assume that the two plants would have performed in a similar way in the absence of ownership change and thus any divergence in their paths of performance is attributed to the change in ownership.

We assess how our matching performs by comparing the sample means between the treatment group (acquired plants) and the control group (plants remaining in Indonesian hands). As evident from Table 2, there is no statistically significant difference in the means of pre-acquisition characteristics between the treatment and the control group.

[14] The application of CEM is not without precedence. For example, Wang et al. (2010) use CEM to estimate the magnitude of spillovers generated by academic "superstars" to their collaborators' publication rates. Singh and Agrawal (2011) use the same matching technique to determine how firms are making use of their recruits' prior stock of ideas. Beatty and Tuttle (2015) employ CEM in studying the effect of the unprecedented increase in Supplemental Nutrition Assistance Program on participants' expenditure on food.

Table 2: Balancing Test.

Variables	Unmatched sample (N=298,868)				Matched sample (pre-acquisition period, N=528)			
	Domestic	Foreign	Diff.	p-value	Control Plants	Acquired	Diff.	p-value
Used in matching								
Log (real output)	7.665	9.492	-1.827	0.000	9.298	9.311	-0.013	0.932
Log (energy expenditure)	3.854	5.542	-1.689	0.000	5.378	5.396	-0.018	0.914
Log (energy use)	6.785	8.470	-1.685	0.000	8.286	8.314	-0.028	0.874
Log (CO_2 emission)	11.169	12.866	-1.697	0.000	12.674	12.713	-0.040	0.818
Log (energy expenditure) Trend	0.046	0.075	-0.029	0.008	0.120	0.093	0.026	0.637
Log (energy use) Trend	0.048	0.073	-0.024	0.037	0.105	0.088	0.017	0.769
Log (CO_2 emission) Trend	0.050	0.075	-0.025	0.032	0.102	0.087	0.016	0.780
Not used in matching								
Log (energy expenditure/output)	-3.828	-3.905	0.077	0.000	-3.928	-3.924	-0.004	0.971
Log(energy use/output)	-0.896	-0.977	0.081	0.000	-1.019	-1.006	-0.014	0.904
Log(CO_2 emission/output)	3.487	3.418	0.069	0.000	3.368	3.393	-0.025	0.818
Log(energy exp./materials exp.)	-2.993	-3.034	0.041	0.042	-3.169	-3.069	-0.100	0.419
Log (employment)	4.063	5.027	-0.964	0.000	4.840	4.991	-0.151	0.133
Exporter dummy	0.082	0.175	-0.093	0.000	0.212	0.212	0.000	1.000
Share of imported materials	0.116	0.245	-0.129	0.000	0.169	0.241	-0.072	0.018
Share of skilled workers	0.136	0.196	-0.060	0.000	0.196	0.193	0.003	0.860
Log(investment in machineries)	5.358	7.376	-2.018	0.000	7.225	7.344	-0.120	0.652
Log (real output) Trend	0.051	0.066	-0.015	0.051	0.125	0.094	0.031	0.609
Log (energy expenditure/output) Trend	-0.003	-0.003	0.000	0.986	-0.007	0.002	-0.009	0.878
Log(energy use/output) Trend	0.000	-0.005	0.005	0.686	-0.021	-0.003	-0.019	0.769
Log(CO_2 emission/output) Trend	0.001	-0.003	0.004	0.735	-0.024	-0.005	-0.019	0.758
Log(energy exp./materials exp.) Trend	-0.009	-0.009	0.000	0.987	-0.003	-0.005	0.002	0.970

Source: Indonesian Census of Manufacturing

The same is true even for the plant characteristics that were not used in the matching procedure.[15] This is in contrast to the unmatched sample, shown in the left panel of Table 2, where the domestic plants are different in almost all the aspects, including their energy consumption, from the foreign owned plants.

After obtaining the matched pairs, we examine the effect of foreign acquisitions on outcomes of interest using a difference-in-differences approach. More specifically, we estimate the following equation on the matched sample which is observed in the pre-acquisition period and in one of the post-acquisition periods:

$$y_{it} = \alpha_i + \gamma Post_t + \beta(Post_t * Acquired_i) + \varepsilon_{it} \tag{2}$$

where i denotes a plant and t the time period. *Acquired* is an indicator variable denoting plants that undergo a foreign acquisition. *Post* is an indicator variable that takes on the value of unity in the year of foreign acquisition (or a subsequent year), and equals zero otherwise. Each plant is observed twice: once in the pre-acquisition and once in the post-acquisition period. We consider three post-acquisition years (the year when the transaction takes place and two subsequent years). Each of these years is considered in a separate estimation to produce cumulative effects. The coefficient of interest β captures the effect of acquisition on the acquired plants, the average treatment effect on the treated (ATT).

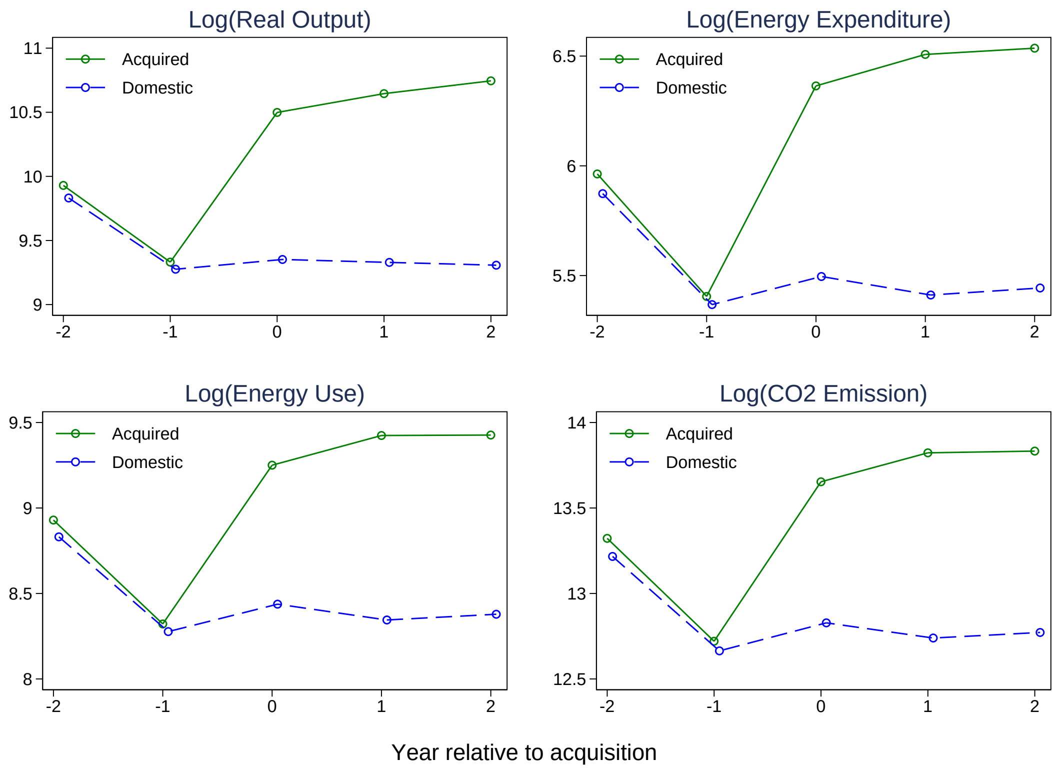
4 Results from the Difference-in-Differences Analysis on the Matched Sample

4.1 Output, Energy Consumption and CO_2 Emissions

We start by presenting the results capturing the *scale effect* of foreign acquisitions. This set of outcomes includes energy use, energy expenditure, CO_2 emission and output levels. The result suggest an increase in the use of energy, both in terms of value and physical units, and emission levels of the acquired plants, which is associated with an increase in output. This is visible in Figure 3 which graphs the trajectories of these variables for the treated (acquired plants) and the control group. Both groups display very similar paths two years prior to the ownership change. The paths start to diverge already in the acquisition year and the gap between the groups increases over the two subsequent years.

[15] The share of imported inputs is an exception, though this variable is neither used in matching nor considered as an outcome.

Figure 3: Trajectories of acquired and domestic plants: Output, energy expenditure and use, and CO_2 emissions.



The figure illustrates the average value of each variable of interest in a given time period for the treated and the control group. The horizontal axes indicate the year relative to the period a treated plant is acquired, where the year of acquisition is denoted with 0.

The effect of foreign acquisitions is formally tested by estimating equation 2 whose results are presented in Table 3. We find that acquired plants experience a statistically significant increase in energy expenditure of 0.815 log point (or about 126%) relative to the control group already during the acquisition year.[16] The difference between the two groups continues to increase to more than .998 log point (or more than 170%) in the subsequent two years. This expansion also holds for acquired plants' physical energy use and CO_2 emissions, although at a relatively lesser magnitude. This expansion in plant-level energy use and emissions is also accompanied by a significant increase in output, suggesting an expansion in the scale of operation associated with foreign acquisition.

To check the robustness of our findings, we consider a longer time horizon (5 years after the ownership change) and restrict our sample to plants for which the outcome of interest can be observed throughout this period (as well as during the two pre-acquisition years). This means that

[16]The change in the variable of interest associated with the foreign acquisition dummy is calculated as $e^{(\beta)} - 1$. In this context, the change is $e^{(-0.815)} - 1 = 1.26$.

Table 3: Regression results on output, energy and pollution levels.

	Acquisition Year	One Year Later	Two Years Later
Panel A	Log (Energy Expenditure, in Rps)		
Post*Acquired	**0.815*** **	**1.011*** **	**0.998*** **
	(0.129)	**(0.145)**	**(0.187)**
Adj. R^2	0.735	0.717	0.623
No. of Obs.	1005	951	902
Panel B	Log (Energy Use, in MTBUs)		
Post*Acquired	**0.750*** **	**0.995*** **	**0.948*** **
	(0.134)	**(0.152)**	**(0.191)**
Adj. R^2	0.738	0.716	0.635
No. of Obs.	1005	951	902
Panel C	Log (CO_2 Emission, in KgCO_2)		
Post*Acquired	**0.749*** **	**0.984*** **	**0.950*** **
	(0.133)	**(0.150)**	**(0.190)**
Adj. R^2	0.738	0.717	0.631
No. of Obs.	1005	951	902
Panel D	Log(Output, in Rps)		
Post*Acquired	**1.098*** **	**1.263*** **	**1.374*** **
	(0.119)	**(0.123)**	**(0.128)**
Adj. R^2	0.696	0.678	0.661
No. of Obs.	1056	1056	1056

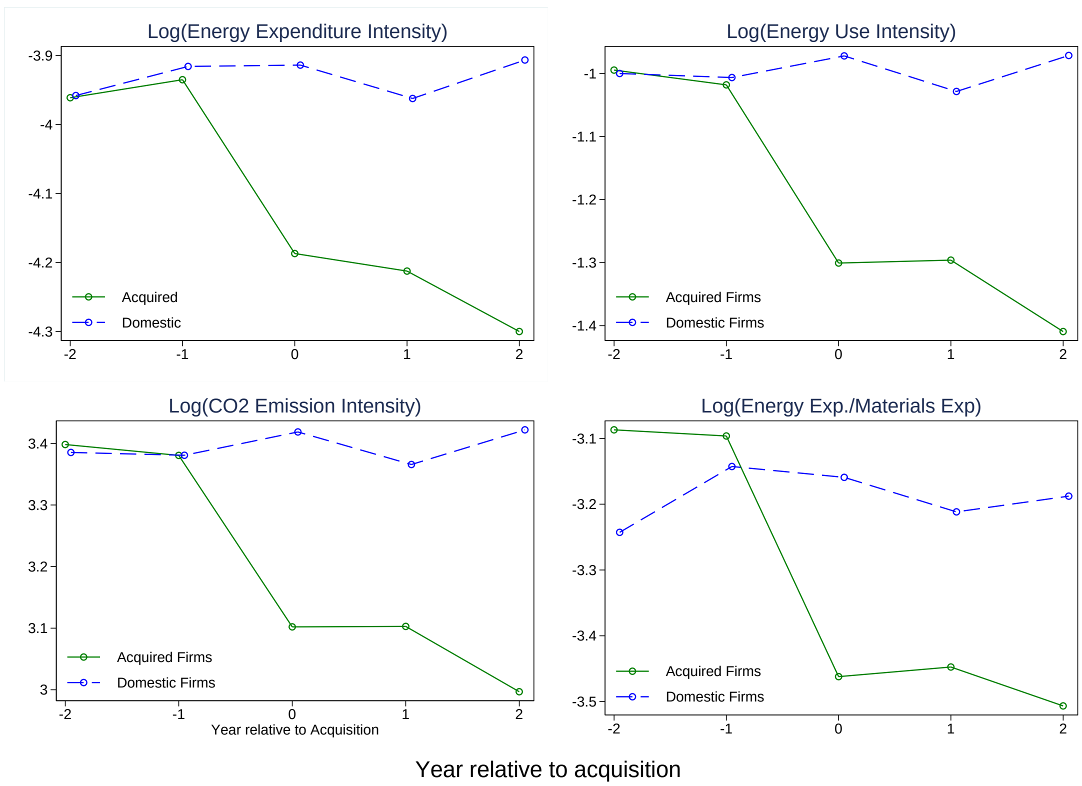
Note: The table reflects the result of estimating equation 2 on the matched sample described in Section 3. The dependent variables are as listed in each panel. Each column in each panel is a separate regression for a particular outcome variable covering two time periods: the year relative to acquisition (as listed in each column) and a year before foreign-owned plants were acquired. Heteroskedasticity-robust standard errors are in parentheses. *Post* dummy and plant fixed effects are included in all specifications. *, **, *** indicate statistical significance at 0.10, 0.05, and 0.01 level, respectively.

we compare the changes over time within the same sample of plants. As illustrated in Table A.III, our results are robust to this change. The estimated coefficients are significant in all specifications, and their magnitudes are slightly larger.

Next we focus on energy and emission intensities as measures of the *technique effect* of foreign acquisitions. These intensities are obtained by dividing energy consumption (measured either in monetary terms or in BTUs) and emissions by the total value of output. As illustrated in Fig 4, acquired plants experience a substantial decrease in their energy consumption and emissions per unit of output relative to the plants that remain in domestic hands.

We statistically validate these findings by estimating equation 2 and summarizing the results in Table 4. The estimated coefficient of interest is statistically significant in all specifications. The estimated magnitudes are also economically meaningful. They suggest that the share of energy cost in the total value of output falls in the acquired plants (relative to the control group) by 22% during the acquisition year, and further declines to 32% after two years. The decline in physical energy and carbon dioxide content of output is larger than the decline in the share of energy cost in total output. In terms of physical energy use, the acquired plants reduce their energy intensity by 27% during the acquisition year and by more than 35% two years after. We find a similar pattern for emission intensity, which suggests that acquired plants tend to use less energy intensive and cleaner production techniques. We show that the results are robust to focusing on plants observed for 5 years after the acquisition (see Table A.IV).

Figure 4: Trajectories of acquired and domestic plants: Intensities in energy expenditure, energy use, and CO_2 emission.



The figure illustrates the average of the variable of interest at a particular time period for matched acquired and domestic plants. The horizontal axes indicate the year relative to the period a treated plant is acquired (i.e. 0 is the year of acquisition and -1 is a year before the acquisition.)

As another test of the persistence of the estimated effects, we estimate the equation of interest focusing in the third, fourth and fifth year under foreign ownership (i.e., t+3, t+4, t+5). Naturally, the number of observations falls as the number of plants observed over a longer horizon falls. The results, presented in Table 5, confirm our hypothesis. We find statistically significant evidence of a widening difference between the energy use and emission intensities of plants acquired by foreign investors and domestic plants.

One drawback on normalizing energy use and CO_2 emissions by output is the potential increase in

Table 4: Regression results for plant-level energy and CO_2 intensities.

	Acquisition Year	One Year Later	Two Years Later
Panel A	Log(Energy Expenditure/Output)		
Post*Acquired	**-0.253****	**-0.239***	**-0.382****
	(0.111)	**(0.126)**	**(0.153)**
Adj.R^2	0.543	0.483	0.407
No. of Obs.	1005	951	902
Panel B	Log(Energy Use/Output)		
Post*Acquired	**-0.318*****	**-0.255***	**-0.432*****
	(0.115)	**(0.134)**	**(0.157)**
Adj. R^2	0.567	0.487	0.438
No. of Obs.	1005	951	902
Panel C	Log(CO_2 Emissions/Output)		
Post*Acquired	**-0.319*****	**-0.266****	**-0.430*****
	(0.115)	**(0.133)**	**(0.157)**
Adj. R^2	0.553	0.477	0.419
No. of Obs.	1005	951	902

Note: The table reflects the result of estimating equation 2 on the matched sample described in Section 3. The dependent variables are as listed in each panel. Each column in each panel is a separate regression for a particular outcome variable covering two time periods: the year relative to acquisition (as listed in each column) and a year before foreign-owned plants were acquired. Heteroskedasticity-robust standard errors are in parentheses. *Post* dummy and plant fixed effects are included in all specifications, but not reported. *, **, *** indicate statistical significance at 0.10, 0.05, and 0.01 level, respectively.

mark-up or premiums for products produced by plants which undergo foreign acquisitions. Thanks to gaining greater access to international markets, acquired plants may enjoy an increase in mark-ups (Javorcik and Poelhekke, 2016). Thus, it is possible that the value of their output may increase, even if the total physical quantity of output remains unchanged. If this is true, then energy and emission intensities may fall, even if energy use and emissions per physical unit of output remain constant. To address this issue, we normalize energy expenditure, physical energy use and emission level by the value of expenditures on materials. The lower right panel in Figure 4 shows the decline in energy intensity experienced by the treated plants relative to the control group is also found for this alternative normalization. The regression estimates, presented in Table 6, confirm this message. They show that acquired plants reduce energy cost, energy physical use and emission level per unit cost of materials relative to domestic plants.

We also test whether the results remain the same if we control for the potential increase in the share of exported output by the acquired plants. We add export share as an explanatory variable in equation 2. The results are summarized in Table 7. As before, we find that the acquired plants decrease their emissions and energy use per unit of materials used and the difference between the two groups widens over time. In particular, acquired plants reduce their energy expenditure intensity by about 23% in the year of acquisition and by 31% two years after. More interestingly, the magnitude of decline in intensity is greater in terms of physical energy use and CO_2 emission,

Table 5: Regression results for plant-level energy and CO_2 intensities, three to five years after the acquisition.

	3 Years Later	4 Years Later	5 Years Later
Panel A	Log(Energy Expenditure/Output)		
Post*Acquired	**-0.493*** **	**-0.640*** **	**-0.614** **
	(0.178)	**(0.220)**	**(0.251)**
Adj. R^2	0.387	0.294	0.335
No. of Obs.	835	792	744
Panel B	Log(Energy Use/Output)		
Post*Acquired	**-0.491*** **	**-0.628*** **	**-0.593** **
	(0.185)	**(0.232)**	**(0.257)**
Adj. R^2	0.418	0.325	0.380
No. of Obs.	835	792	744
Panel C	Log(CO_2 Emissions/Output)		
Post*Acquired	**-0.499*** **	**-0.616*** **	**-0.608** **
	(0.185)	**(0.233)**	**(0.255)**
Adj. R^2	0.401	0.295	0.369
No. of Obs.	835	792	744

Note: The table reflects the result of estimating equation 2 on the matched sample described in Section 3. The dependent variables are as listed in each panel. Each column in each panel is a separate regression for a particular outcome variable covering two time periods: the year relative to acquisition (as listed in each column) and a year before foreign-owned plants were acquired. Heteroskedasticity-robust standard errors are in parentheses. *Post* dummy and plant fixed effects are included in all specifications, but not reported. *, **, *** indicate statistical significance at 0.10, 0.05, and 0.01 level, respectively.

ranging from 28% in the year of acquisition to 34% two years after the ownership change. The effects are statistically significant in all (but one) specification.[17]

4.2 Do Acquired Plants Reallocate Across Energy Inputs?

The final question of interest is whether acquired plants change their mix of energy inputs. We investigate this question in Table 8 which considers as outcome variables the plants' expenditures on major energy sources: fuel and lubricants, electricity (net of own generation), and their respective intensities. The results indicate that foreign ownership affects the plant's mix of energy sources. During the acquisition year, expenditures on fuel and lubricants in acquired plants increase by 84% relative to the control group with the gap increasing to almost 100% two years after. Meanwhile, consumption of electricity in acquired plants increases at a much higher rate, beginning at 169% during the acquisition period, rising to 254% a year after and further increasing at 264% a year later. All of these changes are statistically significant.

As for energy intensity, we observe a significant reduction in the cost of fuel and lubricants per

[17] We also estimate a specification that includes the share of exported output and its interaction with the Foreign Acquisition dummy variable. We find that the estimates our robust to this change (see Table A.V in the Appendix.)

Table 6: Regression results for plant-level energy use and CO_2 emission per unit cost of materials

	Acquisition Year	One Year Later	Two Years Later
Panel A	Log(Energy Expenditure/Materials)		
Post*Acquired	**-0.370*** **	**-0.330** **	-0.408**
	(0.123)	**(0.134)**	**(0.175)**
Adj. R^2	0.604	0.603	0.475
No. of Obs.	972	923	875
Panel B	Log(Energy Use/Materials)		
Post*Acquired	**-0.443*** **	**-0.360** **	**-0.473*** **
	(0.124)	**(0.140)**	**(0.179)**
Adj. R^2	0.631	0.602	0.485
No. of Obs.	972	923	875
Panel C	Log(CO_2 Emission/Materials)		
Post*Acquired	**-0.442*** **	**-0.370*** **	**-0.470*** **
	(0.124)	**(0.139)**	**(0.179)**
Adj. R^2	0.625	0.599	0.474
No. of Obs.	972	923	875

Note: The table reflects the result of estimating equation 2 on the matched sample described in Section 3. The dependent variables are as listed in each panel. Each column in each panel is a separate regression for a particular outcome variable covering two time periods: the year relative to acquisition (as listed in each column) and a year before foreign-owned plants were acquired. Heteroskedasticity-robust standard errors are in parentheses. *Post* dummy and plant fixed effects are included in all specifications, but not reported. *, **, *** indicate statistical significance at 0.10, 0.05, and 0.01 level, respectively.

unit of output during the acquisition period. The acquired plants' fuel intensity declines by 34% during the acquisition period and by about 44% two years after. Surprisingly, we do not observe any significant reduction in the electricity cost per unit of output due to foreign acquisition, which might suggest that expansion in production is mostly driven by increased consumption of electricity.

We conjecture that expansion of acquired firms is fueled mostly by electricity because of the relatively low electricity rates prevailing in Indonesia. This conjecture is consistent with the findings of other studies suggesting that the kind of technology a firm will use to reduce emission (either through pollution abatement or increasing energy efficiency) may be effectively influenced by policies that directly affect factor prices (see, for example, Harrison et al., 2015; Khanna and Zilberman, 2001). Figure 5 shows that Indonesia's industrial electricity tariffs are much lower when compared to its neighboring countries, which might explain why a lot of FDI that flowed into the country during the sample period is found in generally electricity-intensive industries. The low electricity tariffs are due to the country's generous subsidies (Mourougane, 2010).

Table 7: Regression results for plant-level energy use and CO_2 emission intensities after controlling for share of exported output.

	Acquisition	1 Year Later	2 Years Later
	Log (Energy Expenditure/Output)		
Post*Acquired	**-0.258****	**-0.228***	**-0.370****
	(0.111)	**(0.128)**	**(0.153)**
Export Share	0.001	-0.001	-0.001
	(0.001)	(0.002)	(0.002)
Adj. R^2	0.542	0.482	0.406
No. of Obs.	1005	951	902
	Log(Energy Use/Output)		
Post*Acquired	**-0.327*****	**-0.241***	**-0.420*****
	(0.116)	**(0.137)**	**(0.158)**
Export Share	0.001	-0.001	-0.001
	(0.001)	(0.002)	(0.002)
Adj. R^2	0.566	0.486	0.438
No. of Obs.	1005	951	902
	Log(CO_2 Emission/Output)		
Post*Acquired	**-0.326*****	**-0.251***	**-0.417*****
	(0.116)	**(0.136)**	**(0.158)**
Export Share	0.001	-0.001	-0.001
	(0.002)	(0.002)	(0.002)
Adj. R^2	0.552	0.477	0.418
No. of Obs.	1005	951	902

Note: The table reflects the result of estimating equation 2 on the matched sample described in Section 3. The dependent variables are as listed in each panel. Each column in each panel is a separate regression for a particular outcome variable covering two time periods: the year relative to acquisition (as listed in each column) and a year before foreign-owned plants were acquired. Heteroskedasticity-robust standard errors are in parentheses. *Post* dummy and plant fixed effects are included in all specifications, but not reported. *, **, *** indicate statistical significance at 0.10, 0.05, and 0.01 level, respectively.

5 Conclusion

Rising concerns about the potential effect of FDI inflows on natural environment, along with the growing importance of developing countries as FDI destinations, have led to emergence of studies testing the pollution haven hypothesis. Some argue that highly polluting multinationals relocate to countries with weaker environmental standards (pollution havens) in order to circumvent costly regulations in their home country. Those voices view FDI as a vehicle for moving pollution from developed to developing countries. Others, in contrast, point out that FDI has positive (pollution halo) effects because multinationals often have more efficient and cleaner technologies.

This study contributes to this nascent literature by examining the causal effect of FDI on plant-level environmental performance. More specifically, it asks how foreign acquisitions influence plant-level energy and CO_2 emission intensities using data from the Census of Indonesian Manufacturing covering the period 1983-2001. Our analysis improves on the previous literature in three important

Table 8: Regression results for select energy sources

	Acquisition Year	One Year Later	Two Years Later
Panel A	Log(Total Fuel & Lubricants Expenditure, in Rp)		
Post*Acquired	**0.611*** **	**0.686*** **	**0.691*** **
	(0.167)	**(0.186)**	**(0.230)**
Adj. R^2	0.694	0.663	0.586
No. of Obs.	974	924	873
Panel B	Log(Net Electricity Expenditure)		
Post*Acquired	**0.991*** **	**1.263*** **	**1.292*** **
	(0.191)	**(0.225)**	**(0.267)**
Adj. R^2	0.703	0.638	0.605
No. of Obs.	826	782	745
Panel C	Log(Fuel & Lubricants Exp./Output)		
Post*Acquired	**-0.422*** **	**-0.478*** **	**-0.586*** **
	(0.142)	**(0.166)**	**(0.187)**
Adj. R^2	0.603	0.534	0.504
No. of Obs.	974	924	873
Panel D	Log(Net Electricity Expenditure/Output)		
Post*Acquired	-0.087	-0.029	-0.168
	(0.161)	(0.199)	(0.238)
Adj. R^2	0.567	0.424	0.359
No. of Obs.	826	782	745

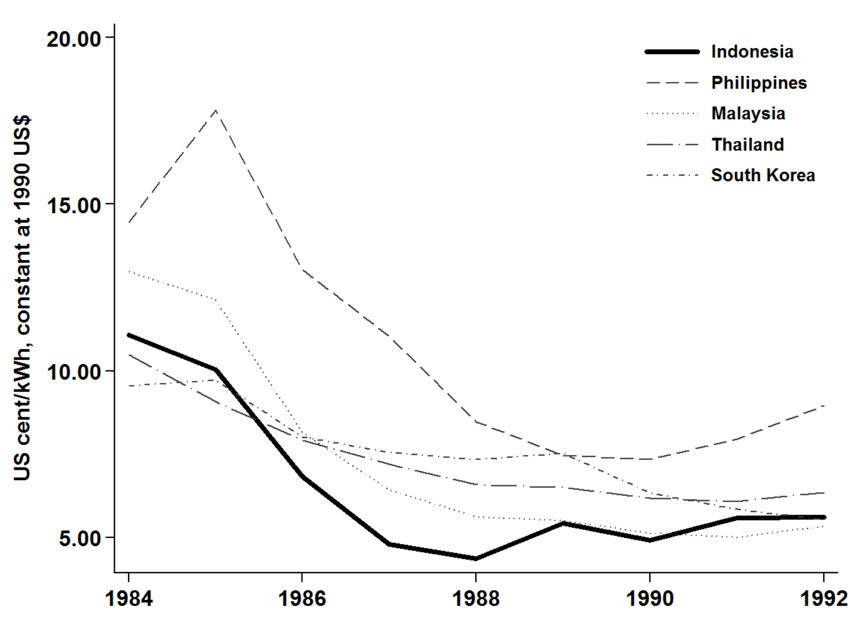
Note: The table reflects the result of estimating equation 2 on the matched sample with below-median preacquisition energy intensity. The dependent variables are as listed in each panel. Each column in each panel is a separate regression for a particular outcome variable covering two time periods: the year relative to acquisition (as listed in each column) and a year before foreign-owned plants were acquired. Heteroskedasticity-robust standard errors are in parentheses. *Post* dummy and plant fixed effects are included in all specifications, but not reported. *, **, *** indicate statistical significance at 0.10, 0.05, and 0.01 level, respectively.

Source of Data: Indonesian Census of Manufacturing

respects. First, we focus on physical consumption of energy and carbon dioxide emissions, information that is rarely available for developing countries. Second, we examine the changes in ownership taking place within the same plant. This allows us to focus on changes in plant-level environmental performance introduced by foreign ownership. Third, rather than focusing on the narrow question of energy expenditure, we consider a wider range of outcomes which can potentially explain the changes in energy consumption and emission patterns of acquired firms.

Our measure of pollution externalities is far from perfect. The analysis is limited to global pollution (i.e. CO_2 emission) and completely ignores the impact of FDI on local pollutants, which may be of greater interest when analyzing the impact of cross-country differences in local environmental regulations. Devising a close approximation of plant-level emissions of local pollutants is extremely challenging as it requires information on plant-level pollution abatement which is not available in our data set. Moreover, our analysis does not address the potential spillover effect of FDI on domestic plants.

Figure 5: Industrial Electricity Rates for Select Asian Counties, 1984-1992.



Source: Malhotra et al. (1994)

Despite these methodological imperfections, the data show remarkable plant-level operational changes associated with ownership changes, which we decompose into scale and technique effects. We see a positive and significant scale effect of acquisition, which increases the output of the plant, and consequently, its levels of energy use and CO_2 emissions. The technique effect, which usually is beneficial to the environment, refers to the improvement in the efficiency of using energy inputs due to FDI-induced innovations and investments. We see indications of falling energy and emission intensities, which implies that each additional unit of output is produced with lower energy and CO_2 content.

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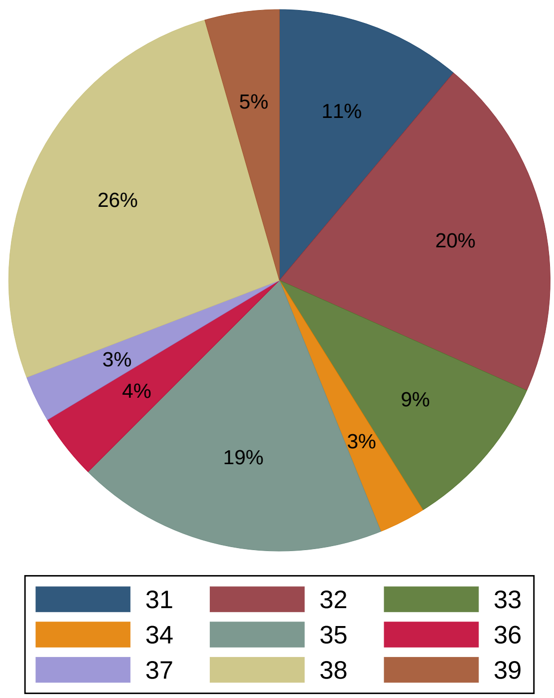
Appendices

Figure A.I: Distribution of foreign-owned plants by industry



31	Food, Beverages and Tobacco
32	Textile, Wearing Apparel and Leather Industries
33	Wood and Wood Products, Including Furniture
34	Paper and Paper Products, Printing and Publishing
35	Chemicals and Chemical, Petroleum, Coal, Rubber and Plastic Products
36	Non-Metallic Mineral Products, except Products of Petroleum and Coal
37	Basic Metal Industries
38	Fabricated Metal Products, Machinery and Equipment
39	Other Manufacturing Industries

Table A.I: Goodness-of-Fit in estimating plant-level energy use (in physical units).

	Obs.	R.sq.	Adj. R-sq.	RMSE
Fuel and Lubricant (Total)				
Gasoline	140,744	0.993	0.993	0.144
Diesel	198,309	0.992	0.992	0.208
Diesel Oil	30,279	0.966	0.966	0.564
Kerosene	104,509	0.696	0.695	1.164
Lubricant	213,705	0.944	0.944	0.520
Bunker Oil	2,049	0.999	0.999	0.102
Coal	1,370	0.975	0.973	0.640
Coke	2,912	0.942	0.940	0.633
Public Gas	9,598	0.931	0.930	0.812
LPG	11,906	0.993	0.993	0.175
Firewood	9,089	0.990	0.990	0.218
Charcoal	1,460	0.988	0.987	0.236
Fuel and Lubricant (Elec. Generation)				
Gasoline	1,435	0.983	0.982	0.303
Diesel	37,683	0.987	0.987	0.285
Diesel Oil	2,538	0.966	0.965	0.580
Kerosene	317	0.981	0.974	0.449
Lubricant	22,606	0.972	0.972	0.357
Bunker Oil	179	0.996	0.995	0.258
Coal	29	0.997	0.988	0.401
Coke	6	1.000	.	-
Public Gas	93	0.991	0.983	0.402
LPG	110	0.985	0.969	0.488
Firewood	44	0.983	0.945	0.760
Charcoal	16	1.000	.	-
Electricity Use				
Sold	702	0.978	0.974	0.489
PLN	216,193	0.979	0.979	0.349
Non-PLN	5,022	0.974	0.974	0.465

Note: The table reports the goodness-of-fit in estimating equation 1. Each variable is expressed in log. LPG denotes liquefied petroleum gas. PLN refers to amount of electricity bought form Indonesia's state-owned power company *Perusahaan Listrik Negar*, while non-PLN refers to those that are bought from independent power producers.
Source: Indonesian Census of Manufacturing

Table A.II: Sources of Conversion Factors

Conversion to Energy (in MBTUs)	
Gasoline	Silverman, D. (Univ. of California, Irvine)
Diesel	US Energy Information Administration
Fuel Oil/Bunker Oil	US Energy Information Administration
Kerosene	US Energy Information Administration
Lubricants	US Energy Information Administration
Coal	US Environmental Protection Agency
Coke	US Energy Information Administration
Public Gas	US Bureau of Mines
Liquefied Petroleum Gas	US Environmental Protection Agency
Firewood	Silverman, D. (Univ. of California, Irvine)
Charcoal	Oak Ridge National Laboratory
Electricity	US Energy Information Administration
Conversion to Carbon Dioxide (in Kg/C)	
Gasoline	US Energy Information Administration
Diesel	US Environmental Protection Agency
Fuel Oil/Bunker Oil	US Environmental Protection Agency
Kerosene	US Environmental Protection Agency
Lubricants	US Energy Information Administration
Coal	US Energy Information Administration
Coke	US Energy Information Administration
Public Gas	US Energy Information Administration
Liquefied Petroluem Gas	US Energy Information Administration
Firewood	Partnership for Policy Integrity
Charcoal	Akagi et al. (2011)
Electricity	US Environmental Protection Agency

A.1 Robustness Check: Longer Time Horizon

This section presents the results from estimating equation 2 on matched sample but focusing on firms with non-missing observations for each outcome variable between pre-acquisition year and six years after. Table A.III summarizes the results for output, energy consumption, and emission levels; while Table A.IV summarizes results for energy and emission intensities.

Table A.III: Regression results on output, energy and pollution levels.

	Acquisition Year	1 Year Later	2 Years Later	3 Years Later	4 Years Later	5 Years Later
Panel A			Log(Output)			
Post*Acquired	**1.116*** **	**1.320*** **	**1.435*** **	**1.485*** **	**1.512*** **	**1.469*** **
	(0.156)	**(0.159)**	**(0.170)**	**(0.181)**	**(0.188)**	**(0.193)**
Adj. R^2	0.676	0.669	0.645	0.618	0.610	0.597
No. of Obs.	634	634	634	634	634	634
Panel B			Log (Energy Expenditure)			
Post*Acquired	**0.560*** **	**0.734*** **	**0.838*** **	**0.804*** **	**0.833*** **	**0.951*** **
	(0.186)	**(0.196)**	**(0.222)**	**(0.226)**	**(0.242)**	**(0.242)**
Adj. R^2	0.725	0.700	0.625	0.636	0.591	0.601
No. of Obs.	424	424	424	424	424	424
Panel C			Log (Energy Use)			
Post*Acquired	**0.524*** **	**0.727*** **	**0.833*** **	**0.844*** **	**0.890*** **	**0.973*** **
	(0.196)	**(0.203)**	**(0.234)**	**(0.234)**	**(0.254)**	**(0.252)**
Adj. R^2	0.718	0.698	0.623	0.645	0.602	0.602
No. of Obs.	424	424	424	424	424	424
Panel D			Log (CO_2 Emission)			
Post*Acquired	**0.523*** **	**0.708*** **	**0.826*** **	**0.820*** **	**0.883*** **	**0.956*** **
	(0.192)	**(0.199)**	**(0.231)**	**(0.233)**	**(0.253)**	**(0.250)**
Adj. R^2	0.723	0.706	0.624	0.643	0.597	0.603
No. of Obs.	424	424	424	424	424	424

Note: The table reflects the result of estimating equation 2 on the matched sample described in Section 3. The dependent variables are as listed in each panel. Each column in each panel is a separate regression for a particular outcome variable covering two time periods: the year relative to acquisition (as listed in each column) and a year before foreign-owned plants were acquired. Heteroskedasticity-robust standard errors are in parentheses. *Post* dummy and plant fixed effects are included in all specifications, but not reported. *, **, *** indicate statistical significance at 0.10, 0.05, and 0.01 level, respectively.

Table A.IV: Regression results on energy and emission intensities.

	Acquisition Year	1 Year Later	2 Years Later	3 Years Later	4 Years Later	5 Years Later
Panel A	Log (Energy Expenditure/Output)					
Post*Acquired	**-0.491*****	**-0.581*****	**-0.623*****	**-0.605*****	**-0.697*****	**-0.597*****
	(0.155)	**(0.172)**	**(0.192)**	**(0.186)**	**(0.202)**	**(0.196)**
Adj. R^2	0.615	0.525	0.443	0.465	0.389	0.443
No. of Obs.	424	424	424	424	424	424
Panel B	Log (Energy Use/Output)					
Post*Acquired	**-0.528*****	**-0.588*****	**-0.629*****	**-0.565*****	**-0.640*****	**-0.576*****
	(0.162)	**(0.181)**	**(0.197)**	**(0.192)**	**(0.214)**	**(0.201)**
Adj. R^2	0.627	0.526	0.467	0.494	0.410	0.470
No. of Obs.	424	424	424	424	424	424
Panel C	Log (CO_2 Emission/Output)					
Post*Acquired	**-0.528*****	**-0.607*****	**-0.635*****	**-0.589*****	**-0.647*****	**-0.593*****
	(0.162)	**(0.179)**	**(0.197)**	**(0.192)**	**(0.214)**	**(0.200)**
Adj. R^2	0.610	0.519	0.446	0.477	0.383	0.458
No. of Obs.	424	424	424	424	424	424

Note: The table reflects the result of estimating equation 2 on the matched sample described in Section 3. The dependent variables are as listed in each panel. Each column in each panel is a separate regression for a particular outcome variable covering two time periods: the year relative to acquisition (as listed in each column) and a year before foreign-owned plants were acquired. Heteroskedasticity-robust standard errors are in parentheses. *Post*dummy and plant fixed effects are included in all specifications, but not reported. *, **, *** indicate statistical significance at 0.10, 0.05, and 0.01 level, respectively.

Table A.V: Regression results on energy and emission intensities, controlling for export share.

	Acquisition Year	1 Year Later	2 Years Later	Acquisition Year	1 Year Later	2 Years Later
Panel A	Energy Expenditure/Output			Energy Expenditure/Output		
Post*Acquired	**-0.258****	**-0.228***	**-0.370****	**-0.275****	-0.202	**-0.424****
	(0.111)	**(0.128)**	**(0.153)**	**(0.131)**	(0.154)	**(0.174)**
Export Share	0.001	-0.001	-0.001	0.000	-0.000	-0.002
	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Int*Export Share				0.001	-0.001	0.003
				(0.003)	(0.003)	(0.003)
Adj. R^2	0.542	0.482	0.406	0.542	0.481	0.406
No. of Obs.	1005	951	902	1005	951	902
Panel B	Energy Use Intensity			Energy Use Intensity		
Post*Acquired	**-0.327*****	**-0.241***	**-0.420*****	**-0.351****	-0.186	**-0.477*****
	(0.116)	**(0.137)**	**(0.158)**	**(0.138)**	(0.164)	**(0.179)**
Export Share	0.001	-0.001	-0.001	0.000	-0.000	-0.002
	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Int*Export Share				0.001	-0.002	0.003
				(0.003)	(0.003)	(0.003)
Adj. R^2	0.566	0.486	0.438	0.565	0.486	0.437
No. of Obs.	1005	951	902	1005	951	902
Panel C	CO_2 Emission Intensity			CO_2 Emission Intensity		
Post*Acquired	**-0.326*****	**-0.251***	**-0.417*****	**-0.353****	-0.206	**-0.479*****
	(0.116)	**(0.136)**	**(0.158)**	**(0.138)**	(0.163)	**(0.179)**
Export Share	0.001	-0.001	-0.001	0.000	-0.000	-0.002
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Int*Export Share				0.001	-0.002	0.003
				(0.003)	(0.003)	(0.003)
Adj. R^2	0.552	0.477	0.418	0.552	0.476	0.418
No. of Obs.	1005	951	902	1005	951	902

Note: The table reflects the result of estimating equation 2 on the matched sample described in Section 3. The dependent variables are as listed in each panel. Each column in each panel is a separate regression for a particular outcome variable covering two time periods: the year relative to acquisition (as listed in each column) and a year before foreign-owned plants were acquired. Columns 2-4 estimates equation 2 with export share as another control variable, while columns 5-7 include an interaction between the acquisition dummy variable and export share. Heteroskedasticity-robust standard errors are in parentheses. Int refers to $Post * Acquired$ in equaton 2. *Post* dummy and plant-fixed effects are included in all specifications, but not reported. *, **, *** indicate statistical significance at 0.10, 0.05, and 0.01 level, respectively.

Source of Data: Indonesian Census of Manufacturing